Peer-Reviewed Research on Climate Change by USDA Authors January 2017-August 2019

Research Tags:

Forestry: Forests, trees, wildfires
Weather: Temperature change, temperature variability, drought, storms, and wildfires
Soil: Soil health, soil carbon content, and nutrients
Water: Bodies of water, health of water bodies
Crops: Commodities grown for human consumption or animal feed
Livestock: Animals raised by humans
Wildlife: Wild, non-domesticated animals
Emissions: Greenhouse gas emissions, criteria pollution emissions
Energy: Electricity, renewable energy, heating, biofuels
Grassland: Meadows, savannahs, prairies, tundras
Economics: Money, commodity prices, farm economics
Research: Tools, modeling, designs, other items related to research

Abbas, A. M., Rubio-Casal, A. E., De Cires, A., Grewell, B. J., & Castillo, J. M. (2019). Differential tolerance of native and invasive tree seedlings from arid African deserts to drought and shade. *South African Journal of Botany, 123*, 228-240. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063397382&doi=10.1016%2fj.sajb.2019.03.018&partnerID=40&md5=b0262a764bd3c02d493ca08f80ccc22b. doi:10.1016/j.sajb.2019.03.018

Research Tags: Forestry

Abstract: *Efforts to understand why some species become successful invaders and why some habitats are more at risk from invasive species is an important research focus in invasion ecology. With current global climate change, evaluation of the effects of shade and drought on cohabiting native and invasive species from extreme ecosystems is especially important. Acacia tortilis subsp. raddiana is a tree taxon native to arid African deserts. Prosopis glandulosa, native to the southwestern United States and Mexico, is invading African arid and semiarid regions that are habitat for A. t. subsp. raddiana. The aim of this study was to evaluate and compare the tolerance and responses of the seedlings of these two tree species to shade, water stress and their interactions. We measured and recorded growth rates and morphological, biochemical and physiological plant traits under two radiation and two water treatments in greenhouse conditions. Radiation intensity was a stronger driver of the performance of both species than water availability. Beyond the independent effects of shade and drought, the interactions of these factors yielded synergistic effects on seedlings of both tree species, affecting key plant traits. The seedlings of A. t. subsp. raddiana were able to implement important shifts in key functional traits in response to altering abiotic stress conditions, behaving as a stress-tolerant species that is well-adapted to the habitat it occupies in hot arid African deserts. In contrast, the fast-growing seedlings of P. glandulosa were stress-avoiding. The alien P. glandulosa seedlings were highly sensitive to water and shade stress. Moreover, they were particularly sensitive to drought in shade conditions. However, although alien P. glandulosa seedlings were exposed to high stress levels, they were able to avoid permanent damage to their photosynthetic apparatus by mechanisms such as increasing energy dissipation by heat emission and by adjusting the relative allocation of resources to above- and below-ground structures. Our results are useful for conservation planning and restoration of invaded hyperarid ecosystems.*

Abrams, M. D., & Nowacki, G. J. (2018). Large-scale catastrophic disturbance regimes can mask climate change

impacts on vegetation – a reply to Pederson et al. (2014). *Global Change Biology, 24*(1), e395-e396. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-84923037993&doi=10.1111%2fgcb.12828&partnerID=40&md5=637bbb662bba68549d375cfb736a3348. doi:10.1111/gcb.12828
Research Tags: Weather
No Abstract

Abrams, M. D., & Nowacki, G. J. (2019). Global change impacts on forest and fire dynamics using paleoecology and tree census data for eastern North America. *Annals of Forest Science, 76*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061078624&doi=10.1007%2fs13595-018-0790-y&partnerID=40&md5=083d657400abac2af5c093e02b041de2. doi:10.1007/s13595-018-0790-y
Research Tags: Forestry, Weather
Abstract: *Key message: The tree census, paleopollen, fossil charcoal, human population, and climate data presented here provide unique support for important anthropogenic influences on fire over the last 2000 years in the eastern USA. This includes multiple instances of climate fire anomalies that may be best explained by the role of human-caused burning. Context: The coupling of paleoecological and tree census data to address larger global change questions is a novel research approach to describe and ascribe recent vegetation dynamics vis-à-vis the climate versus disturbance debate. Aims: The aims of the study are to (1) compile and compare pre-European settlement versus modern upland arboreal pollen and tree survey data from a large number of studies in various forest regions in the eastern USA, (2) analyze fossil charcoal dating back 2000 years for the northern versus central/southern tiers of the eastern USA, and (3) compare and contrast compositional and ecophysiological attributes for both datasets and temporal changes to known climate or disturbance phenomena to elucidate global change impacts and the drivers of forest change. Methods: We analyzed paleoecological (pollen and charcoal) and tree census studies to compare protohistoric and modern vegetation assemblage for eastern North America, including the drivers of forest change. A total of seven forest types in the north and central regions of the eastern USA were used to co-analyze fossil pollen, fossil charcoal, and tree survey data. Results: Disparities and consistencies existed when independently assessing witness tree and pollen records. Although forests north of the tension zone line (TZL) contained mostly Fagus, Pinus, Tsuga, and Acer witness trees, pollen records were dominated, as expected, by high-pollen-producing Pinus, Quercus, Tsuga, and Betula. Here, present-day pollen and tree survey data revealed significant declines in Fagus, Pinus, Tsuga, and Larix and increases in Acer, Populus, Fraxinus, Quercus, and Abies. South of the TZL, both witness tree and pollen records pointed to Quercus and Pinus domination, with declines in Quercus and Castanea and increases in Acer and Betula based on present-day data. Modern assemblages comprise tree genera that are increasingly cool-adapted, shade-tolerant, drought-intolerant pyrophobes. Paleocharcoal data from 1 to 1750 AD indicate a slight increase in burning in southern forests and stable levels in the north, despite the increasing cold associated with the Little Ice Age. The most significant increase in burning followed the dramatic increase in human population associated with European settlement prior to the early twentieth century. Conclusion: Post-1940, fire suppression was an ecologically transformative event in all datasets. Our analysis identifies multiple instances in which fire and vegetation changes were likely driven by shifts in human population and land use beyond those expected from climate alone.*

Adams, A. B., Pontius, J., Galford, G. L., Merrill, S. C., & Gudex-Cross, D. (2018). Modeling carbon storage across a heterogeneous mixed temperate forest: the influence of forest type specificity on regional-scale carbon storage estimates. *Landscape Ecology, 33*(4), 641-658. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042530181&doi=10.1007%2fs10980-018-0625-0&partnerID=40&md5=7cc21349ad719e979676b5a76afda322. doi:10.1007/s10980-018-0625-0
Research Tags: Forestry
Abstract: *Purpose: Accurately assessing forest carbon storage on a landscape scale is critical to understanding global carbon cycles and the effects of land cover changes on ecological processes. Calculations of regional-scale forest carbon storage that rely on maps of land cover typically reflect only coarse forest classes. How differences in carbon stored by different tree species may affect such assessments is largely unexplored. We examined a range of forest carbon storage models to understand the effects of forest type specificity on*

carbon storage estimates in the northeastern United States. Methods: Models estimated forest carbon in total aboveground and coarse root biomass based on three levels of forest classification specificity: (1) relative basal area by species, (2) species associations, and (3) broad forest types per IPCC (in: IPCC guidelines for national greenhouse gas inventories, IPCC, Japan, 2006) guidelines. Results: The specificity of forest type classifications influenced results with generally lower carbon storage estimates resulting from higher-specificity forest classifications. The two most specific models, with mean carbon storage estimates of 103–107 Mg/ha, were most accurate compared to field validation points. These estimates are greater than 2013 field-based U.S. Forest Service estimates (84–90 Mg/ha). Conclusions: There are many sources of uncertainty in landscape-scale carbon storage assessments. Here we show that improving detail in one of these sources, forest stand composition, increases the accuracy of these assessments, and better reflects carbon storage patterns across heterogeneous landscapes. While more work is needed, particularly to improve stand age maps, this information can inform the interpretation of current carbon storage estimates and improve future estimates in heterogeneous forests.

Adams, B. T., Matthews, S. N., Peters, M. P., Prasad, A., & Iverson, L. R. (2019). Mapping floristic gradients of forest composition using an ordination-regression approach with landsat OLI and terrain data in the Central Hardwoods region. *Forest Ecology and Management, 434*, 87-98. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058224348&doi=10.1016%2fj.foreco.2018.12.018&partnerID=40&md5=7e21c9cde7c810799645f18fbd64d9f6. doi:10.1016/j.foreco.2018.12.018

Research Tags: Forestry

Abstract: *Mapping forest properties with supervised remote sensing has historically and increasingly remained vital to research and management efforts, and the demand for such products will only increase as better tools and data increase the usability of such maps. Multispectral imagery by the Landsat program has been an invaluable resource for forest type characterization for several decades. As an alternative to traditional classification approaches dominating these efforts, we instead employed an ordination-regression approach to mapping forest composition as floristic gradients across a ~5000-km^2 forestland in southeastern Ohio's Central Hardwoods. Plot data (n = 699 plots; 99 species/genera) from a comprehensive sample of both overstory and understory woody plants across structurally- (open to closed canopy) and topographically-variable forest conditions were projected onto a non-metric multidimensional scaling (NMDS) ordination solution. Floristic gradients, via their ordination scores, were related to spectral reflectance provided by a multitemporal Landsat 8-Operational Land Imager (OLI) image and various terrain variables using Random Forests models. Approximately 61%, 49%, and 25% of the floristic variation among the three axes of the NMDS ordination were related to the remotely-sensed variables during regression modeling. The axes were predicted onto three images and merged to a RGB color composite for the final floristic gradient map, displaying multivariate vegetation variation across the landscape in terms of variation in color. The color values, by referencing ordination space position within the original solution, provide a statistical approximation of the taxonomic composition of individual forest stands in relation to the plot data. We found this approach highly effective and an attractive alternative to traditional classifications. It is time-efficient, more realistic in that compositional turnover is expressed in continuous fields rather than arbitrary breaks, and less subjective, overcoming the generalization problem inherent in categorizing vegetation assemblages a priori. Moving forward, our model will be a valuable tool in developing suitable management options on individual forest stands for the restoration of desired species, adapting to a changing climate, and improving wildlife habitat in forestlands across the Central Hardwoods.*

Adams, H. D., Zeppel, M. J. B., Anderegg, W. R. L., Hartmann, H., Landhäusser, S. M., Tissue, D. T., . . . McDowell, N. G. (2017). A multi-species synthesis of physiological mechanisms in drought-induced tree mortality. *Nature Ecology and Evolution, 1*(9), 1285-1291. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031921138&doi=10.1038%2fs41559-017-0248-x&partnerID=40&md5=bf7a7d78fa06fba1ed1b710edc373f9e. doi:10.1038/s41559-017-0248-x

Research Tags: Forestry, Weather

Abstract: *Widespread tree mortality associated with drought has been observed on all forested continents and global change is expected to exacerbate vegetation vulnerability. Forest mortality has implications for future biosphere-atmosphere interactions of carbon, water and energy balance, and is poorly represented in dynamic* *vegetation models. Reducing uncertainty requires improved mortality projections founded on robust physiological processes. However, the proposed mechanisms of drought-induced mortality, including hydraulic failure and carbon starvation, are unresolved. A growing number of empirical studies have investigated these mechanisms, but data have not been consistently analysed across species and biomes using a standardized physiological framework. Here, we show that xylem hydraulic failure was ubiquitous across multiple tree taxa at drought-induced mortality. All species assessed had 60% or higher loss of xylem hydraulic conductivity, consistent with proposed theoretical and modelled survival thresholds. We found diverse responses in non-structural carbohydrate reserves at mortality, indicating that evidence supporting carbon starvation was not universal. Reduced non-structural carbohydrates were more common for gymnosperms than angiosperms, associated with xylem hydraulic vulnerability, and may have a role in reducing hydraulic function. Our finding that hydraulic failure at drought-induced mortality was persistent across species indicates that substantial improvement in vegetation modelling can be achieved using thresholds in hydraulic function.*

Addington, R. N., Aplet, G. H., Battaglia, M. A., Briggs, J. S., Brown, P. M., Cheng, A. S., . . . Wolk, B. (2018). Principles and practices for the restoration of ponderosa pine and dry mixed-conifer forests of the Colorado front range. *USDA Forest Service - General Technical Report RMRS-GTR, 2018*(373), 1-121. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041411665&partnerID=40&md5=128811ca82de0c6099e0eaafd7c243a9.

Research Tags: Forestry, Weather

Abstract: *Wildfires have become larger and more severe over the past several decades on Colorado's Front Range, catalyzing greater investments in forest management intended to mitigate wildfire risks. The complex ecological, social, and political context of the Front Range, however, makes forest management challenging, especially where multiple management goals including forest restoration exist. In this report, we present a science-based framework for managers to develop place-based approaches to forest restoration of Front Range ponderosa pine and dry mixed-conifer forests. We first present ecological information describing how Front Range forest structure and composition are shaped at multiple scales by interactions among topography, natural disturbances such as fire, and forest developmental processes. This information serves as a foundation for identifying priority areas for treatment and designing restoration projects across scales. Treatment guidelines generally reduce forest densities and surface and crown fuels, enhance spatial heterogeneity across scales, and retain drought- and fire-tolerant species, old trees, and structures important for wildlife. Implementation of these guidelines is expected to enhance forest resilience to disturbance and climate change, as well as sustain important ecosystem services. Finally, this report emphasizes the importance of adaptive management and learning through monitoring and experimentation to address uncertainties inherent in the restoration process.*

Adesemoye, A. O., Yuen, G., & Watts, D. B. (2017). Microbial inoculants for optimized plant nutrient use in integrated pest and input management systems. In *Probiotics and Plant Health* (pp. 21-40).

Research Tags: Crops

Abstract: *The use of fertilizers and pesticides has greatly increased agricultural productivity over the past few decades. However, there is still an ongoing search for additional or alternate tools that can proffer agricultural sustainability and meet the needs of profitability and greater food production for the growing world population. This review examines the enhancement of plant nutrient use efficiency derived from interactions of the diverse microorganisms that live in and around plants such as plant growth-promoting rhizobacteria (PGPR) and mycorrhizal fungi. These microorganisms form the major bases of the biorational sector of the agriculture industry which has exploded in the last few years with the production of many new microbial inoculant products and the improvement of existing products. Microbial inoculants cannot replace chemical fertilizers now or in the immediate future; thus this review discusses the concept of integrated pest and input management (IPIM), compatibility of inoculants with existing chemicals, and efficacy issues associated with biologicals. Also discussed are inoculant products, the conditions that may affect their success, the untapped potentials for agriculture, and the possible impacts on greenhouse gas emissions and global warming.*

Adhikari, K., Owens, P. R., Libohova, Z., Miller, D. M., Wills, S. A., & Nemecek, J. (2019). Assessing soil organic carbon stock of Wisconsin, USA and its fate under future land use and climate change. *Science of the Total*

Environment, 667, 833-845. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062472482&doi=10.1016%2fj.scitotenv.2019.02.420&partnerID=40&md5=c570ba15d2ccfe4519a4862fd28d251b. doi:10.1016/j.scitotenv.2019.02.420

Research Tags: Soil

Abstract: *Carbon stored in soils contributes to a variety of soil functions, including biomass production, water storage and filtering, biodiversity maintenance, and many other ecosystem services. Understanding soil organic carbon (SOC) spatial distribution and projection of its future condition is essential for future CO_2 emission estimates and management options for storing carbon. However, modeling SOC spatiotemporal dynamics is challenging due to the inherent spatial heterogeneity and data limitation. The present study developed a spatially explicit prediction model in which the spatial relationship between SOC observation and seventeen environmental variables was established using the Cubist regression tree algorithm. The model was used to compile a baseline SOC stock map for the top 30 cm soil depth in the State of Wisconsin (WI) at a 90 m × 90 m grid resolution. Temporal SOC trend was assessed by comparing baseline and future SOC stock maps based on the space-for-time substitution model. SOC prediction for future considers land use, precipitation and temperature for the year 2050 at medium (A1B) CO_2 emissions scenario of the Intergovernmental Panel on Climate Change. Field soil observations were related to factors that are known to influence SOC distribution using the digital soil mapping framework. The model was validated on 25% test profiles (R^2 : 0.38; RMSE: 0.64; ME: −0.03) that were not used during model training that used the remaining 75% of the data (R^2 : 0.76; RMSE: 0.40; ME: −0.006). In addition, maps of the model error, and areal extent of Cubist prediction rules were reported. The model identified soil parent material and land use as key drivers of SOC distribution including temperature and precipitation. Among the terrain attributes, elevation, mass-balance index, mid-slope position, slope-length factor and wind effect were important. Results showed that Wisconsin soils had an average baseline SOC stock of 90 Mg ha^{-1} and the distribution was highly variable (CV: 64%). It was estimated that WI soils would have an additional 20 Mg ha^{-1} SOC by the year 2050 under changing land use and climate. Histosols and Spodosols were expected to lose 19 Mg ha^{-1} and 4 Mg ha^{-1} , respectively, while Mollisols were expected to accumulate the largest SOC stock (62 Mg ha^{-1}). All land-use types would be accumulating SOC by 2050 except for wetlands (−34 Mg C ha^{-1}). This study found that Wisconsin soils will continue to sequester more carbon in the coming decades and most of the Driftless Area will be sequestering the greatest SOC (+63 Mg C ha^{-1}). Most of the SOC would be lost from the Northern Lakes and Forests ecological zone (−12 Mg C ha^{-1}). The study highlighted areas of potential C sequestration and areas under threat of C loss. The maps generated in this study would be highly useful in farm management and environmental policy decisions at different spatial levels in Wisconsin.*

Adkins, S., Baker, C. A., Warfield, C. Y., Estévez de Jensen, C., Badillo-Vargas, I., Webster, C. G., . . . Naidu, R. (2018) Viruses of ornamentals emerging in Florida and the Caribbean region. In*: Vol. 1193*. *Acta horticulturae* (pp. 17-20).

Research Tags: Crops

Abstract: *Historically, Tomato spotted wilt virus and Impatiens necrotic spot virus have been significant constraints to crop production worldwide. With the emergence of Tomato chlorotic spot virus (TCSV) and a natural Groundnut ringspot virus (GRSV) reassortant in Florida and the Caribbean region, the significance of tospoviruses in production of major solanaceous vegetables including tomato and pepper has increased. In addition, TCSV has been reported in common solanaceous weeds including American black nightshade (Solanum americanum) and jimsonweed (Datura stramonium), in Florida and/or Puerto Rico. Experimental host range studies demonstrated that TCSV and/or GRSV can also infect solanaceous (Petunia and Brugmansia) and non-solanaceous (Garden Impatiens) ornamentals. During 2014, the first natural TCSV infections of non-solanaceous ornamentals porcelainflower (Hoya wayetii), false Christmas cactus (Schlumbergera truncata) and annual vinca (Catharanthus roseus) were detected in Florida. Since then, TCSV has been documented in other important crop and weed species, indicating host and geographic range expansion of this tospovirus. Several other viruses have also been detected in plants with symptoms similar to those induced by TCSV. In view of projected climate change-driven shifts in cropping systems, further knowledge of emerging plant viruses in Florida and the Caribbean region will help strengthen agricultural security.*

Adler, P. R., Spatari, S., D'Ottone, F., Vazquez, D., Peterson, L., Del Grosso, S. J., . . . Parton, W. J. (2018). Legacy effects of individual crops affect N<inf>2</inf>O emissions accounting within crop rotations. *GCB Bioenergy, 10*(2), 123-136. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021856016&doi=10.1111%2fgcbb.12462&partnerID=40&md5=58f5c8f4533c34b8dbfde8ee38f49db7. doi:10.1111/gcbb.12462

Research Tags: Crops, Emissions

Abstract: *Uruguay is pursuing renewable energy production pathways using feedstocks from its agricultural sector to supply transportation fuels, among them ethanol produced from commercial technologies that use sweet and grain sorghum. However, the environmental performance of the fuel is not known. We investigate the life cycle environmental and cost performance of these two major agricultural crops used to produce ethanol that have begun commercial production and are poised to grow to meet national energy targets for replacing gasoline. Using both attributional and consequential life cycle assessment (LCA) frameworks for system boundaries to quantify the carbon intensity, and engineering cost analysis to estimate the unit production cost of ethanol from grain and sweet sorghum, we determined abatement costs. We found 1) an accounting error in estimating* N_2O *emissions for a specific crop in multiple crop rotations when using Intergovernmental Panel on Climate Change(IPCC) Tier 1 methods within an attributional LCA framework, due to N legacy effects; 2) choice of baseline and crop identity in multiple crop rotations evaluated within the consequential LCA framework both affect the global warming intensity (GWI) of ethanol; and 3) although abatement costs for ethanol from grain sorghum are positive and from sweet sorghum they are negative, both grain and sweet sorghum pathways have a high potential for reducing transport fuel GWI by more than 50% relative to gasoline, and are within the ranges targeted by the US renewable transportation fuel policies.*

Agne, M. C., Beedlow, P. A., Shaw, D. C., Woodruff, D. R., Lee, E. H., Cline, S. P., & Comeleo, R. L. (2018). Interactions of predominant insects and diseases with climate change in Douglas-fir forests of western Oregon and Washington, U.S.A. *Forest Ecology and Management, 409*, 317-332. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034967725&doi=10.1016%2fj.foreco.2017.11.004&partnerID=40&md5=8d85bf97259442f856c5f1e7b9131d9a. doi:10.1016/j.foreco.2017.11.004

Research Tags: Wildlife, Forestry

Abstract: *Forest disturbance regimes are beginning to show evidence of climate-mediated changes, such as increasing severity of droughts and insect outbreaks. We review the major insects and pathogens affecting the disturbance regime for coastal Douglas-fir forests in western Oregon and Washington State, USA, and ask how future climate changes may influence their role in disturbance ecology. Although the physiological constraints of light, temperature, and moisture largely control tree growth, episodic and chronic disturbances interacting with biological factors have substantial impacts on the structure and functioning of forest ecosystems in this region. Understanding insect and disease interactions is critical to predicting forest response to climate change and the consequences for ecosystem services, such as timber, clean water, fish and wildlife. We focused on future predictions for warmer wetter winters, hotter drier summers, and elevated atmospheric* CO_2 *to hypothesize the response of Douglas-fir forests to the major insects and diseases influencing this forest type: Douglas-fir beetle, Swiss needle cast, black stain root disease, and laminated root rot. We hypothesize that (1) Douglas-fir beetle and black stain root disease could become more prevalent with increasing, fire, temperature stress, and moisture stress, (2) future impacts of Swiss needle cast are difficult to predict due to uncertainties in May-July leaf wetness, but warmer winters could contribute to intensification at higher elevations, and (3) laminated root rot will be influenced primarily by forest management, rather than climatic change. Furthermore, these biotic disturbance agents interact in complex ways that are poorly understood. Consequently, to inform management decisions, insect and disease influences on disturbance regimes must be characterized specifically by forest type and region in order to accurately capture these interactions in light of future climate-mediated changes.*

Agnihotri, R., Ramesh, A., Singh, S., & Sharma, M. P. (2017). Impact of agricultural management practices on mycorrhizal functioning and soil microbiological parameters under soybean-based cropping systems. In *Adaptive Soil Management: From Theory to Practices* (pp. 301-322).

Research Tags: Soil, Crops

Abstract: *The use of modern agricultural techniques for enhanced production has been advocated, however, its*

impact on below ground microbial networks is overlooked and adversely affected. The abiotic stresses like temperature (heat, cold chilling/frost), water (drought, flooding/hypoxia), radiation (UV, ionizing radiation), chemicals (mineral deficiency/excess, pollutants heavy metals/pesticides, gaseous toxins), mechanical (wind, soil movement, submergence) are responsible for over 50% reduction in agricultural production. On the other hand, organic farming practices yield fruitful results. This has highlighted the emerging need of switching over to some eco-friendly agricultural practices which can enhance the growth of plant, improve soil quality, mitigate drought without having adverse impacts on environment. Rhizosphere which is the narrow zone surrounding the roots of plant (Hiltner 1904) contains microbial communities which have the potential to benefit plants. Arbuscular mycorrhizal fungi are obligate symbionts which form association with about 90% of the land plant species (Gadkar et al. 2001). However, agricultural practices like tillage, crop rotation, fallowing, organic farming, fertilizers, etc., influence the functioning of AMF in many ways. Soybean is rich in phytochemicals that are beneficial for human beings. The inoculation of soybean and some other crops including cereals, pulses, and other leguminous crops with AMF leads to an enhancement in abiotic stress tolerance, disease resistance, overall growth, soil carbon sequestration, nutrient uptake, etc. This chapter summarizes the overall impact of different agricultural practices on mycorrhiza and other soil microbial communities under soybean-based cropping system.

Ahiablame, L., Sheshukov, A. Y., Rahmani, V., & Moriasi, D. (2017). Annual baseflow variations as influenced by climate variability and agricultural land use change in the Missouri River Basin. *Journal of Hydrology, 551*, 188-202. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020707938&doi=10.1016%2fj.jhydrol.2017.05.055&partnerID=40&md5=2b6727d993d205f1862e3df6f9ab7792. doi:10.1016/j.jhydrol.2017.05.055

Research Tags: Water

Abstract: *The Missouri River system has a large water storage capacity, where baseflow plays an important role. Understanding historical baseflow characteristics with respect to climate and land use impacts is essential for effective planning and management of water resources in the Missouri River Basin (MORB). This study evaluated statistical trends in baseflow and precipitation for 99 MORB minimally disturbed watersheds during 1950–2014. Elasticity of baseflow to climate variability and agricultural land use change were quantified for the 99 studied watersheds. Baseflow was derived from daily streamflow records with a recursive digital filter method. The results showed that baseflow varied between 38 and 80% (0 and 331 mm/year) of total streamflow with an average of 60%, indicating that more than half of streamflow in the MORB is derived from baseflow. The trend analysis revealed that precipitation increased during the study period in 78 out of 99 watersheds, leading to 1–3.9% noticeable increase in baseflow for 68 of 99 watersheds. Although the changes in baseflow obtained in this study were a result of the combined effects of climate and land use change across the basin, upward trends in baseflow generally coincide with increased precipitation and agricultural land use trends in the basin. Agricultural land use increase mostly led to a 0–5.7% decrease in annual baseflow in the basin, except toward east of the basin where baseflow mostly increased with agricultural land use increase (0.1–2.0%). In general, a 1% increase in precipitation and a 1% increase in agricultural land use resulted in 1.5% increase and 0.2% decrease in baseflow, respectively, during the study period. These results are entirely dependent on the quality of data used; however, they provide useful insight into the relative influence of climate and land use change on baseflow conditions in the Great Plains region of the USA.*

Ajaz, A., Taghvaeian, S., Khand, K., Gowda, P. H., & Moorhead, J. E. (2019). Development and evaluation of an agricultural drought index by harnessing soil moisture and weather data. *Water (Switzerland), 11*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068559623&doi=10.3390%2fw11071375&partnerID=40&md5=ecaea26eaadb04233a32c182213633f8. doi:10.3390/w11071375

Research Tags: Weather, Soil

Abstract: *A new agricultural drought index was developed for monitoring drought impacts on agriculture in Oklahoma. This new index, called the Soil Moisture Evapotranspiration Index (SMEI), estimates the departure of aggregated root zone moisture from reference evapotranspiration. The SMEI was estimated at five locations across Oklahoma representing different climates. The results showed good agreement with existing soil moisture-based (SM) and meteorological drought indices. In addition, the SMEI had improved performance* *compared to other indices in capturing the effects of temporal and spatial variations in drought. The relationship with crop production is a key characteristic of any agricultural drought index. The correlations between winter wheat production and studied drought indices estimated during the growing period were investigated. The correlation coefficients were largest for SMEI (r > 0.9) during the critical crop growth stages when compared to other drought indices, and r decreased by moving from semi-arid to more humid regions across Oklahoma. Overall, the results suggest that the SMEI can be used effectively for monitoring the effects of drought on agriculture in Oklahoma.*

Alanya-Rosenbaum, S., & Bergman, R. D. (2019). Life-cycle impact and exergy based resource use assessment of torrefied and non-torrefied briquette use for heat and electricity generation. *Journal of Cleaner Production, 233*, 918-931. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068042791&doi=10.1016%2fj.jclepro.2019.05.298&partnerID=40&md5=244ce4ca07040a4d7621d2a265bddc13. doi:10.1016/j.jclepro.2019.05.298

Research Tags: Energy, Forestry

Abstract: *Forest residue biomass can be used as bioenergy feedstock, however, issues associated with its properties including low density and high moisture content constrains its valorization. Using mobile conversion technologies that can operate in remote areas and are capable of converting forest residues into high quality energy products can address the issues associated with its valorization for renewable energy production. This study evaluated environmental sustainability of using an integrated novel system of semi-mobile biomass conversion technologies (BCTs) to utilize low-value forest residue biomass as high value bioenergy products. A cradle-to-grave life cycle assessment (LCA) and resource use assessment on a unit-process level was conducted for two bio-products: nontorrefied briquettes (NTB) and torrefied briquettes (TOB). Their use for production of useful thermal energy in wood stoves for domestic heating and electricity at power plants were investigated along with their alternatives. The analyses were performed with SimaPro 8.5 using the DATASMART database. The impact assessment results showed a notable decrease in global warming (GW) impact when substituting fossil fuels with these two bio-products. Specifically, for domestic heating on an equivalent energy basis, a 50% substitution of propane with NTB and TOB showed GHG emission reductions of 46% and 41%, respectively. For electricity generation, 10% cofiring at coal power plant with NTB and TOB showed GHG emission reductions of 6% and 8%, respectively. For the TOB supply chain, a large portion of the GW impact of the came from the torrefaction process and followed by the drying process. This was due to the propane use in these processes. Comparative analysis showed that near-woods biomass conversion for TOB production instead of processing feedstock at an in-town facility with access to grid electricity found 48%–55% lower GW impact for both electricity and heat generation scenarios, respectively. Resourced footprint analysis showed that most exergy extraction from the natural environment came from the drying process for NTB supply chain. In the TOB product system, torrefaction was the major contributor.*

Albano, C. M., McClure, M. L., Gross, S. E., Kitlasten, W., Soulard, C. E., Morton, C., & Huntington, J. (2019). Spatial patterns of meadow sensitivities to interannual climate variability in the Sierra Nevada. *Ecohydrology*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069893735&doi=10.1002%2feco.2128&partnerID=40&md5=566bdbf8a364435b2ad10da87a6fa3d5. doi:10.1002/eco.2128

Research Tags: Grassland

Abstract: *Conservation of montane meadows is a high priority for land and water managers given their critical role in buffering the effects of climate variability and their vulnerability to increasing temperatures and evaporative demands. Recent advances in cloud computing have provided new opportunities to examine ecological responses to climate variability over the past few decades and at large spatial scales. In this study, we characterized the sensitivities (magnitude and direction of the slope) of meadow vegetation responses to interannual variations in climate. We calculated sensitivity as the regression slope between a 31-year (1985–2016) time series of Landsat-derived vegetation indices characterizing late-season vegetation vigour and water balance variables from the Basin Characterization Model. We identified April 1 snowpack as the climate variable the majority of meadows were most sensitive to. We assessed how vegetation sensitivities to snowpack varied with hydrogeomorphic context (e.g., climate, geology, soils, watershed geometry, and land cover) across the Sierra Nevada mountain range using factor analysis to reduce the dimensionality of the hydrogeomorphic* *data and multiple linear regression to model sensitivity responses. We found that meadow sensitivities to snowpack varied with long-term average meadow climate, indicators of watershed subsurface water storage capacity, and indicators of meadow vegetation composition. Alpine and subalpine meadows with high average annual precipitation but limited catchment subsurface storage exhibited the largest sensitivities. Our results provide a novel regional perspective on spatial patterns of meadow sensitivities to climate variability and the landscape-scale hydrogeomorphic factors that influence late-season water availability in meadow ecosystems in the Sierra Nevada.*

Albright, T. P., Mutiibwa, D., Gerson, A. R., Smith, E. K., Talbot, W. A., O'Neill, J. J., . . . Wolf, B. O. (2017). Mapping evaporative water loss in desert passerines reveals an expanding threat of lethal dehydration. *Proceedings of the National Academy of Sciences of the United States of America, 114*(9), 2283-2288. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014204135&doi=10.1073%2fpnas.1613625114&partnerID=40&md5=4bd82180209752a9a0bd6ea03504bf5c. doi:10.1073/pnas.1613625114

Research Tags: Weather

Abstract: *Extreme high environmental temperatures produce a variety of consequences for wildlife, including mass die-offs. Heat waves are increasing in frequency, intensity, and extent, and are projected to increase further under climate change. However, the spatial and temporal dynamics of die-off risk are poorly understood. Here, we examine the effects of heat waves on evaporative water loss (EWL) and survival in five desert passerine birds across the southwestern United States using a combination of physiological data, mechanistically informed models, and hourly geospatial temperature data. We ask how rates of EWL vary with temperature across species; how frequently, over what areas, and how rapidly lethal dehydration occurs; how EWL and die-off risk vary with body mass; and how die-off risk is affected by climate warming. We find that smaller-bodied passerines are subject to higher rates of mass-specific EWL than larger-bodied counterparts and thus encounter potentially lethal conditions much more frequently, over shorter daily intervals, and over larger geographic areas. Warming by 4 °C greatly expands the extent, frequency, and intensity of dehydration risk, and introduces new threats for larger passerine birds, particularly those with limited geographic ranges. Our models reveal that increasing air temperatures and heat wave occurrence will potentially have important impacts on the water balance, daily activity, and geographic distribution of arid-zone birds. Impacts may be exacerbated by chronic effects and interactions with other environmental changes. This work underscores the importance of acute risks of high temperatures, particularly for small-bodied species, and suggests conservation of thermal refugia and water sources.*

Alexander, P., Prestele, R., Verburg, P. H., Arneth, A., Baranzelli, C., Batista e Silva, F., . . . Rounsevell, M. D. A. (2017). Assessing uncertainties in land cover projections. *Global Change Biology, 23*(2), 767-781. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84982237065&doi=10.1111%2fgcb.13447&partnerID=40&md5=f456ac6f035dc69cf46ebf65a4befc4f. doi:10.1111/gcb.13447

Research Tags: Research

Abstract: *Understanding uncertainties in land cover projections is critical to investigating land-based climate mitigation policies, assessing the potential of climate adaptation strategies and quantifying the impacts of land cover change on the climate system. Here, we identify and quantify uncertainties in global and European land cover projections over a diverse range of model types and scenarios, extending the analysis beyond the agro-economic models included in previous comparisons. The results from 75 simulations over 18 models are analysed and show a large range in land cover area projections, with the highest variability occurring in future cropland areas. We demonstrate systematic differences in land cover areas associated with the characteristics of the modelling approach, which is at least as great as the differences attributed to the scenario variations. The results lead us to conclude that a higher degree of uncertainty exists in land use projections than currently included in climate or earth system projections. To account for land use uncertainty, it is recommended to use a diverse set of models and approaches when assessing the potential impacts of land cover change on future climate. Additionally, further work is needed to better understand the assumptions driving land use model results and reveal the causes of uncertainty in more depth, to help reduce model uncertainty and improve the projections of land cover.*

Alhameid, A., Tobin, C., Maiga, A., Kumar, S., Osborne, S., & Schumacher, T. (2017). Intensified Agroecosystems and

Changes in Soil Carbon Dynamics. In *Soil Health and Intensification of Agroecosystems* (pp. 195-214).
Research Tags: Soil
Abstract: *Land use change, intensive farming systems, and poor land management practices are related to reduced soil organic carbon (SOC) and soil health. One way to address these concerns is by implementing ecological principles to manage agroecosystems for environmental and economic benefits. This chapter examines diverse crop rotations, cover crops, and integrated crop-livestock (ICL) systems as examples of sustainable intensification. Long-term diverse crop rotations, cover crops, no-tillage systems, and ICL systems alter SOC dynamics, microbial activity, and impact ecological services such as nutrient cycling and water quality. Research has shown that effects of sustainable intensification on increasing soil carbon content and improving ecological services such as reduced greenhouse gas emissions, and improved nutrient cycling often require long-term sustained management. Short-term effects have been observed but less frequently. The observed impacts of sustainable intensification are location-dependent, being sensitive to the local climate, soil, and details of management practice implementation.*

Allen, B. L., Fawcett, A., Anker, A., Engeman, R. M., Lisle, A., & Leung, L. K. P. (2018). Environmental effects are stronger than human effects on mammalian predator-prey relationships in arid Australian ecosystems. *Science of the Total Environment, 610-611*, 451-461. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028707663&doi=10.1016%2fj.scitotenv.2017.08.051&partnerID=40&md5=12fa54472e4ae8e90d3dbe7bd1a03046. doi:10.1016/j.scitotenv.2017.08.051
Research Tags: Wildlife
Abstract: *Climate (drought, rainfall), geology (habitat availability), land use change (provision of artificial waterpoints, introduction of livestock), invasive species (competition, predation), and direct human intervention (lethal control of top-predators) have each been identified as processes driving the sustainability of threatened fauna populations. We used a systematic combination of empirical observational studies and experimental manipulations to comprehensively evaluate the effects of these process on a model endangered rodent, dusky hopping-mice (Notomys fuscus). We established a large manipulative experiment in arid Australia, and collected information from relative abundance indices, camera traps, GPS-collared dingoes (Canis familiaris) and dingo scats, along with a range of related environmental data (e.g. rainfall, habitat type, distance to artificial water etc.). We show that hopping-mice populations were most strongly influenced by geological and climatic effects of resource availability and rainfall, and not land use, invasive species, or human effects of livestock grazing, waterpoint provision, or the lethal control of dingoes. Hopping-mice distribution declined along a geological gradient of more to less available hopping-mice habitat (sand dunes), and their abundance was driven by rainfall. Hopping-mice populations fluctuated independent of livestock presence, artificial waterpoint availability or repeated lethal dingo control. Hopping-mice populations appear to be limited first by habitat availability, then by food availability, then by predation. Contemporary top-predator control practices (for protection of livestock) have little influence on hopping-mice behaviour or population dynamics. Given our inability to constrain the effects of predation across broad scales, management actions focusing on increasing available food and habitat (e.g. alteration of fire and herbivory) may have a greater chance of improving the conservation status of hopping-mice and other small mammals in arid areas. Our study also reaffirms the importance of using systematic and experimental approaches to detect true drivers of population distribution and dynamics where multiple potential drivers operate simultaneously.*

Allen, P. M., Arnold, J. G., Auguste, L., White, J., & Dunbar, J. (2018). Application of a simple headcut advance model for gullies. *Earth Surface Processes and Landforms, 43*(1), 202-217. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030213122&doi=10.1002%2fesp.4233&partnerID=40&md5=9bd3c98a150b2c9750886fa644be9206. doi:10.1002/esp.4233
Research Tags: Water, Soil
Abstract: *Gully erosion begins in streambanks and uplands as a consequence of adjustments in driving forces on the landscape imposed by changes in land use or climate. The deleterious effects of gullies worldwide have led to many site-specific studies of gully form and function. In the continental United States, gully erosion in agricultural land has destroyed valuable farmland yet, prediction of gully processes remains problematic on a national scale. This research has proposed a simple method to predict gully headcut advance. When combined with SWAT hydrologic flow routines, the model predicted gully headcut advance with reasonable accuracy on a*

daily time step for time periods exceeding two decades. The model was tested in two distinct land resource areas of the United States with differing climate, soils, cover and drainage. The inputs for the headcut model have been kept simple as the model will be applied over large areas. Model inputs consist of headcut height, headcut resistance (based on soil erodibility and a root-cover factor), and daily flow. The model is compared with an annual time step model used in assessment of headcut advance and appears to offer a better way to assess gully headcut advance.

Almagro, A., Oliveira, P. T. S., Nearing, M. A., & Hagemann, S. (2017). Projected climate change impacts in rainfall erosivity over Brazil. *Scientific Reports, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027494522&doi=10.1038%2fs41598-017-08298-y&partnerID=40&md5=0bbc85396e8cc74f6b1455fc6acfc473. doi:10.1038/s41598-017-08298-y

Research Tags: Water, Soil

Abstract: *The impacts of climate change on soil erosion may bring serious economic, social and environmental problems. However, few studies have investigated these impacts on continental scales. Here we assessed the influence of climate change on rainfall erosivity across Brazil. We used observed rainfall data and downscaled climate model output based on Hadley Center Global Environment Model version 2 (HadGEM2-ES) and Model for Interdisciplinary Research On Climate version 5 (MIROC5), forced by Representative Concentration Pathway 4.5 and 8.5, to estimate and map rainfall erosivity and its projected changes across Brazil. We estimated mean values of 10,437 mm ha^{-1} h^{-1} year^{-1} for observed data (1980–2013) and 10,089 MJ mm ha^{-1} h^{-1} year^{-1} and 10,585 MJ mm ha^{-1} h^{-1} year^{-1} for HadGEM2-ES and MIROC5, respectively (1961–2005). Our analysis suggests that the most affected regions, with projected rainfall erosivity increases ranging up to 109% in the period 2007–2040, are northeastern and southern Brazil. Future decreases of as much as −71% in the 2071–2099 period were estimated for the southeastern, central and northwestern parts of the country. Our results provide an overview of rainfall erosivity in Brazil that may be useful for planning soil and water conservation, and for promoting water and food security.*

Almutairi, K. F., Bryla, D. R., & Strik, B. C. (2017). Potential of deficit irrigation, irrigation cutoffs, and crop thinning to maintain yield and fruit quality with less water in northern highbush blueberry. *Hortscience, 52*(4), 625-633. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019467019&doi=10.21273%2fHORTSCI11533-16&partnerID=40&md5=fa26197c29e4b366c3fbcd02144cb50d. doi:10.21273/HORTSCI11533-16

Research Tags: Crops, Water, Weather

Abstract: *Drought and mandatory water restrictions are limiting the availability of irrigation water in many important blueberry growing regions, such as Oregon, Washington, and California. New strategies are needed to maintain yield and fruit quality with less water. To address the issue, three potential options for reducing water use, including deficit irrigation, irrigation cutoffs, and crop thinning, were evaluated for 2 years in a mature planting of northern highbush blueberry (*Vaccinium corymbosum *L. 'Elliott'). Treatments consisted of no thinning and 50% crop removal in combination with either full irrigation at 100% of estimated crop evapotranspiration (ET_c), deficit irrigation at 50% ET_c (applied for the entire growing season), or full irrigation with irrigation cutoff for 4–6 weeks during early (early- to late-green fruit) or late (fruit coloring to harvest) stages of fruit development. Stem water potential was similar with full and deficit irrigation but, regardless of crop thinning, declined by 0.5–0.6 MPa when irrigation was cutoff early and by >2.0 MPa when irrigation was cutoff late. In one or both years, the fruiting season was advanced with either deficit irrigation or late cutoff, whereas cutting off irrigation early delayed the season. Yield was unaffected by deficit irrigation in plants with a full crop load but was reduced by an average of 35% when irrigation was cutoff late each year. Cutting off irrigation early likewise reduced yield, but only in the 2nd year when the plants were not thinned; however, early cutoff also reduced fruit soluble solids and berry weight by 7% to 24% compared with full irrigation. Cutting off irrigation late produced the smallest and firmest fruit with the highest soluble solids and total acidity among the treatments, as well as the slowest rate of fruit loss in cold storage. Deficit irrigation had the least effect on fruit quality and, based on these results, appears to be the most viable option for maintaining yield with less water in northern highbush blueberry. Relative to full irrigation, the practice reduced water use by 2.5 ML·ha^{-1} per season.*

Alonzo, M., Morton, D. C., Cook, B. D., Andersen, H. E., Babcock, C., & Pattison, R. (2017). Patterns of canopy and surface layer consumption in a boreal forest fire from repeat airborne lidar. *Environmental Research Letters, 12*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021301898&doi=10.1088%2f1748-9326%2faa6ade&partnerID=40&md5=355a38a605458040fd347ac70fa3a3cb. doi:10.1088/1748-9326/aa6ade

Research Tags: Forestry, Weather

Abstract: *Fire in the boreal region is the dominant agent of forest disturbance with direct impacts on ecosystem structure, carbon cycling, and global climate. Global and biome-scale impacts are mediated by burn severity, measured as loss of forest canopy and consumption of the soil organic layer. To date, knowledge of the spatial variability in burn severity has been limited by sparse field sampling and moderate resolution satellite data. Here, we used pre- and post-fire airborne lidar data to directly estimate changes in canopy vertical structure and surface elevation for a 2005 boreal forest fire on Alaska's Kenai Peninsula. We found that both canopy and surface losses were strongly linked to pre-fire species composition and exhibited important fine-scale spatial variability at sub-30 m resolution. The fractional reduction in canopy volume ranged from 0.61 in lowland black spruce stands to 0.27 in mixed white spruce and broadleaf forest. Residual structure largely reflects standing dead trees, highlighting the influence of pre-fire forest structure on delayed carbon losses from aboveground biomass, post-fire albedo, and variability in understory light environments. Median loss of surface elevation was highest in lowland black spruce stands (0.18 m) but much lower in mixed stands (0.02 m), consistent with differences in pre-fire organic layer accumulation. Spatially continuous depth-of-burn estimates from repeat lidar measurements provide novel information to constrain carbon emissions from the surface organic layer and may inform related research on post-fire successional trajectories. Spectral measures of burn severity from Landsat were correlated with canopy (r = 0.76) and surface (r = −0.71) removal in black spruce stands but captured less of the spatial variability in fire effects for mixed stands (canopy r = 0.56, surface r = −0.26), underscoring the difficulty in capturing fire effects in heterogeneous boreal forest landscapes using proxy measures of burn severity from Landsat.*

Álvarez-Berríos, N. L., Soto-Bayó, S., Holupchinski, E., Fain, S. J., & Gould, W. A. (2018). Correlating drought conservation practices and drought vulnerability in a tropical agricultural system. *Renewable Agriculture and Food Systems, 33*(3), 279-291. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042561811&doi=10.1017%2fS174217051800011X&partnerID=40&md5=beced9a1cb77940f162e125be1164cdd. doi:10.1017/S174217051800011X

Research Tags: Weather, Crops

Abstract: *Recent droughts in Puerto Rico and throughout the Caribbean have emphasized the region's agricultural vulnerability to this hazard and the increasing need for adaptation mechanisms to support sustainable production. In this study, we assessed the geographic extent of agricultural conservation practices incentivized by US Department of Agriculture Natural Resources Conservation Service (NRCS) and evaluated their large-scale contribution to drought adaptability. We identified concentrations of drought-related practices (e.g. cover crops, ponds) applied between 2000 and 2016. Using information from spatial databases and interviews with experts, we assessed the spatial correlation between these practices and areas exposed to drought as identified by the US Drought Monitor. Between 2000 and 2016, Puerto Rico experienced seven drought episodes concentrated around the south, east and southeastern regions. The most profound drought occurred between 2014 and 2016 when the island experienced 80 consecutive weeks of moderate drought, 48 of severe drought and 33 of extreme drought conditions. A total of 44 drought-related conservation practices were applied at 6984 locations throughout 860 km2 of farmlands between 2000 and 2016 through the NRCS-Environmental Quality Incentives Program (EQIP). Practices related to water availability were statistically clustered along the coasts, whereas soil and plant health practices were clustered in the mountainous region. While these concentrations strongly correlated with areas exposed to moderate drought conditions, >80% did not coincide with areas that experienced severe or extreme drought conditions, suggesting that areas highly exposed to drought conditions generally lacked drought preparedness assisted by EQIP. Climate projections indicate an increase in the frequency and intensity of drought events, particularly in the eastern region of Puerto Rico. Our analysis highlighted the need to implement more conservation practices in these areas subject to drought intensification and exposure. Government programs intended to address vulnerabilities and enhance capacity and resilience may not be reaching areas of highest exposure. Recommendations include raising*

producer awareness of past and future exposure and making programs more accessible to a broader audience.

Al-Yaari, A., Ducharne, A., Cheruy, F., Crow, W. T., & Wigneron, J. P. (2019). Satellite-based soil moisture provides missing link between summertime precipitation and surface temperature biases in CMIP5 simulations over conterminous United States. *Scientific Reports, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061295084&doi=10.1038%2fs41598-018-38309-5&partnerID=40&md5=e0f2fb6214c152aa22dffe83510c49d2. doi:10.1038/s41598-018-38309-5

Research Tags: Soil, Weather

Abstract: *Past studies have shown that climate simulations have substantial warm and dry biases during the summer in the conterminous United States (CONUS), particularly in the central Great Plains (CGP). These biases have critical implications for the interpretation of climate change projections, but the complex overlap of multiple land-atmosphere feedback processes make them difficult to explain (and therefore correct). Even though surface soil moisture (SM) is often cited as a key control variable in these processes, there are still knowledge gaps about its specific role. Here, we use recently developed remotely sensed SM products to analyse the link between spatial patterns of summertime SM, precipitation and air temperature biases over CONUS in 20 different CMIP5 simulations. We identify three main types of bias combinations: (i) a dry/warm bias over the CGP region, with a significant inter-model correlation between SM and air temperature biases (R = −0.65), (ii) a wet/cold bias in NW CONUS, and (iii) a dry/cold bias in SW CONUS. Combined with irrigation patterns, these results suggest that land-atmosphere feedbacks over the CGP are not only local but have a regional dimension, and demonstrate the added-value of large-scale SM observations for resolving the full feed-back loop between precipitation and temperature.*

Amatya, D. M., Fialkowski, M., & Bitner, A. (2019). A Daily Water Table Depth Computing Model for Poorly Drained Soils. *Wetlands, 39*(1), 39-54. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052635806&doi=10.1007%2fs13157-018-1069-7&partnerID=40&md5=9bd499c24ce3a4f890fd398dc71d4963. doi:10.1007/s13157-018-1069-7

Research Tags: Water, Soil

Abstract: *The objective of this paper is to present a relatively simplified model to predict daily water table (WT) by solving ordinary differential equation* $dWT(t)/dt = F(\alpha_1, \alpha_2, \alpha_3, WT_0(t), RF(t), PET(t))$, *with* $\alpha_1, \alpha_2, \alpha_3, WT_0$ *as parameters, and RF (rainfall) and PET (potential evapotranspiration), respectively, as inputs. The model was calibrated and validated with WT on four poorly to moderately drained soils (Lenoir, Rains, Lynchburg, and Goldsboro) on a forested wetland. Calibration results were in good agreement with the measured WT for all soils, except the Goldsboro with deeper WT.* r^2 *(coefficient of determination) and NSE (Nash-Sutcliffe Efficiency) statistics both ranged from 0.81 for the Lenoir to 0.89 and 0.87, respectively, for the Lynchburg. Average absolute daily deviation (AADD) varied from 10.8 cm for Lenoir to 16.7 cm for Rains. The performance was somewhat poorer, during relatively dry periods with deeper WT, yielding* r^2 *and NSE as low as 0.55 and 0.29, respectively, for Lenoir, and large AADD for Lynchburg. Discrepancies were associated with WT overprediction for deeper depths. The new model is capable of describing the WT for poorly drained high water table soils, with a potential for assessing effects of land management, wetland hydrology, and climate changes.*

Anache, J. A. A., Flanagan, D. C., Srivastava, A., & Wendland, E. C. (2018). Land use and climate change impacts on runoff and soil erosion at the hillslope scale in the Brazilian Cerrado. *Science of the Total Environment, 622-623*, 140-151. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035756363&doi=10.1016%2fj.scitotenv.2017.11.257&partnerID=40&md5=e7ea1cc8290eabe66534baec589f1dc5. doi:10.1016/j.scitotenv.2017.11.257

Research Tags: Soil, Water

Abstract: *Land use and climate change can influence runoff and soil erosion, threatening soil and water conservation in the Cerrado biome in Brazil. The adoption of a process-based model was necessary due to the lack of long-term observed data. Our goals were to calibrate the WEPP (Water Erosion Prediction Project) model for different land uses under subtropical conditions in the Cerrado biome; predict runoff and soil erosion for these different land uses; and simulate runoff and soil erosion considering climate change. We performed the model calibration using a 5-year dataset (2012–2016) of observed runoff and soil loss in four different land uses (wooded Cerrado, tilled fallow without plant cover, pasture, and sugarcane) in experimental plots. Selected* *soil and management parameters were optimized for each land use during the WEPP model calibration with the existing field data. The simulations were conducted using the calibrated WEPP model components with a 100-year climate dataset created with CLIGEN (weather generator) based on regional climate statistics. We obtained downscaled General Circulation Model (GCM) projections, and runoff and soil loss were predicted with WEPP using future climate scenarios for 2030, 2060, and 2090 considering different Representative Concentration Pathways (RCPs). The WEPP model had an acceptable performance for the subtropical conditions. Land use can influence runoff and soil loss rates in a significant way. Potential climate changes, which indicate the increase of rainfall intensities and depths, may increase the variability and rates of runoff and soil erosion. However, projected climate changes did not significantly affect the runoff and soil erosion for the four analyzed land uses at our location. Finally, the runoff behavior was distinct for each land use, but for soil loss we found similarities between pasture and wooded Cerrado, suggesting that the soil may attain a sustainable level when the land management follows conservation principles.*

Anapalli, S. S., Fisher, D. K., Reddy, K. N., Krutz, J. L., Pinnamaneni, S. R., & Sui, R. (2019). Quantifying water and CO <inf>2</inf> fluxes and water use efficiencies across irrigated C <inf>3</inf> and C <inf>4</inf> crops in a humid climate. *Science of the Total Environment, 663*, 338-350. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060889002&doi=10.1016%2fj.scitotenv.2018.12.471&partnerID=40&md5=34432bbb1e3336d9dc86d170d3e70a08. doi:10.1016/j.scitotenv.2018.12.471

Research Tags: Water, Crops, Emissions

Abstract: *Underground aquifers that took millions of years to fill are being depleted due to unsustainable water withdrawals for crop irrigation. Concurrently, atmospheric warming due to anthropogenic greenhouse gases is enhancing demands for water inputs in agriculture. Accurate information on crop-ecosystem water use efficiencies [EWUE, amount of CO2 removed from the soil-crop-air system per unit of water used in evapotranspiration (ET)] is essential for developing environmentally and economically sustainable water management practices that also help account for CO2, the most abundant of the greenhouse gases, exchange rates from cropping systems. We quantified EWUE of corn (a C4 crop) and soybean and cotton (C3 crops) in a predominantly clay soil under humid climate in the Lower Mississippi (MS) Delta, USA. Crop-ecosystem level exchanges of CO2 and water from these three cropping systems were measured in 2017 using the eddy covariance method. Ancillary micrometeorological data were also collected. On a seasonal basis, all three crops were net sinks for CO2 in the atmosphere: corn, soybean, and cotton fixed −31,331, −23,563, and −8856 kg ha−1 of CO2 in exchange for 483, 552, and 367 mm of ET, respectively (negative values show that CO2 is fixed in the plant or removed from the air). The seasonal NEE estimated for cotton was 72% less than corn and 62% less than soybean. Half-hourly averaged maximum net ecosystem exchange (NEE) from these cropping systems were −33.6, −27.2, and −14.2 kg CO2 ha−1, respectively. Average daily NEE were −258, −169, and −65 kg CO2 ha−1, respectively. The EWUE in these three cropping systems were 53, 43, and 24 kg CO2 ha−1 mm−1 of water. Results of this investigation can help in adopting crop mixtures that are environmentally and economically sustainable, conserving limited water resources in the region.*

Anapalli, S. S., Reddy, K. N., & Jagadamma, S. (2018). Conservation tillage impacts and adaptations in irrigated corn production in a humid climate. *Agronomy Journal, 110*(6), 2673-2686. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056631987&doi=10.2134%2fagronj2018.03.0195&partnerID=40&md5=3791dce0fcc6c2b505289e08ad510bd7. doi:10.2134/agronj2018.03.0195

Research Tags: Crops, Soil

Abstract: *We initiated a long-term experiment in 2008 on 1.25-ha farm-scale plots to assess the production impacts of no-till with full residue retention (NT) system over a conventional tillage (CT) system under irrigated corn (*Zea mays *L.) production on a Dundee silt loam soil in a humid climate. Data collected in the experiment from 2009 to 2015 were mainly confined to grain yield at harvest. In 2016 and 2017, additional data were collected including soil surface crop residue mass and soil surface residue cover; corn leaf area index (LAI) and biomass; soil water, temperature, N, C, and bulk density (*D_b*); and the corn phenology. In 7 out of 9 yr (2009–17), harvested grain yields under NT were significantly lower than those harvested under CT. To investigate the possible reasons for the yield decreases under NT, we integrated the experiment with the Root Zone Water Quality Model to synthesize information on the various components in the system. The N loss to runoff and deep percolation, denitrification caused by higher soil water content, and a low N mineralization*

rate caused by lower soil temperatures under NT potentially contributed to the observed grain yield decrease under this treatment. Simulations showed that an additional N application at 40 kg ha^{-1} at planting or a split application of 50 kg ha^{-1} at planting and the remaining 174 kg ha^{-1} in the second week of May could make the yield return under NT comparable to that under CT.

Anderegg, W. R. L., Wolf, A., Arango-Velez, A., Choat, B., Chmura, D. J., Jansen, S., . . . Pacala, S. (2017). Plant water potential improves prediction of empirical stomatal models. *PLoS ONE, 12*(10). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031096214&doi=10.1371%2fjournal.pone.0185481&partnerID=40&md5=b025979052ee04d16f2ed380eac31147. doi:10.1371/journal.pone.0185481

Research Tags: Research, Crops

Abstract: *Climate change is expected to lead to increases in drought frequency and severity, with deleterious effects on many ecosystems. Stomatal responses to changing environmental conditions form the backbone of all ecosystem models, but are based on empirical relationships and are not well-tested during drought conditions. Here, we use a dataset of 34 woody plant species spanning global forest biomes to examine the effect of leaf water potential on stomatal conductance and test the predictive accuracy of three major stomatal models and a recently proposed model. We find that current leaf-level empirical models have consistent biases of over-prediction of stomatal conductance during dry conditions, particularly at low soil water potentials. Furthermore, the recently proposed stomatal conductance model yields increases in predictive capability compared to current models, and with particular improvement during drought conditions. Our results reveal that including stomatal sensitivity to declining water potential and consequent impairment of plant water transport will improve predictions during drought conditions and show that many biomes contain a diversity of plant stomatal strategies that range from risky to conservative stomatal regulation during water stress. Such improvements in stomatal simulation are greatly needed to help unravel and predict the response of ecosystems to future climate extremes.*

Anderegg, W. R. L., Wolf, A., Arango-Velez, A., Choat, B., Chmura, D. J., Jansen, S., . . . Pacala, S. (2018). Woody plants optimise stomatal behaviour relative to hydraulic risk. *Ecology Letters, 21*(7), 968-977. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048657385&doi=10.1111%2fele.12962&partnerID=40&md5=454a21a228a1152d414c75ea38c51333. doi:10.1111/ele.12962

Research Tags: Forestry

Abstract: *Stomatal response to environmental conditions forms the backbone of all ecosystem and carbon cycle models, but is largely based on empirical relationships. Evolutionary theories of stomatal behaviour are critical for guarding against prediction errors of empirical models under future climates. Longstanding theory holds that stomata maximise fitness by acting to maintain constant marginal water use efficiency over a given time horizon, but a recent evolutionary theory proposes that stomata instead maximise carbon gain minus carbon costs/risk of hydraulic damage. Using data from 34 species that span global forest biomes, we find that the recent carbon-maximisation optimisation theory is widely supported, revealing that the evolution of stomatal regulation has not been primarily driven by attainment of constant marginal water use efficiency. Optimal control of stomata to manage hydraulic risk is likely to have significant consequences for ecosystem fluxes during drought, which is critical given projected intensification of the global hydrological cycle.*

Andersen, J. C., Havill, N. P., Caccone, A., & Elkinton, J. S. (2017). Postglacial recolonization shaped the genetic diversity of the winter moth (Operophtera brumata) in Europe. *Ecology and Evolution, 7*(10), 3312-3323. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017175405&doi=10.1002%2fece3.2860&partnerID=40&md5=994e07da94e366981d9c09af9e8d7e69. doi:10.1002/ece3.2860

Research Tags: Wildlife

Abstract: *Changes in climate conditions, particularly during the Quaternary climatic oscillations, have long been recognized to be important for shaping patterns of species diversity. For species residing in the western Palearctic, two commonly observed genetic patterns resulting from these cycles are as follows: (1) that the numbers and distributions of genetic lineages correspond with the use of geographically distinct glacial refugia and (2) that southern populations are generally more diverse than northern populations (the "southern richness, northern purity" paradigm). To determine whether these patterns hold true for the widespread pest* *species the winter moth (Operophtera brumata), we genotyped 699 individual winter moths collected from 15 Eurasian countries with 24 polymorphic microsatellite loci. We find strong evidence for the presence of two major genetic clusters that diverged ~18 to ~22 ka, with evidence that secondary contact (i.e., hybridization) resumed ~ 5 ka along a well-established hybrid zone in Central Europe. This pattern supports the hypothesis that contemporary populations descend from populations that resided in distinct glacial refugia. However, unlike many previous studies of postglacial recolonization, we found no evidence for the "southern richness, northern purity" paradigm. We also find evidence for ongoing gene flow between populations in adjacent Eurasian countries, suggesting that long-distance dispersal plays an important part in shaping winter moth genetic diversity. In addition, we find that this gene flow is predominantly in a west-to-east direction, suggesting that recently debated reports of cyclical outbreaks of winter moth spreading from east to west across Europe are not the result of dispersal.*

Anderson, M., Diak, G., Gao, F., Knipper, K., Hain, C., Eichelmann, E., . . . Yang, Y. (2019). Impact of insolation data source on remote sensing retrievals of evapotranspiration over the California delta. *Remote Sensing, 11*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061375577&doi=10.3390%2frs11030216&partnerID=40&md5=465057b2843724bb27cc58af3fb2255c. doi:10.3390/rs11030216

Research Tags: Weather, Research

Abstract: *The energy delivered to the land surface via insolation is a primary driver of evapotranspiration (ET)—the exchange of water vapor between the land and atmosphere. Spatially distributed ET products are in great demand in the water resource management community for real-time operations and sustainable water use planning. The accuracy and deliverability of these products are determined in part by the characteristics and quality of the insolation data sources used as input to the ET models. This paper investigates the practical utility of three different insolation datasets within the context of a satellite-based remote sensing framework for mapping ET at high spatiotemporal resolution, in an application over the Sacramento–San Joaquin Delta region in California. The datasets tested included one reanalysis product: The Climate System Forecast Reanalysis (CFSR) at 0.25° spatial resolution, and two remote sensing insolation products generated with geostationary satellite imagery: a product for the continental United States at 0.2°, developed by the University of Wisconsin Space Sciences and Engineering Center (SSEC) and a coarser resolution (1°) global Clouds and the Earth's Radiant Energy System (CERES) product. The three insolation data sources were compared to pyranometer data collected at flux towers within the Delta region to establish relative accuracy. The satellite products significantly outperformed CFSR, with root-mean square errors (RMSE) of 2.7, 1.5, and 1.4* $MJ{\cdot}m^{-2}{\cdot}d^{-1}$ *for CFSR, CERES, and SSEC, respectively, at daily timesteps. The satellite-based products provided more accurate estimates of cloud occurrence and radiation transmission, while the reanalysis tended to underestimate solar radiation under cloudy-sky conditions. However, this difference in insolation performance did not translate into comparable improvement in the ET retrieval accuracy, where the RMSE in daily ET was 0.98 and 0.94* $mm\ d^{-1}$ *using the CFSR and SSEC insolation data sources, respectively, for all the flux sites combined. The lack of a notable impact on the aggregate ET performance may be due in part to the predominantly clear-sky conditions prevalent in central California, under which the reanalysis and satellite-based insolation data sources have comparable accuracy. While satellite-based insolation data could improve ET retrieval in more humid regions with greater cloud-cover frequency, over the California Delta and climatologically similar regions in the western U.S., the CFSR data may suffice for real-time ET modeling efforts.*

Anderson, M., Gao, F., Knipper, K., Hain, C., Dulaney, W., Baldocchi, D., . . . Kustas, W. (2018). Field-scale assessment of land and water use change over the California delta using remote sensing. *Remote Sensing, 10*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048942485&doi=10.3390%2frs10060889&partnerID=40&md5=8aa3dbd3d1a8acf3b31eec8a5421f538. doi:10.3390/rs10060889

Research Tags: Research

Abstract: *The ability to accurately monitor and anticipate changes in consumptive water use associated with changing land use and land management is critical to developing sustainable water management strategies in water-limited climatic regions. In this paper, we present an application of a remote sensing data fusion technique for developing high spatiotemporal resolution maps of evapotranspiration (ET) at scales that can be* *associated with changes in land use. The fusion approach combines ET map timeseries developed using an multi-scale energy balance algorithm applied to thermal data from Earth observation platforms with high spatial but low temporal resolution (e.g., Landsat) and with moderate resolution but frequent temporal coverage (e.g., MODIS (Moderate Resolution Imaging Spectroradiometer)). The approach is applied over the Sacramento-San Joaquin Delta region in California—an area critical to both agricultural production and drinking water supply within the state that has recently experienced stresses on water resources due to a multi-year (2012–2017) extreme drought. ET "datacubes" with 30-m resolution and daily timesteps were constructed for the 2015–2016 water years and related to detailed maps of land use developed at the same spatial scale. The ET retrievals are evaluated at flux sites over multiple land covers to establish a metric of accuracy in the annual water use estimates, yielding root-mean-square errors of 1.0, 0.8, and 0.3 mm day^{-1} at daily, monthly, and yearly timesteps, respectively, for all sites combined. Annual ET averaged over the Delta changed only 3 mm year^{-1} between water years, from 822 to 819 mm year^{-1}, translating to an area-integrated total change in consumptive water use of seven thousand acre-feet (TAF). Changes were largest in areas with recorded land-use change between water years—most significantly, fallowing of crop land presumably in response to reductions in water availability and allocations due to the drought. Moreover, the time evolution in water use associated with wetland restoration—an effort aimed at reducing subsidence and carbon emissions within the inner Delta—is assessed using a sample wetland chronosequence. Region-specific matrices of consumptive water use associated with land use changes may be an effective tool for policymakers and farmers to understand how land use conversion could impact consumptive use and demand.*

Anderson, P. H., Johnsen, K. H., Butnor, J. R., Gonzalez-Benecke, C. A., & Samuelson, L. J. (2018). Predicting longleaf pine coarse root decomposition in the southeastern US. *Forest Ecology and Management, 425*, 1-8. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047110479&doi=10.1016%2fj.foreco.2018.05.024&partnerID=40&md5=a8fbb93b2f03d17217c0f7d9c0976f6a. doi:10.1016/j.foreco.2018.05.024

Research Tags: Forestry, Soil

Abstract: *Storage of belowground carbon (C) is an important component of total forest C. However, belowground C changes temporally due to forest growth and tree mortality (natural and via harvesting) and these fluctuations are critical for modeling C in forests under varying management regimes. To date, little progress has been made in quantifying the rate of decay of southern pines in general, and specifically in longleaf pine (*Pinus palustris *Mill.) coarse root systems. Decomposition rates of lateral roots and tap roots of longleaf pine were quantified* in situ *under field conditions across the species' range to create a model for necromass loss. The roots of 37 longleaf pine stumps were excavated from Florida, Georgia, Louisiana, and North Carolina. The age of the trees when cut ranged from 14 to 260 years, and the time since cut ranged from 5 to 70 years. Remaining lateral roots to a 1 m depth plus the entire tap root were removed, dried, weighed and analyzed for C and nitrogen (N) content. Total dry necromass of harvested roots ranged from 8 to 195 kg tree^{-1}. Soil C and N content at 15 cm depth were significantly higher near the stump compared to half-way between and adjacent to the nearest living longleaf pine. A regression model was developed to predict necromass loss. The final model included years since cut, stump diameter, and average minimum monthly air temperature as predictors ($R^2 = 0.83$). For example, a 100-year-old tree would have a predicted root decomposition rate (k) of −0.120 for lateral roots and −0.038 per year for tap roots. Results suggest that longleaf pine coarse roots persist in the environment longer than the tap roots of loblolly pine.*

Angel, J. R., Widhalm, M., Todey, D., Massey, R., & Biehl, L. (2017). The U2U Corn Growing Degree Day tool: Tracking corn growth across the US Corn Belt. *Climate Risk Management, 15*, 73-81. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85005801895&doi=10.1016%2fj.crm.2016.10.002&partnerID=40&md5=f247755334674f97aae951b226f1ae00. doi:10.1016/j.crm.2016.10.002

Research Tags: Crops, Research

Abstract: *The Corn Growing Degree Day (Corn GDD) tool is a web-based product that can provide decision support on a variety of issues throughout the entire growing season by integrating current conditions, historical climate data, and projections of Corn GDD through the end of the growing season based on both National Weather Service computer model forecasts and climatology. The Corn GDD tool can help agricultural producers make a variety of important decisions before and during the growing season. This support can include:*

assessing the risk of early and late frosts and freezes that can cause crop damage; comparing corn hybrid maturity requirements and Corn GDD projections to select seed varieties and plan activities such as spraying; guiding marketing decisions based on historical and projected Corn GDDs when considering forward crop pricing (i.e., futures market). The Corn GDD tool provides decision support for corn producers in the central U.S. corn-producing states. Survey results, web statistics, and user feedback indicate that this tool is being actively used by decision makers.

Ankathi, S. K., Long, D. S., Gollany, H. T., Das, P., & Shonnard, D. (2018). Life cycle assessment of oilseed crops produced in rotation with dryland cereals in the inland Pacific Northwest. *International Journal of Life Cycle Assessment*, 1-15. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048002242&doi=10.1007%2fs11367-018-1488-y&partnerID=40&md5=2a452f8f31136c811015d685e52848a6. doi:10.1007/s11367-018-1488-y
Research Tags: Crops, Emissions
Abstract: *Purpose*
Oilseed crops are expected to become an important feedstock for production of renewable jet fuel. The objective of this study is to determine the life cycle energy and greenhouse gas (GHG) emissions of several 2- and 3-year crop rotations with cereals and oilseeds in a low precipitation environment of the inland Pacific Northwest. The purpose is to ascertain whether cropping intensification could improve energy efficiency and reduce GHG emissions.
Methods
A life cycle assessment (LCA) was carried out to evaluate the fossil energy and carbon footprint of nine cropping systems characterized by different inputs applied to spring carinata [Brassica carinata (A.) Braun] and winter canola (B. napus L.) in rotation with wheat (Triticum aevistum L.) and other cereal crops. Grain yield and field activity data from cropping systems were acquired from a field experiment over a 5-year period. Gas emissions were measured weekly over 2 years using static chamber methodology and laboratory gas chromatography. Inputs for the LCA regarding fertilizers, machinery fuel use, and pesticides were from the field trials and literature for fuel use.
Results and discussion
Emission results of winter wheat (WW) rotations are between 300 and 400 g CO2 eq. kg−1 WW, in the range for US average WW cropping emissions (i.e., 300–600 g CO2 eq. kg−1 WW). Reduced tillage fallow (RTF)-Winter oilseed (WO)-RTF-WW and summer fallow (SF)-WW rotation were the most promising, from a trade-off of GHG emissions versus total crop sales over 6 years per hectare with low emissions and high sales. The best oilseed result was 660 g CO2 eq. kg−1 for canola following RTF. Highest yields were observed when cereal or oilseed crops were planted following RTF. Efficiency in terms of Energy Return on Energy Investment was 3.85 for winter oilseed yields 1338.9 kg ha−1 and 1.6 for spring oilseed yields 552.2 kg ha−1.
Conclusions
Compared to SF-WW, bioenergy oilseed cultivation may increase CO2 equivalent emissions in 3-year cereal-based rotations due to increased inputs with inclusion of fallow-substitution cultivation. Fossil energy inputs required to produce oilseed crops were smaller than the total energy in final seed and thus oilseeds have the potential to reduce reliance on fossil fuels. Improving energy efficiency and encouraging adoption by growers will depend on ability to enhance agronomic performance with higher yielding, drought and cold tolerant oilseed varieties.

Anyamba, A., Chretien, J. P., Britch, S. C., Soebiyanto, R. P., Small, J. L., Jepsen, R., . . . Linthicum, K. J. (2019). Global Disease Outbreaks Associated with the 2015–2016 El Niño Event. *Scientific Reports, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061508531&doi=10.1038%2fs41598-018-38034-z&partnerID=40&md5=0437d98fc6caf1ead18ad18a15aef2fe. doi:10.1038/s41598-018-38034-z
Research Tags: Weather
Abstract: *Interannual climate variability patterns associated with the El Niño-Southern Oscillation phenomenon result in climate and environmental anomaly conditions in specific regions worldwide that directly favor outbreaks and/or amplification of variety of diseases of public health concern including chikungunya, hantavirus, Rift Valley fever, cholera, plague, and Zika. We analyzed patterns of some disease outbreaks during the strong 2015–2016 El Niño event in relation to climate anomalies derived from satellite*

measurements. Disease outbreaks in multiple El Niño-connected regions worldwide (including Southeast Asia, Tanzania, western US, and Brazil) followed shifts in rainfall, temperature, and vegetation in which both drought and flooding occurred in excess (14–81% precipitation departures from normal). These shifts favored ecological conditions appropriate for pathogens and their vectors to emerge and propagate clusters of diseases activity in these regions. Our analysis indicates that intensity of disease activity in some ENSO-teleconnected regions were approximately 2.5–28% higher during years with El Niño events than those without. Plague in Colorado and New Mexico as well as cholera in Tanzania were significantly associated with above normal rainfall ($p < 0.05$); while dengue in Brazil and southeast Asia were significantly associated with above normal land surface temperature ($p < 0.05$). Routine and ongoing global satellite monitoring of key climate variable anomalies calibrated to specific regions could identify regions at risk for emergence and propagation of disease vectors. Such information can provide sufficient lead-time for outbreak prevention and potentially reduce the burden and spread of ecologically coupled diseases.

Aradhya, M., Velasco, D., Ibrahimov, Z., Toktoraliev, B., Maghradze, D., Musayev, M., . . . Preece, J. E. (2017). Genetic and ecological insights into glacial refugia of walnut (Juglans regia L.). *PLoS ONE, 12*(10). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031289221&doi=10.1371%2fjournal.pone.0185974&partnerID=40&md5=0ffc0d8605aa012e590e247c96e80e79. doi:10.1371/journal.pone.0185974
Research Tags: Forestry
Abstract: *The distribution and survival of trees during the last glacial maximum (LGM) has been of interest to paleoecologists, biogeographers, and geneticists. Ecological niche models that associate species occurrence and abundance with climatic variables are widely used to gain ecological and evolutionary insights and to predict species distributions over space and time. The present study deals with the glacial history of walnut to address questions related to past distributions through genetic analysis and ecological modeling of the present, LGM and Last Interglacial (LIG) periods. A maximum entropy method was used to project the current walnut distribution model on to the LGM (21–18 kyr BP) and LIG (130–116 kyr BP) climatic conditions. Model tuning identified the walnut data set filtered at 10 km spatial resolution as the best for modeling the current distribution and to hindcast past (LGM and LIG) distributions of walnut. The current distribution model predicted southern Caucasus, parts of West and Central Asia extending into South Asia encompassing northern Afghanistan, Pakistan, northwestern Himalayan region, and southwestern Tibet, as the favorable climatic niche matching the modern distribution of walnut. The hindcast of distributions suggested the occurrence of walnut during LGM was somewhat limited to southern latitudes from southern Caucasus, Central and South Asian regions extending into southwestern Tibet, northeastern India, Himalayan region of Sikkim and Bhutan, and southeastern China. Both CCSM and MIROC projections overlapped, except that MIROC projected a significant presence of walnut in the Balkan Peninsula during the LGM. In contrast, genetic analysis of the current walnut distribution suggested a much narrower area in northern Pakistan and the surrounding areas of Afghanistan, northwestern India, and southern Tajikistan as a plausible hotspot of diversity where walnut may have survived glaciations. Overall, the findings suggest that walnut perhaps survived the last glaciations in several refugia across a wide geographic area between 30° and 45° North latitude. However, humans probably played a significant role in the recent history and modern distribution of walnut.*

Araya, A., Kisekka, I., Lin, X., Vara Prasad, P. V., Gowda, P. H., Rice, C., & Andales, A. (2017). Evaluating the impact of future climate change on irrigated maize production in Kansas. *Climate Risk Management, 17*, 139-154. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027103239&doi=10.1016%2fj.crm.2017.08.001&partnerID=40&md5=787a35e8df5c88098132b7c375e7dc31. doi:10.1016/j.crm.2017.08.001
Research Tags: Crops
Abstract: *The United States southern and central High Plains including western Kansas are experiencing declining ground water supplies from the Ogallala as a result of withdrawals for irrigation exceeding annual recharge, this situation will be exacerbated by future climate change. The purpose of this simulation based study was to 1) assess the impact of future climate change on maize (Zea mays L.) yield in western Kansas; and 2) evaluate and understand the possible impacts of climate change on maize irrigation water productivity, transpiration, evapotranspiration and days to maturity. The Crop Estimation through Resource and Environment Synthesis (CERES-Maize) crop model within the Decision Support System for Agrotechnology*

Transfer Cropping Systems Model (DSSAT-CSM) was used in combination with multiple Global Climate Models under two Representative Concentration Pathways (RCPs), and two irrigation scenarios [full (450 mm) and deficit (300)] under three planting dates [early (20th April), normal (5th May) and late (15th May)]. Results showed that maize yield during the mid-21st century will decline relative to the present on average by 18–33% under RCP4.5 and 37–46% under RCP8.5. The yield decline might be caused mainly by shortening of the growing period (9–18% decline in days to maturity), attributed to elevated temperatures. The reduction in transpiration relative to the baseline reached 15% for RCP8.5 under deficit irrigation whereas the reduction was minimal (1–7%) under full irrigation. Indicating that significant yield reductions might occur due to combined effects of deficit irrigation and shortening of the maturity period. Yield increase due to elevated CO2 concentration [CO2] might be masked by the increased temperatures. The current study showed large disparity in simulated yield among the various GCMs. Planting date did not substantially improve yield but there was less simulation variability among GCMs with early planting compared to normal and late planting. There was no substantial difference among the planting dates for water productivity, however, there was a slight tendency of improvement in irrigation water productivity for deficit irrigation under early planting compared to normal and late planting. Under all planting dates and RCPs, the irrigation water productivity of maize under deficit irrigation was slightly higher than that under full irrigation. The difference in irrigation water productivity of maize between the deficit and full irrigation was larger for early compared to normal and late planting. These differences justify that early planting may be suitable under future climate compared to late planting even though the simulated yield with early planting under similar RCPs and irrigation levels are not significantly different from late planting.

Armatas, C., Venn, T., & Watson, A. (2017). Understanding social–ecological vulnerability with Q-methodology: a case study of water-based ecosystem services in Wyoming, USA. *Sustainability Science, 12*(1), 105-121. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84966693635&doi=10.1007%2fs11625-016-0369-1&partnerID=40&md5=b6ee879ac6ca0521971d6cff2255fe34. doi:10.1007/s11625-016-0369-1

Research Tags: Water

Abstract: *A broad range of participatory methods can be employed to understand the vulnerability of social–ecological systems threatened by various drivers of change including climate change and land-use change. Understanding this vulnerability is critical for managing natural resources, particularly water resources that flow across jurisdictional boundaries, and support conflicting uses. This paper demonstrates Q-methodology, a promising participatory method infrequently applied in the vulnerability context, with a case study investigation of the vulnerability of stakeholders reliant on water-based ecosystem services derived from the Shoshone National Forest in Wyoming, USA. The approach identified four distinct viewpoints regarding vulnerability, including an environmental perspective, agricultural perspective, Native American perspective, and recreation perspective. The distinct viewpoints highlighted disparate levels of importance related to 34 water benefits, such as commercial irrigation, oil and natural gas extraction, river-based fishing, and cultural and spiritual use. A diverse range of drivers of change threatening important water benefits were also identified, including pollution, too much management intervention, and development of recreation opportunities. The potential benefits of Q-methodology for vulnerability assessment include a rank-ordering exercise that elicits preferences for tradeoffs, and statistical derivation of a small number of perspectives about the topic.*

Arnberger, A., Ebenberger, M., Schneider, I. E., Cottrell, S., Schlueter, A. C., von Ruschkowski, E., . . . Gobster, P. H. (2018). Visitor Preferences for Visual Changes in Bark Beetle-Impacted Forest Recreation Settings in the United States and Germany. *Environmental Management, 61*(2), 209-223. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038809329&doi=10.1007%2fs00267-017-0975-4&partnerID=40&md5=810fd0c9de3fb44c9e99d60a5ab829d5. doi:10.1007/s00267-017-0975-4

Research Tags: Wildlife, Forestry

Abstract: *Extensive outbreaks of tree-killing insects are increasing across forests in Europe and North America due to climate change and other factors. Yet, little recent research examines visitor response to visual changes in conifer forest recreation settings resulting from forest insect infestations, how visitors weigh trade-offs between physical and social forest environment factors, or how visitor preferences might differ by nationality.*

This study explored forest visitor preferences with a discrete choice experiment that photographically simulated conifer forest stands with varying levels of bark beetle outbreaks, forest and visitor management practices, and visitor use levels and compositions. On-site surveys were conducted with visitors to State Forest State Park in Colorado (n = 200), Lake Bemidji State Park in Minnesota (n = 228), and Harz National Park in Germany (n = 208). Results revealed that the condition of the immediate forest surrounding was the most important variable influencing visitors' landscape preferences. Visitors preferred healthy mature forest stands and disliked forests with substantial dead wood. The number of visitors was the most important social factor influencing visitor landscape preferences. Differences in the influence of physical and social factors on visual preferences existed between study sites. Findings suggest that both visual forest conditions and visitor use management are important concerns in addressing landscape preferences for beetle-impacted forest recreation areas.

Arthur, F. H. (2018). Residual efficacy of deltamethrin as assessed by rapidity of knockdown of Tribolium castaneum on a treated surface: Temperature and seasonal effects in field and laboratory settings. *Journal of Stored Products Research, 76*, 151-160. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042323620&doi=10.1016%2fj.jspr.2018.02.001&partnerID=40&md5=73fa96e53fa21583d26966138a1c8f69. doi:10.1016/j.jspr.2018.02.001

Research Tags: Crops

Abstract: *Concrete arenas were treated with the pyrethroid deltamethrin at rates of 8, 16, and 24 mg active ingredient [AI]/m2, and held either in a chamber set at 27 °C, inside a non-climate controlled interior building, or the floor of an empty grain bin. Bioassays of the arenas were conducted post-treatment by exposing mixed-sex adult Tribolium castaneum Herbst and assessing knockdown every 30 min for 3 h. Four separate trials were conducted, two during Autumn of 2015 and 2016 and two during Summer of 2016 and 2017. Knockdown did not increase with increasing application rate. Equations were fit to the combined rate data at each residual bioassay week for each location, and mean data were also compared to determine differences in knockdown at different times among the arenas held in the different locations. During Summer, knockdown was generally slower after two weeks on arenas held inside the grain bin compared to arenas held inside the building or inside the chamber. The arenas inside the bin experienced more hours of temperature above 32.2 °C during Summer compared to arenas inside the building or chamber. These extra hours of high temperature accumulation could have contributed to increased degradation of the residues, resulting in slower knockdown. During Autumn rapidity of knockdown was generally similar on arenas held in all three locations. In all trials, the total hours of temperature accumulation were far greater in the chamber compared to the building or the grain bin, but this had little effect on efficacy. Managers can use this information to more precisely apply deltamethrin, either as a pre-binning treatment inside a grain bin or elevator silo or as a residual treatment inside a milling or production facility.*

Asbjornsen, H., Campbell, J. L., Jennings, K. A., Vadeboncoeur, M. A., McIntire, C., Templer, P. H., . . . Rustad, L. E. (2018). Guidelines and considerations for designing field experiments simulating precipitation extremes in forest ecosystems. *Methods in Ecology and Evolution, 9*(12), 2310-2325. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055527025&doi=10.1111%2f2041-210X.13094&partnerID=40&md5=36d894cf651601900396082eab5a8a8c. doi:10.1111/2041-210X.13094

Research Tags: Research, Forestry

Abstract: *Precipitation regimes are changing in response to climate change, yet understanding of how forest ecosystems respond to extreme droughts and pluvials remains incomplete. As future precipitation extremes will likely fall outside the range of historical variability, precipitation manipulation experiments (PMEs) are critical to advancing knowledge about potential ecosystem responses. However, few PMEs have been conducted in forests compared to short-statured ecosystems, and forest PMEs have unique design requirements and constraints. Moreover, past forest PMEs have lacked coordination, limiting cross-site comparisons. Here, we review and synthesize approaches, challenges, and opportunities for conducting PMEs in forests, with the goal of guiding design decisions, while maximizing the potential for coordination.*

We reviewed 63 forest PMEs at 70 sites world-wide. Workshops, meetings, and communications with experimentalists were used to generate and build consensus around approaches for addressing the key challenges and enhancing coordination.

Past forest PMEs employed a variety of study designs related to treatment level, replication, plot and

infrastructure characteristics, and measurement approaches. Important considerations for establishing new forest PMEs include: selecting appropriate treatment levels to reach ecological thresholds; balancing cost, logistical complexity, and effectiveness in infrastructure design; and preventing unintended water subsidies. Response variables in forest PMEs were organized into three broad tiers reflecting increasing complexity and resource intensiveness, with the first tier representing a recommended core set of common measurements.

Differences in site conditions combined with unique research questions of experimentalists necessitate careful adaptation of guidelines for forest PMEs to balance local objectives with coordination among experiments. We advocate adoption of a common framework for coordinating forest PME design to enhance cross-site comparability and advance fundamental knowledge about the response and sensitivity of diverse forest ecosystems to precipitation extremes.

Asem-Hiablie, S., Battagliese, T., Stackhouse-Lawson, K. R., & Alan Rotz, C. (2019). A life cycle assessment of the environmental impacts of a beef system in the USA. *International Journal of Life Cycle Assessment, 24*(3), 441-455. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047795163&doi=10.1007%2fs11367-018-1464-6&partnerID=40&md5=101e6b9b1e3a26bf9799c45a23d30212. doi:10.1007/s11367-018-1464-6

Research Tags: Livestock, Water, Emissions

Abstract: *Purpose*

The need to assess the sustainability attributes of the United States beef industry is underscored by its importance to food security locally and globally. A life cycle assessment (LCA) of the US beef value chain was conducted to develop baseline information on the environmental impacts of the industry includ`ing metrics of the cradle-to-farm gate (feed production, cow-calf, and feedlot operations) and post-farm gate (packing, case-ready, retail, restaurant, and consumer) segments.

Methods

Cattle production (cradle-to-farm gate) data were obtained using the integrated farm system model (IFSM) supported with production data from the Roman L. Hruska US Meat Animal Research Center (USMARC). Primary data for the packing and case-ready phases were obtained from packers that jointly processed nearly 60% of US beef while retail and restaurant primary data represented 8 and 6%, respectively, of each sector. Consumer data were obtained from public databases and literature. The functional unit or consumer benefit (CB) was 1 kg of consumed, boneless, edible beef. The relative environmental impacts of processes along the full beef value chain were assessed using a third party validated BASF Corporation Eco-Efficiency Analysis methodology.

Results and discussion

Value chain LCA results indicated that the feed and cattle production phases were the largest contributors to most environmental impact categories. Impact metrics included water emissions (7005 L diluted water eq/CB), cumulative energy demand (1110 MJ/CB), and land use (47.4 m2a eq/CB). Air emissions were acidification potential (726 g SO2 eq/CB), photochemical ozone creation potential (146.5 g C2H4 eq/CB), global warming potential (48.4 kg CO2 eq/CB), and ozone depletion potential (1686 µg CFC11 eq/CB). The remaining metrics calculated were abiotic depletion potential (10.3 mg Ag eq/CB), consumptive water use (2558 L eq/CB), and solid waste (369 g municipal waste eq/CB). Of the relative points adding up to 1 for each impact category, the feed phase contributed 0.93 to the human toxicity potential.

Conclusions

This LCA is the first of its kind for beef and has been third party verified in accordance with ISO 14040:2006a and 14044:2006b and 14045:2012 standards. An expanded nationwide study of beef cattle production is now being performed with region-specific cattle production data aimed at identifying region-level benchmarks and opportunities for further improvement in US beef sustainability.

Ashworth, A. J., DeBruyn, J. M., Allen, F. L., Radosevich, M., & Owens, P. R. (2017). Microbial community structure is affected by cropping sequences and poultry litter under long-term no-tillage. *Soil Biology and Biochemistry, 114*, 210-219. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026351599&doi=10.1016%2fj.soilbio.2017.07.019&partnerID=40&md5=3c70ae525505ed2a9896e57fbc8823ae. doi:10.1016/j.soilbio.2017.07.019

Research Tags: Soil, Crops

Abstract: *Soil microorganisms play essential roles in soil organic matter dynamics and nutrient cycling in agroecosystems and have been used as soil quality indicators. The response of soil microbial communities to land management is complex and the long-term impacts of cropping systems on soil microbes is largely unknown. Therefore, changes in soil bacterial community composition were assessed in response to cropping sequences and bio-covers at long-term no-tillage sites. Main effects of four different cropping sequences of corn (Zea mays L.), cotton (Gossypium hirsutum L.), and soybean (Glycine max L.) were rotated in four year phases for 12-yrs at two Tennessee Research and Education Centers in a randomized complete block design with split-block treatments of four winter bio-covers: hairy vetch (Vicia villosa L.), wheat (Triticum aestivum L.), poultry litter, and a fallow control. Using Illumina high-throughput sequencing of 16S rRNA genes, bacterial community composition was determined. Composition, diversity, and relative abundance of specific taxa were correlated per cropping system, bio-cover, and their interaction. We found that i) richness and diversity varied temporally and spatially, coinciding with soil carbon, pH, nutrient levels, and climatic variability; ii) community composition varied by cropping system, with continuous corn, soybean, and the corn-soybean rotation presenting a hybrid of the continuous corn and soybean communities; however, continuous cotton resulted in the most varied assemblage; iii) bio-covers asserted the greatest influence on microbial communities; specifically poultry litter treatments differed from cover crops (all of which received inorganic-N). Consequently, microbial diversity was greatest under nutrient rich bio-covers (poultry litter) and high residue producing, less pesticide-intensive cropping sequences (soybean and corn compared to cotton), suggesting a more dynamic soil ecology under these no-till cropping systems. This suggests that nutrient management (inorganic fertilizers vs. animal manure) and greater crop rotations (within 4-yr phases) may directly drive phylogenetic community structure and subsequent ecosystem services across agricultural landscapes.*

Ashworth, A. J., Toler, H. D., Allen, F. L., & Auge, R. M. (2018). Global meta-analysis reveals agro-grassland productivity varies based on species diversity over time. *PLoS ONE, 13*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049648489&doi=10.1371%2fjournal.pone.0200274&partnerID=40&md5=3883cc9f34c9a3d7e6ab1d0e053b5bf6. doi:10.1371/journal.pone.0200274

Research Tags: Grassland

Abstract: *Ecological research suggests increased diversity may improve ecosystem services, as well as yield stability; however, such theories are sometimes disproven by agronomic research, particularly at higher diversity levels. We conducted a meta-analysis on 2,753 studies in 48 articles published over the last 53 years to test: if biological N_2 fixation (BNF) supplies adequate nitrogen (N) for plant growth relative to synthetic fertilizers; how crop physiological traits affect legume-grass symbiosis; and, how cultural practices affect BNF over a range of soils and climates overtime (in polycultures versus sole grasslands). Globally, net primary productivity (NPP; total aboveground production response of grass and legume in higher-diversity treatments) increased 44% via legume associations relative to sole grass controls (including both with and without N fertilizer). Several moderating variables affected NPP including: (i) plant photosynthetic pathway (mixtures of C_3 grasses resulted in a 57% increase in NPP, whereas mixtures of C_4 grasses resulted in a 31% increase; similarly cool-season legumes increased NPP 52% compared to a 27% increase for warm-season legumes relative to grasslands without diversity); (ii) legume life cycle [NPP response for perennial legume mixtures was 50% greater than sole grass controls, followed by a 28% increase for biennial, and a 0% increase for annual legumes)]; and, (iii) species richness (one leguminous species in a grassland agroecosystem resulted in 52% increase in NPP, whereas >2 legumes resulted in only 6% increases). Temporal and spatial effect sizes also influenced facilitation, considering facilitation was greatest (114% change) in Mediterranean climates followed by oceanic (84%), and tropical savanna (65%) environments; conversely, semiarid and subarctic systems had lowest Rhizobium-induced changes (5 and 0% change, respectively). Facilitation of grass production by legumes was also affected by soil texture. For example, a 122% NPP increase was observed in silt clay soils compared to 14% for silt loam soils. Niche complementarity effects were greatest prior to 1971 (61% change), compared to recent studies (2011–2016; -7% change), likely owing to reduced global sulfur deposition and increased ambient temperatures overtime. These historical trends suggest potential for legume intercrops to displace inorganic-N fertilizer and sustainably intensify global NPP. Results herein provide a framework for ecologists and agronomists to improve crop diversification systems, refine research goals, and heighten BNF capacities in agro-grasslands.*

Aspinwall, M. J., Fay, P. A., Hawkes, C. V., Lowry, D. B., Khasanova, A., Bonnette, J., . . . Juenger, T. E. (2017). Intraspecific variation in precipitation responses of a widespread C<inf>4</inf> grass depends on site water limitation. *Journal of Plant Ecology, 10*(2), 310-321. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85025072848&doi=10.1093%2fjpe%2frtw040&partnerID=40&md5=f1e1414f6c218cb3fa952da1b0c01088. doi:10.1093/jpe/rtw040

Research Tags: Weather, Grassland

Abstract: *Variation in precipitation strongly influences plant growth, species distributions and genetic diversity. Intraspecific variation in phenotypic plasticity, the ability of a genotype to alter its growth, morphology or physiology in response to the environment, could influence species responses to changing precipitation and climate change. Despite this, the patterns and mechanisms of intraspecific variation in plasticity to variable precipitation, and the degree to which genotype responses to precipitation are influenced by variation in edaphic conditions, remain poorly understood. Thus, we determined whether genotypes of a widespread C4 grass (Panicum virgatum L., switchgrass) varied in aboveground productivity in response to changes in precipitation, and if site edaphic conditions modified genotype aboveground productivity responses to precipitation. We also determined if genotype productivity responses to precipitation are related to plasticity in underlying growth and phenological traits.*

Nine P. virgatum genotypes originating from an aridity gradient were grown under four treatments spanning the 10th to the 90th percentiles of annual precipitation at two sites in central Texas: one site with deep, fine-textured soils and another site with shallow, coarse-textured soils. We measured volumetric soil water content (VWC), aboveground net primary productivity (ANPP), tiller production (tiller number), average tiller mass, canopy height, leaf area index (LAI) and flowering time on all plants at both sites and examined genotype responses to changes in precipitation.

Across precipitation treatments, VWC was 39% lower and more variable at the site with shallow, coarse-textured soils compared to the site with deep, fine-textured soils. ANPP averaged across genotypes and precipitation treatments was also 103% higher at the site with deep, fine-textured soils relative to the site with shallow, coarse-textured soils, indicating substantial differences in site water limitation. Where site water limitation was higher, ANPP of most genotypes increased with increasing precipitation. Where site water limitation was less, genotypes expressed variable plasticity in response to precipitation, from no change to almost a 5-fold increase in ANPP with increasing precipitation. Genotype ANPP increased with greater tiller mass, LAI and later flowering time at both sites, but not with tiller number at either site. Genotype ANPP plasticity increased with genotype tiller mass and LAI plasticity at the site with deep, fine-textured soils, and only with genotype tiller mass plasticity at the site with shallow, coarse-textured soils. Thus, variation in genotype ANPP plasticity was explained primarily by variation in tiller and leaf growth. Genotype ANPP plasticity was not associated with temperature or aridity at the genotype's origin. Edaphic factors such as soil depth and texture may alter genotype ANPP responses to precipitation, and the underlying growth traits contributing to the ANPP response. Thus, edaphic factors may contribute to spatial variation in genotype performance and success under altered precipitation.

Assmann, J. J., Myers-Smith, I. H., Phillimore, A. B., Bjorkman, A. D., Ennos, R. E., Prevéy, J. S., . . . Hollister, R. D. (2019). Local snow melt and temperature—but not regional sea ice—explain variation in spring phenology in coastal Arctic tundra. *Global Change Biology, 25*(7), 2258-2274. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065038419&doi=10.1111%2fgcb.14639&partnerID=40&md5=38fab42a7f8e7d70b17825d2db9f4b88. doi:10.1111/gcb.14639

Research Tags: Water

Abstract: *The Arctic is undergoing dramatic environmental change with rapidly rising surface temperatures, accelerating sea ice decline and changing snow regimes, all of which influence tundra plant phenology. Despite these changes, no globally consistent direction of trends in spring phenology has been reported across the Arctic. While spring has advanced at some sites, spring has delayed or not changed at other sites, highlighting substantial unexplained variation. Here, we test the relative importance of local temperatures, local snow melt date and regional spring drop in sea ice extent as controls of variation in spring phenology across different sites and species. Trends in long-term time series of spring leaf-out and flowering (average span: 18 years) were highly variable for the 14 tundra species monitored at our four study sites on the Arctic coasts of Alaska, Canada and Greenland, ranging from advances of 10.06 days per decade to delays of 1.67 days per decade.*

Spring temperatures and the day of spring drop in sea ice extent advanced at all sites (average 1°C per decade and 21 days per decade, respectively), but only those sites with advances in snow melt (average 5 days advance per decade) also had advancing phenology. Variation in spring plant phenology was best explained by snow melt date (mean effect: 0.45 days advance in phenology per day advance snow melt) and, to a lesser extent, by mean spring temperature (mean effect: 2.39 days advance in phenology per °C). In contrast to previous studies examining sea ice and phenology at different spatial scales, regional spring drop in sea ice extent did not predict spring phenology for any species or site in our analysis. Our findings highlight that tundra vegetation responses to global change are more complex than a direct response to warming and emphasize the importance of snow melt as a local driver of tundra spring phenology.

Augustine, D. J., Blumenthal, D. M., Springer, T. L., LeCain, D. R., Gunter, S. A., & Derner, J. D. (2018). Elevated CO<inf>2</inf> induces substantial and persistent declines in forage quality irrespective of warming in mixedgrass prairie. *Ecological Applications*, *28*(3), 721-735. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045851112&doi=10.1002%2feap.1680&partnerID=40&md5=1cf743a3505a625ce050d7b47c04a4f5. doi:10.1002/eap.1680

Research Tags: Grassland, Livestock

Abstract: *Increasing atmospheric [CO_2] and temperature are expected to affect the productivity, species composition, biogeochemistry, and therefore the quantity and quality of forage available to herbivores in rangeland ecosystems. Both elevated CO_2 (eCO_2) and warming affect plant tissue chemistry through multiple direct and indirect pathways, such that the cumulative outcomes of these effects are difficult to predict. Here, we report on a 7-yr study examining effects of CO_2 enrichment (to 600 ppm) and infrared warming (+1.5°C day/3°C night) under realistic field conditions on forage quality and quantity in a semiarid, mixedgrass prairie. For the three dominant forage grasses, warming effects on in vitro dry matter digestibility (IVDMD) and tissue [N] were detected only in certain years, varied from negative to positive, and were relatively minor. In contrast, eCO_2 substantially reduced IVDMD (two most abundant grasses) and [N] (all three dominant grass species) in most years, except the two wettest years. Furthermore, eCO_2 reduced IVDMD and [N] independent of warming effects. Reduced IVDMD with eCO_2 was related both to reduced [N] and increased acid detergent fiber (ADF) content of grass tissues. For the six most abundant forage species (representing 96% of total forage production), combined warming and eCO_2 increased forage production by 38% and reduced forage [N] by 13% relative to ambient climate. Although the absolute magnitude of the decline in IVDMD and [N] due to combined warming and eCO_2 may seem small (e.g., from 63.3 to 61.1% IVDMD and 1.25 to 1.04% [N] for Pascopyrum smithii), such shifts could have substantial consequences for the rate at which ruminants gain weight during the primary growing season in the largest remaining rangeland ecosystem in North America. With forage production increases, declining forage quality could potentially be mitigated by adaptively increasing stocking rates, and through management such as prescribed burning, fertilization at low rates, and legume interseeding to enhance forage quality.*

Augustine, D. J., Derner, J. D., Milchunas, D., Blumenthal, D., & Porensky, L. M. (2017). Grazing moderates increases in C<inf>3</inf> grass abundance over seven decades across a soil texture gradient in shortgrass steppe. *Journal of Vegetation Science*, *28*(3), 562-572. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011649670&doi=10.1111%2fjvs.12508&partnerID=40&md5=b64ade8bb8f626df5b7d94ba57ef3cda. doi:10.1111/jvs.12508

Research Tags: Livestock, Grassland

Abstract: *Questions*
How does long-term exclusion of cattle grazing influence plant community composition in a semi-arid grassland? Can spatial variation in the effects of cattle grazing exclusion be explained by variation in soil texture?
Location
Shortgrass steppe, northeast Colorado, USA, in the North American Great Plains.
Method
We used 16 long-term (72 yr) cattle exclosures to examine the effects of grazers on plant communities and evaluate whether grazer effects interact with soil texture.
Results

Although shortgrass steppe communities are relatively unaffected by grazing in the short-term (one to two decades), exclusion of cattle grazing for seven decades caused a compositional shift from dominance by a C4 shortgrass (Bouteloua gracilis) to co-dominance by a C3 midgrass (Pascopyrum smithii) and B. gracilis. The strength of this shift was highly variable across sites. Soil texture was correlated with the abundance of certain plant species, but did not explain variation in the magnitude of grazer effects. Grazed communities contained perennial and annual growth forms with a diversity of strategies to co-exist with grazers and B. gracilis. Ungrazed communities included increased abundance of annual, ruderal forbs and three woody plant species. Grazing effects occurred against a backdrop of changing plant communities: during the past seven decades, C3 perennial graminoids and sub-shrubs have increased in relative abundance in both grazed and ungrazed communities.
Conclusions
Our long-term experiment shows that community responses to grazing in this semi-arid grassland occur very slowly, but are predictable, with C4 shortgrasses eventually giving way to taller C3 grasses and ruderal forbs. Spatial variation in grazing effects across sites (and lack of a relationship with soil texture) may reflect the importance of fine-scale heterogeneity in C3 grass abundance, and the slow rate at which taller C3 grasses can coalesce into mono-dominant patches that outcompete C4 shortgrasses. Increased abundance of C3 species over the past seven decades, both in the presence and absence of grazing, may be related to recovery from the severe drought and dust storms of the 1930s as well as enhanced growth of C3 plants under increasing atmospheric [CO2].

Averyt, K., Derner, J. D., Dilling, L., Guerrero, R., Joyce, L., McNeeley, S., . . . Travis, W. (2018). Regional climate response collaboratives: Multi-institutional support for climate resilience. *Bulletin of the American Meteorological Society, 99*(5), 891-898. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048027891&doi=10.1175%2fBAMS-D-17-0183.1&partnerID=40&md5=64ccc4241fe08b2f60a31030b3e9dc17. doi:10.1175/BAMS-D-17-0183.1
Research Tags: Research
Abstract: *Federal investments by U.S. agencies to enhance climate resilience at regional scales grew over the past decade (2010s). To maximize efficiency and effectiveness in serving multiple sectors and scales, it has become critical to leverage existing agency-specific research, infrastructure, and capacity while avoiding redundancy. We discuss lessons learned from a multi-institutional "regional climate response collaborative" that comprises three different federally supported climate service entities in the Rocky Mountain west and northern plains region. These lessons include leveraging different strengths of each partner, creating deliberate mechanisms to increase cross-entity communication and joint ownership of projects, and placing a common priority on stakeholder-relevant research and outcomes. We share the conditions that fostered successful collaboration, which can be transferred elsewhere, and suggest mechanisms for overcoming potential barriers. Synergies are essential for producing actionable research that informs climate-related decisions for stakeholders and ultimately enhances climate resilience at regional scales.*

Ávila-Carrasco, J. R., Júnez-Ferreira, H. E., Gowda, P. H., Steiner, J. L., Moriasi, D. N., Starks, P. J., . . . Bautista-Capetillo, C. (2018). Evaluation of Satellite-Derived Rainfall Data for Multiple Physio-Climatic Regions in the Santiago River Basin, Mexico. *Journal of the American Water Resources Association, 54*(5), 1068-1086. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050916629&doi=10.1111%2f1752-1688.12672&partnerID=40&md5=9557690f24f527302c8260eb87a20260. doi:10.1111/1752-1688.12672
Research Tags: Research, Weather
Abstract: *Assessment of water resources requires reliable rainfall data, and rain gauge networks may not provide adequate spatial representation due to limited point measurements. The Tropical Rainfall Measuring Mission (TRMM) provides rainfall data at global scale, and has been used with good results. However, TRMM data are an indirect measurement of rainfall, and therefore must be validated for its proper use. In this work, a validation scheme was designed and implemented to compare the TRMM Version 7 (V7) monthly rainfall product at different time frames with data measured in two hydrologic subregions of the Santiago River Basin (SRB) in Mexico: Río Alto Santiago and Río Bajo Santiago (RBS). Additionally, three physio-climatic regions provide an assessment of the interplay of topography, distance from coastal regions, and seasonal weather patterns on the correspondence between both datasets. The TRMM V7 rainfall product exhibited good*

agreement with the rain gauge data particularly for the RBS and for the whole SRB during wettest summer and autumn seasons. However, strong regional dependence was observed due to differences in climate and topography. Overall, in spite of some noted underestimations, the monthly TRMM V7 rainfall product was found to provide useful information that can be used to complement limited monitoring as is the case of RBS. An improved combined rainfall product could be generated and thus gaining the most benefits from both data sources.

Avila-Quezada, G. D., Esquivel, J. F., Silva-Rojas, H. V., Leyva-Mir, S. G., Garcia-Avila, C. J., Quezada-Salinas, A., . . . Melgoza-Castillo, A. (2018). Emerging plant diseases under a changing climate scenario: Threats to our global food supply. *Emirates Journal of Food and Agriculture, 30*(6), 443-450. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052134160&doi=10.9755%2fejfa.2018.v30.i6.1715&partnerID=40&md5=d47f68b64e849f74a44538717d090a3f. doi:10.9755/ejfa.2018.v30.i6.1715
Research Tags: Crops, Forestry
Abstract: *This review highlights the impact of emerging diseases; emerging diseases and pathogen dispersion; disease spread; and possible causes contributing to the emergence of pathogens. Some diseases are caused by potentially dangerous pathogens that have led changes in humanity. Despite our efforts in the fight against these dangerous pathogens; the influences of natural phenomena such as hurricanes or strong winds that disperse pathogens remain. However, some actions such as investment in research priorities that are focused on quarantined pathogens and official regulations can help in disease prevention. We discuss emerging diseases as a threat to crops, identify future research areas, and encourage the establishment of research networks focused on quarantine pathogens to address the problem and minimize risks.*

Babst, F., Bodesheim, P., Charney, N., Friend, A. D., Girardin, M. P., Klesse, S., . . . Evans, M. E. K. (2018). When tree rings go global: Challenges and opportunities for retro- and prospective insight. *Quaternary Science Reviews, 197*, 1-20. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051103830&doi=10.1016%2fj.quascirev.2018.07.009&partnerID=40&md5=c0d09f4846927c7620ff853b741f0e8f. doi:10.1016/j.quascirev.2018.07.009
Research Tags: Forestry, Research
Abstract: *The demand for large-scale and long-term information on tree growth is increasing rapidly as environmental change research strives to quantify and forecast the impacts of continued warming on forest ecosystems. This demand, combined with the now quasi-global availability of tree-ring observations, has inspired researchers to compile large tree-ring networks to address continental or even global-scale research questions. However, these emergent spatial objectives contrast with paleo-oriented research ideas that have guided the development of many existing records. A series of challenges related to how, where, and when samples have been collected is complicating the transition of tree rings from a local to a global resource on the question of tree growth. Herein, we review possibilities to scale tree-ring data (A) from the sample to the whole tree, (B) from the tree to the site, and (C) from the site to larger spatial domains. Representative tree-ring sampling supported by creative statistical approaches is thereby key to robustly capture the heterogeneity of climate-growth responses across forested landscapes. We highlight the benefits of combining the temporal information embedded in tree rings with the spatial information offered by forest inventories and earth observations to quantify tree growth and its drivers. In addition, we show how the continued development of mechanistic tree-ring models can help address some of the non-linearities and feedbacks that complicate making inference from tree-ring data. By embracing scaling issues, the discipline of dendrochronology will greatly increase its contributions to assessing climate impacts on forests and support the development of adaptation strategies.*

Baez-Gonzalez, A. D., de Jesus Torres-Meza, M., Royo-Marquez, M. H., & Kiniry, J. R. (2018). Climate variability and trends in climate extremes in the priority conservation area El Tokio and adjacent areas in northeastern Mexico. *Weather and Climate Extremes, 22*, 36-47. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058165972&doi=10.1016%2fj.wace.2018.10.001&partnerID=40&md5=9092cf6929455886f63b1365cc8c9de5. doi:10.1016/j.wace.2018.10.001
Research Tags: Grassland
Abstract: *El Tokio, a priority conservation area in Mexico and North America, and its adjacent areas hold the*

world's last remaining colonies of the Mexican Black-tailed Prairie Dog (Cynomys mexicanus) and serve as home to over 250 bird species, including global wintering grassland birds of high conservation concern, and other rare, endemic and endangered species of flora and fauna. While alarming changes in distribution and migration patterns of species existing in the study area have been reported, studies on the role of climate in these changes are scarce, partly because of the lack of climate information. To fill this gap, this study defined the climate types and eight bioclimatic variables of five ecoregions within and adjacent to El Tokio and analyzed climate indices showing trends of climate extremes, using 30-year climate data and the software RClimDex 1.0 RCs. Results showed climate variability in the study area, with 14 climate types, mostly arid and semi-arid. The analysis of bioclimatic variables showed that the Plains of Zacatecano-Potosino Plateau ecoregion, which contains prairie dog colonies, had the highest annual and mean temperature in the most humid, driest and hottest trimesters of the year; its precipitation had lower seasonality in relation to other ecoregions. Climate indices to detect trends in climate extremes showed greater intensity in precipitation, but also longer dry intervals during the year in the Plains of Zacatecano-Potosno Plateau, while the adjacent Sierra with Forests ecoregion, which borders some colonies, showed trends of warmer winters, summers with fewer days with high minimum temperatures, and precipitation that was less in amount and intensity. The generated climate datasets and analyses contribute essential input for climate change studies and for biological studies and conservation programs for the species and ecosystems present in the biologically rich study area, some of which are greatly threatened and of international concern.

Baez-Gonzalez, A. D., Kiniry, J. R., Meki, M. N., Williams, J. R., Alvarez Cilva, M., Ramos Gonzalez, J. L., & Magallanes Estala, A. (2018). Potential impact of future climate change on sugarcane under dryland conditions in Mexico. *Journal of Agronomy and Crop Science, 204*(5), 515-528. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044948765&doi=10.1111%2fjac.12278&partnerID=40&md5=91e64be478b378e9bff4d75ffabd5f15. doi:10.1111/jac.12278

Research Tags: Crops

Abstract: *Assessments of impacts of future climate change on widely grown sugarcane varieties can guide decision-making and help ensure the economic stability of numerous rural households. This study assessed the potential impact of future climatic change on sugarcane grown under dryland conditions in Mexico and identified key climate factors influencing yield. The Agricultural Land Management Alternatives with Numerical Assessment Criteria (ALMANAC) model was used to simulate sugarcane growth and yield under current and future climate conditions. Management, soil and climate data from farm sites in Jalisco (Pacific Mexico) and San Luis Potosi (Northeastern Mexico) were used to simulate baseline yields. Baseline climate was developed with 30-year historical data from weather stations close to the sites. Future climate for three decadal periods (2021–2050) was constructed by adding forecasted climate values from downscaled outputs of global circulation models to baseline values. Climate change impacts were assessed by comparing baseline yields with those in future decades under the A2 scenario. Results indicate positive impacts of future climate change on sugarcane yields in the two regions, with increases of 1%–13% (0.6–8.0 Mg/ha). As seen in the multiple correlation analysis, evapotranspiration explains 77% of the future sugarcane yield in the Pacific Region, while evapotranspiration and number of water and temperature stress days account for 97% of the future yield in the Northeastern Region. The midsummer drought (canicula) in the Pacific Region is expected to be more intense and will reduce above-ground biomass by 5%–13% (0.5–1.7 Mg/ha) in July–August. Harvest may be advanced by 1–2 months in the two regions to achieve increases in yield and avoid early flowering that could cause sucrose loss of 0.49 Mg ha−1 month−1. Integrating the simulation of pest and diseases under climate change in crop modelling may help fine-tune yield forecasting.*

Bai, W. N., Yan, P. C., Zhang, B. W., Woeste, K. E., Lin, K., & Zhang, D. Y. (2018). Demographically idiosyncratic responses to climate change and rapid Pleistocene diversification of the walnut genus Juglans (Juglandaceae) revealed by whole-genome sequences. *New Phytologist, 217*(4), 1726-1736. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035205210&doi=10.1111%2fnph.14917&partnerID=40&md5=081839b06211cbc23f73c852d92811b6. doi:10.1111/nph.14917

Research Tags: Forestry

Abstract: *Whether species demography and diversification are driven primarily by extrinsic environmental changes such as climatic oscillations in the Quaternary or by intrinsic biological interactions like coevolution* *between antagonists is a matter of active debate. In fact, their relative importance can be assessed by tracking past population fluctuations over considerable time periods.*

We applied the pairwise sequentially Markovian coalescent approach on the genomes of 11 temperate Juglans species to estimate trajectories of changes in effective population size (Ne) and used a Bayesian-coalescent based approach that simultaneously considers multiple genomes (G-PhoCS) to estimate divergence times between lineages.

Ne curves of all study species converged 1.0 million yr ago, probably reflecting the time when the walnut genus last shared a common ancestor. This estimate was confirmed by the G-PhoCS estimates of divergence times. But all species did not react similarly to the dramatic climatic oscillations following early Pleistocene cooling, so the timing and amplitude of changes in Ne differed among species and even among conspecific lineages.

The population histories of temperate walnut species were not driven by extrinsic environmental changes alone, and a key role was probably played by species-specific factors such as coevolutionary interactions with specialized pathogens.

Bailey, V. L., Bond-Lamberty, B., DeAngelis, K., Grandy, A. S., Hawkes, C. V., Heckman, K., . . . Wallenstein, M. D. (2018). Soil carbon cycling proxies: Understanding their critical role in predicting climate change feedbacks. *Global Change Biology, 24*(3), 895-905. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042143469&doi=10.1111%2fgcb.13926&partnerID=40&md5=b631331c730d405f95b763c80b0b4b43. doi:10.1111/gcb.13926

Research Tags: Soil

Abstract: *The complexity of processes and interactions that drive soil C dynamics necessitate the use of proxy variables to represent soil characteristics that cannot be directly measured (correlative proxies), or that aggregate information about multiple soil characteristics into one variable (integrative proxies). These proxies have proven useful for understanding the soil C cycle, which is highly variable in both space and time, and are now being used to make predictions of the fate and persistence of C under future climate scenarios. However, the C pools and processes that proxies represent must be thoughtfully considered in order to minimize uncertainties in empirical understanding. This is necessary to capture the full value of a proxy in model parameters and in model outcomes. Here, we provide specific examples of proxy variables that could improve decision-making, and modeling skill, while also encouraging continued work on their mechanistic underpinnings. We explore the use of three common soil proxies used to study soil C cycling: metabolic quotient, clay content, and physical fractionation. We also consider how emerging data types, such as genome-sequence data, can serve as proxies for microbial community activities. By examining some broad assumptions in soil C cycling with the proxies already in use, we can develop new hypotheses and specify criteria for new and needed proxies.*

Bajracharya, R. M., Lal, R., & Kimble, J. M. (2018). Soil organic carbon distribution in aggregates and primary particle fractions as influenced by erosion phases and landscape position. In *Soil Processes and the Carbon Cycle* (pp. 353-367).

Research Tags: Soil

No Abstract

Baker, J. M., & Griffis, T. J. (2017). Feasibility of recycling excess agricultural nitrate with electrodialysis. *Journal of Environmental Quality, 46*(6), 1528-1534. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034262226&doi=10.2134%2fjeq2017.05.0215&partnerID=40&md5=5c4e72343d5e4039eedaff352fe77833. doi:10.2134/jeq2017.05.0215

Research Tags: Crops, Soil

Abstract: *One of the most serious environmental problems associated with agriculture is excessive nitrate N in waters leaving fields. It is a health hazard in drinking water and a primary cause of hypoxia in ocean waters receiving drainage from agricultural regions. Recent mitigation efforts have focused on techniques that promote denitrification—conversion of excess agricultural nitrate to* N_2*. This seems inherently wasteful since industrial production of nitrate fertilizer from* N_2 *requires a substantial input of energy and is a major source of greenhouse gas emissions. Thus, it is desirable to develop methods to recycle nitrate, keeping it in a form* *suitable for reuse as fertilizer. One possibility is electrodialysis, in which direct current is passed through alternating cation- and anion-permeable membranes, creating separate streams of dilute and concentrated water. We tested the concept under controlled conditions in a greenhouse and in a field setting on a contaminated trout stream with nitrate N concentrations consistently above 20 mg L^{-1}. The solar-powered field system removed 42% of the nitrate from water passing through it and concentrated it in a tank for subsequent application as fertilizer. The upper limit of concentration was approximately 520 mg L^{-1}, above which precipitation of calcite limited operation. Economic analysis indicates that in comparison to denitrification methods such as bioreactors, electrodialysis is likely to be more expensive per unit of nitrate removed. The approach will be most feasible for situations in which nitrate concentrations are well above environmental standards for extended periods, to maximize operating time and nitrate removal rate.*

Bakker, M. G., Brown, D. W., Kelly, A. C., Kim, H. S., Kurtzman, C. P., McCormick, S. P., . . . Ward, T. J. (2018). Fusarium mycotoxins: a trans-disciplinary overview. *Canadian Journal of Plant Pathology*, *40*(2), 161-171. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042911939&doi=10.1080%2f07060661.2018.1433720&partnerID=40&md5=1d82806f3b473044bba3dc1c25cf12de. doi:10.1080/07060661.2018.1433720

Research Tags: Crops

Abstract: *Due to health risks and economic losses associated with mycotoxins produced by Fusarium species, there is a compelling need for an improved understanding of these fungi from across diverse perspectives and disciplinary approaches. In this article, we provide a transdisciplinary overview of: (i) Fusarium phylogenetics; (ii) linkages between mycotoxin biosynthetic gene clusters and chemical structures; (iii) biotransformation of mycotoxins to reduce toxicity; (iv) Fusarium population biology; (v) genomics of secondary metabolite production; and (vi) mycotoxigenic fusaria in a phytobiomes context. Phylogenetic studies have made tremendous progress in delineating the species that comprise the genus Fusarium, many of which are morphologically cryptic. Accurate species identification and a thorough understanding of the distribution of mycotoxin biosynthetic genes among those species will facilitate control of mycotoxin contamination. The biochemical pathways leading to the formation of several Fusarium mycotoxins have been elegantly linked with the genes responsible for each chemical transformation during synthesis, and for most structural differences among chemotypes. Screens for the biotransformation of mycotoxins have led to the description of chemical modifications that impact bioactivity and have implications for monitoring and testing of the food supply. Population biology studies have revealed the potential for introductions of foreign genotypes to alter regional populations of mycotoxigenic fusaria. Genomic analyses have begun to reveal the complex evolutionary history of the genes responsible for mycotoxin production, both across and within lineages. Improved understanding of how climate variability impacts plant–Fusarium interactions and mycotoxin accumulation is necessary for effective plant resistance. Additionally, improved understanding of interactions between Fusarium and other members of crop microbiomes is expected to produce novel strategies for limiting disease and mycotoxin accumulation.*

Ballesteros-Possu, W., Brandle, J. R., & Schoeneberger, M. (2017). Potential of windbreak trees to reduce carbon emissions by agricultural operations in the US. *Forests, 8*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018429260&doi=10.3390%2ff8050138&partnerID=40&md5=a4ed21473e54dd877e7f564addac0189. doi:10.3390/f8050138

Research Tags: Emissions, Forestry

Abstract: *Along with sequestering C in forest, trees on farms are able to contribute to greenhouse mitigation through emission avoidance mechanisms. To evaluate the magnitude of these contributions, emission avoidance contributions for field and farmstead windbreak designs in regions across the United States were estimated, along with greenhouse gas (GHG) emission budgets for corn, soybean, winter wheat, and potato operations. We looked at farming scenarios with large (600 ha), mid (300 ha), and small-size (60 ha) farms containing farmsteads built before and after 2000, and growing different cropping systems. Windbreak scenarios were assumed to be up to 5% of the crop area for field windbreaks, while emission avoidance for farmstead windbreaks were assumed to provide a 10% and 25% reduction in energy usage for space conditioning and heating, respectively. Total reduction of C equivalent (CE) emissions by windbreaks on farm systems ranged from a low of 0.9 Mg CE year^{-1} for a 60-ha farm with a home built before 2000 to 39.1 Mg CE* *year⁻¹ for a 600-ha farm with a home built after 2000. By reducing fossil fuel usage from farm operations, windbreaks provide a promising strategy for reducing GHG emissions from agriculture in the USA.*

Barandiaran, D., Wang, S. Y. S., & De Rose, R. J. (2017). Gridded snow water equivalent reconstruction for utah using forest inventory and analysis tree-ring data. *Water (Switzerland), 9*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020674202&doi=10.3390%2fw9060403&partnerID=40&md5=67fe4ac5b4a1ba3190ce52152f8a5aee. doi:10.3390/w9060403
Research Tags: Water, Forestry, Research
Abstract: *Snowpack observations in the Intermountain West are sparse and short, making them difficult for use in depicting past variability and extremes. This study presents a reconstruction of April 1 snow water equivalent (SWE) for the period of 1850–1989 using increment cores collected by the U.S. Forest Service, Interior West Forest Inventory and Analysis program (FIA). In the state of Utah, SWE was reconstructed for 38 snow course locations using a combination of standardized tree-ring indices derived from both FIA increment cores and publicly available tree-ring chronologies. These individual reconstructions were then interpolated to a 4-km grid using an objective analysis with elevation correction to create an SWE product. The results showed a significant correlation with observed SWE as well as good correspondence to regional tree-ring-based drought reconstructions. Diagnostic analysis showed statewide coherent climate variability on inter-annual and inter-decadal time-scales, with added geographical details that would not be possible using courser pre-instrumental proxy datasets. This SWE reconstruction provides water resource managers and forecasters with better spatial resolution to examine past variability in snowpack, which will be important as future hydroclimatic variability is amplified by climate change.*

Barbosa, J. M., Asner, G. P., Hughes, R. F., & Johnson, M. T. (2017). Landscape-scale GPP and carbon density infor} patterns and impacts of an invasive tree across wet forests of Hawaii. *Ecological Applications, 27*(2), 403-415. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014548437&doi=10.1002%2feap.1445&partnerID=40&md5=00a5803a7ddae0b8849066d49199400e. doi:10.1002/eap.1445
Research Tags: Forestry
Abstract: *Plant invasion typically occurs within a landscape-scale framework of abiotic and biotic conditions, often resulting in emergent feedbacks among environment, ecosystem functions, and the dominance of invasive species. Understanding the mechanisms underlying successful invasions is an important component of conservation and management efforts, but this has been poorly investigated in a spatially explicit manner. Knowing where and why invasion patterns change throughout the landscape enables managers to use context-specific controls on the spread of invasive species. Using high-resolution airborne imaging spectroscopy, we studied plant performance in growth within and across landscapes to examine the dominance and spatial distribution of an invasive tree, Psidium cattleianum (strawberry guava), in heterogeneous environmental conditions of a submontane Hawaiian tropical forest. We assessed invader performance using the GPP ratio index, which is the relative difference in remotely sensed estimates of gross primary productivity between canopies of guava and canopies of the invaded plant community. In addition, we used airborne LiDAR data to evaluate the impacts of guava invasion on the forest aboveground carbon density in different environments. Structural equation modeling revealed that substrate type and elevation above sea level interact and amplify landscape-scale differences in productivity between the invasive species and the host plant community (GPP ratio); differences that ultimately control levels of dominance of guava. We found shifts in patterns of forest carbon storage based on both gradual increase of invader dominance and changes in environmental conditions. Overall, our results demonstrate that the remotely sensed index defined as the GPP ratio provided an innovative spatially explicit approach to track and predict the success of invasive plants based in their canopy productivity, particularly within a landscape-scale framework of varying environmental factors such as soils and elevation. This approach may help managers accurately predict where invaders of forests, scrublands, or grasslands are likely to exhibit high levels of dominance before the environment is fully invaded.*

Barrette, M., Bélanger, L., De Grandpré, L., & Royo, A. A. (2017). Demographic disequilibrium caused by canopy gap expansion and recruitment failure triggers forest cover loss. *Forest Ecology and Management, 401*, 117-124. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023599344&doi=10.1016%2fj.foreco.2017.07.012&partnerID=40&md5=97db58a564315793e7ba587a0979f112. doi:10.1016/j.foreco.2017.07.012

Research Tags: Forestry, Wildlife

Abstract: *In the absence of large-scale stand replacing disturbances, boreal forests can remain in the old-growth stage over time because of a dynamic equilibrium between small-scale mortality and regeneration processes. Although this gap paradigm has been a cornerstone of forest dynamics theory and practice for decades, evidence suggests that it could be disrupted, threatening the integrity and sustainability of continuous forest cover. The objective of this study was to evaluate the gap dynamics in old-growth boreal forests across a large landscape where deer populations currently exist at high abundance. We hypothesized that chronic deer browsing is limiting recruitment, particularly of palatable species, creating a demographic disequilibrium between canopy mortality and recruitment. We analysed understory regeneration density and distribution in relation to canopy gap size and condition on multiple sample areas within a 360* km^2 *area of old-growth balsam fir (Abies balsamea [L.] Miller) forest on Anticosti Island, Canada. The combined effect of accelerating canopy gap expansion and recruitment failure created a demographic disequilibrium important enough to cause a loss of forest cover. The forest is now at risk of shifting to alternative successional pathways that seem to be dependent upon gaps size. Rather than sustaining historic balsam fir composition, sucession in 57% of gap area was more susceptible to following a pathway leading toward white spruce parklands, while sucession in the other 43% was more susceptible to following a pathway toward white spruce forests. The occurrence of these novel ecosystems represents a threat to biodiversity and ecosystem services that are provided by preindustrial forests. Climate change could exacerbate these threats by allowing deer to go into as yet unoccupied boreal forests that are driven by gap dynamics. Novel management issues will arise in these boreal ecosystems and challenge forest managers. When the traditional approaches of identifying gaps will not work because the forest itself is losing cover, the method we have developed will help forest managers recognize demographic disequilibrium threatening maintenance of forests.*

Barton, A. M., Keeton, W. S., & Spies, T. A. (2019). *Ecology and recovery of eastern old-growth forests*.

Research Tags: Forestry

No Abstract (Book): *North American landscapes have been shaped by humans for millennia through fire, agriculture, and hunting. But the arrival of Europeans several centuries ago ushered in an era of rapid conversion of eastern forests to cities, farms, transportation networks, and second-growth woodlands. Recently, numerous remnants of old growth have been discovered, and scientists are developing strategies for their restoration that will foster biological diversity and reduce impacts of climate change. Forest ecologists William Keeton and Andrew Barton bring together an edited volume that breaks new ground in our understanding of eastern old-growth forest ecosystems and their importance for resilience in an age of rapid environmental change. Leading experts examine topics of contemporary forest ecology across a broad geographic canvas in the eastern United States.*

Bassil, N., Bidani, A., Hummer, K., Rowland, L. J., Olmstead, J., Lyrene, P., & Richards, C. (2018). Assessing genetic diversity of wild southeastern North American Vaccinium species using microsatellite markers. *Genetic Resources and Crop Evolution, 65*(3), 939-950. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033673780&doi=10.1007%2fs10722-017-0585-2&partnerID=40&md5=e87791fefa4d157fdbef652577e64319. doi:10.1007/s10722-017-0585-2

Research Tags: Crops

Abstract: *Wild species representatives from Northwestern, Central and Southern Florida, and neighboring U.S. states were collected in multiple United States Department of Agriculture (USDA) exploration expeditions and are being preserved at the USDA, Agricultural Research Service, National Clonal Germplasm Repository in Corvallis, Oregon. Germplasm from these southeastern regions of North America is particularly vulnerable to loss in the wild due to encroachment of human development in key habitats and biotic and abiotic stresses from climate change. Fourteen simple sequence repeats (SSRs), previously developed from the highbush blueberry (Vaccinium corymbosum) cultivar 'Bluecrop', were used to estimate genetic diversity and genetic differentiation of 67 diploid individuals from three species, including 19 V. elliottii, 12 V. fuscatum, and 35 V. darrowii accessions collected throughout the species' ranges. Results from our analyses indicated that the samples from each species could be reliably resolved using genetic distance measures with ordination and* *neighbor joining approaches. In addition, we estimated admixture among these species by using Bayesian assignment tests, and were able to identify a mis-labeled accession of V. darrowii 'Johnblue', two mis-classified accessions (CVAC 735.001 and CVAC 1223.001), and four accessions of previously undescribed hybrid origin (CVAC 734.001, CVAC 1721.001, CVAC 1741.001, and Florida 4B CVAC 1790). Allele composition at the 14 SSRs confirmed that Florida 4B CVAC 1790, the donor of low chilling for the southern highbush blueberry, was the critical parent of US 74. Genetic diversity assessment and identification of these wild accessions are crucial for optimal germplasm management and expand opportunities to utilize natural variation in breeding programs.*

Batllori, E., Parisien, M. A., Parks, S. A., Moritz, M. A., & Miller, C. (2017). Potential relocation of climatic environments suggests high rates of climate displacement within the North American protection network. *Global Change Biology, 23*(8), 3219-3230. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016433316&doi=10.1111%2fgcb.13663&partnerID=40&md5=2440884495c8e4e7528039ba65354845. doi:10.1111/gcb.13663

Research Tags: Research

Abstract: *Ongoing climate change may undermine the effectiveness of protected area networks in preserving the set of biotic components and ecological processes they harbor, thereby jeopardizing their conservation capacity into the future. Metrics of climate change, particularly rates and spatial patterns of climatic alteration, can help assess potential threats. Here, we perform a continent-wide climate change vulnerability assessment whereby we compare the baseline climate of the protected area network in North America (Canada, United States, México—NAM) to the projected end-of-century climate (2071–2100). We estimated the projected pace at which climatic conditions may redistribute across NAM (i.e., climate velocity), and identified future nearest climate analogs to quantify patterns of climate relocation within, among, and outside protected areas. Also, we interpret climatic relocation patterns in terms of associated land-cover types. Our analysis suggests that the conservation capacity of the NAM protection network is likely to be severely compromised by a changing climate. The majority of protected areas (~80%) might be exposed to high rates of climate displacement that could promote important shifts in species abundance or distribution. A small fraction of protected areas (<10%) could be critical for future conservation plans, as they will host climates that represent analogs of conditions currently characterizing almost a fifth of the protected areas across NAM. However, the majority of nearest climatic analogs for protected areas are in nonprotected locations. Therefore, unprotected landscapes could pose additional threats, beyond climate forcing itself, as sensitive biota may have to migrate farther than what is prescribed by the climate velocity to reach a protected area destination. To mitigate future threats to the conservation capacity of the NAM protected area network, conservation plans will need to capitalize on opportunities provided by the existing availability of natural land-cover types outside the current network of NAM protected areas.*

Bauer, N., Rose, S. K., Fujimori, S., van Vuuren, D. P., Weyant, J., Wise, M., . . . Muratori, M. (2018). Global energy sector emission reductions and bioenergy use: overview of the bioenergy demand phase of the EMF-33 model comparison. *Climatic Change*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054585395&doi=10.1007%2fs10584-018-2226-y&partnerID=40&md5=2164f2683ef479f23f44cde7e64f7f4c. doi:10.1007/s10584-018-2226-y

Research Tags: Economics, Energy

Abstract: *We present an overview of results from 11 integrated assessment models (IAMs) that participated in the 33rd study of the Stanford Energy Modeling Forum (EMF-33) on the viability of large-scale deployment of bioenergy for achieving long-run climate goals. The study explores future bioenergy use across models under harmonized scenarios for future climate policies, availability of bioenergy technologies, and constraints on biomass supply. This paper provides a more transparent description of IAMs that span a broad range of assumptions regarding model structures, energy sectors, and bioenergy conversion chains. Without emission constraints, we find vastly different* CO_2 *emission and bioenergy deployment patterns across models due to differences in competition with fossil fuels, the possibility to produce large-scale bio-liquids, and the flexibility of energy systems. Imposing increasingly stringent carbon budgets mostly increases bioenergy use. A diverse set of available bioenergy technology portfolios provides flexibility to allocate bioenergy to supply different final energy as well as remove carbon dioxide from the atmosphere by combining bioenergy with carbon capture*

and sequestration (BECCS). Sector and regional bioenergy allocation varies dramatically across models mainly due to bioenergy technology availability and costs, final energy patterns, and availability of alternative decarbonization options. Although much bioenergy is used in combination with CCS, BECCS is not necessarily the driver of bioenergy use. We find that the flexibility to use biomass feedstocks in different energy sub-sectors makes large-scale bioenergy deployment a robust strategy in mitigation scenarios that is surprisingly insensitive with respect to reduced technology availability. However, the achievability of stringent carbon budgets and associated carbon prices is sensitive. Constraints on biomass feedstock supply increase the carbon price less significantly than excluding BECCS because carbon removals are still realized and valued. Incremental sensitivity tests find that delayed readiness of bioenergy technologies until 2050 is more important than potentially higher investment costs.

Baule, W., Allred, B., Frankenberger, J., Gamble, D., Andresen, J., Gunn, K. M., & Brown, L. (2017). Northwest Ohio crop yield benefits of water capture and subirrigation based on future climate change projections. *Agricultural Water Management, 189*, 87-97. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019092341&doi=10.1016%2fj.agwat.2017.04.019&partnerID=40&md5=ef18dc43cc0e665bbb0b1d5b2c076b78. doi:10.1016/j.agwat.2017.04.019

Research Tags: Crops, Water

Abstract: *Climate change projections for the Midwest U.S. indicate a future with increased growing season dryness that will adversely impact crop production sustainability. Systems that capture water for later subirrigation use have potential as a climate adaptation strategy to mitigate this increased crop water stress. Three such systems were operated in northwest Ohio from 1996 to 2008, and they exhibited substantial crop yield benefits, especially in dry growing seasons, but also to a lesser extent in near normal or wet growing seasons. The goal of this research was to estimate the increase in crop yield benefits of water capture and subirrigation systems that can be expected under projcted 2041–2070 climate conditions in northwest Ohio. Historical subirrigated field crop yield differences with fields having free drainage only, relative to growing season dryness/wetness, were used to determine future northwest Ohio subirrigated field crop yield increases, based on the modeled climate for 2041–2070. Climate records for 2041–2070 were projected using three bias corrected model combinations, CRCM + CGCM3, RCM3 + GFDL, and MM5I + HadCM3. Growing season dryness/wetness was classified based on the difference between rainfall and the crop adjusted potential evapotranspiration using the 1984–2013 climate record at the three system locations. Projected 2041–2070 growing season precipitation varied substantially between the three model combinations; however, all three indicated increased growing season dryness due to rising temperature and solar radiation. The overall subirrigated field corn yield increase rose to an estimated 27.5%–30.0% in 2041–2070 from 20.5% in 1996–2008, while the subirrigated field soybean yield increase improved from 12.2% in 1996–2008 to 19.8%–21.5% for 2041–2070. Consequently, as growing season drought becomes more frequent, the crop yield benefits with water capture and subirrigation systems will improve, and these systems therefore provide a viable climate adaptation strategy for agricultural production.*

Beach, R. H., Sulser, T. B., Crimmins, A., Cenacchi, N., Cole, J., Fukagawa, N. K., . . . Ziska, L. H. (2019). Combining the effects of increased atmospheric carbon dioxide on protein, iron, and zinc availability and projected climate change on global diets: a modelling study. *The Lancet Planetary Health, 3*(7), e307-e317. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068988347&doi=10.1016%2fS2542-5196%2819%2930094-4&partnerID=40&md5=411277ce776276c9b68b20fcd388b7ed. doi:10.1016/S2542-5196(19)30094-4

Research Tags: Economics, Emissions, Crops

Abstract: *Background*

Increasing atmospheric concentrations of carbon dioxide (CO2) affect global nutrition via effects on agricultural productivity and nutrient content of food crops. We combined these effects with economic projections to estimate net changes in nutrient availability between 2010 and 2050.

Methods

In this modelling study, we used the International Model for Policy Analysis of Agricultural Commodities and Trade to project per capita availability of protein, iron, and zinc in 2050. We used estimated changes in productivity of individual agricultural commodities to model effects on production, trade, prices, and consumption under moderate and high greenhouse gas emission scenarios. Two independent sources of data,

which used different methodologies to determine the effect of increased atmospheric CO2 on different key crops, were combined with the modelled food supply results to estimate future nutrient availability.
Findings
Although technological change, market responses, and the effects of CO2 fertilisation on yield are projected to increase global availability of dietary protein, iron, and zinc, these increases are moderated by negative effects of climate change affecting productivity and carbon penalties on nutrient content. The carbon nutrient penalty results in decreases in the global availability of dietary protein of 4·1%, iron of 2·8%, and zinc of 2·5% as calculated using one dataset, and decreases in global availability of dietary protein of 2·9%, iron of 3·9%, and zinc of 3·4% using the other dataset. The combined effects of projected increases in atmospheric CO2 (ie, carbon nutrient penalty, CO2 fertilisation, and climate effects on productivity) will decrease growth in the global availability of nutrients by 19·5% for protein, 14·4% for iron, and 14·6% for zinc relative to expected technology and market gains by 2050. The many countries that currently have high levels of nutrient deficiency would continue to be disproportionately affected.
Interpretation
This approach is an improvement in estimating future global food security by simultaneously projecting climate change effects on crop productivity and changes in nutrient content under increased concentrations of CO2, which accounts for a much larger effect on nutrient availability than CO2 fertilisation. Regardless of the scenario used to project future consumption patterns, the net effect of increasing concentrations of atmospheric CO2 will slow progress in decreasing global nutrient deficiencies.

Begum, S., Kudo, K., Rahman, M. H., Nakaba, S., Yamagishi, Y., Nabeshima, E., . . . Funada, R. (2018). Climate change and the regulation of wood formation in trees by temperature. *Trees - Structure and Function, 32*(1), 3-15. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027894788&doi=10.1007%2fs00468-017-1587-6&partnerID=40&md5=be4cc6e3460030fb8e51d97e399156e0. doi:10.1007/s00468-017-1587-6
Research Tags: Weather, Forestry
Abstract: *The cambial activity of trees is associated with seasonal cycles of activity and dormancy in temperate zones. The timing of cambial reactivation in early spring and dormancy in autumn plays an important role in determination of the cambial growth and the environmental adaptivity of temperate trees. This review focuses on the temperature regulation of the timing of cambial reactivation and xylem differentiation and highlights recent advances of bud growth in relation to cambial activity of temperate trees. In addition, we discuss relationships between the timing of cambial reactivation, start of xylem differentiation and changes in levels of storage materials to identify the source of the energy required for cell division and differentiation. We also present a summary of current understanding of the effects of rapid increases and decreases in temperature on cambial activity, by localized heating and cooling, respectively. Increases in temperature from late winter to early spring influence the physiological processes that are involved in the initiation of cambial reactivation and xylem differentiation both in localized heated stems and under natural conditions. Localized cooling has a direct effect on cell expansion, the thickening of walls of differentiating tracheids, and the rate of division of cambial cells. A rapid decrease in temperature of the stem might be the critical factor in the control of latewood formation and the cessation of cambial activity. Therefore, temperature is the main driver of cambial activity in temperate trees and trees are able to feel changes in temperature through the stem. The climate change might affect wood formation in trees.*

Belyazid, S., Phelan, J., Nihlgård, B., Sverdrup, H., Driscoll, C., Fernandez, I., . . . Clark, C. (2019). Assessing the Effects of Climate Change and Air Pollution on Soil Properties and Plant Diversity in Northeastern U.S. Hardwood Forests: Model Setup and Evaluation. *Water, Air, and Soil Pollution, 230*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065027391&doi=10.1007%2fs11270-019-4145-6&partnerID=40&md5=66e849347f907671b7f90094be08587b. doi:10.1007/s11270-019-4145-6
Research Tags: Soil, Forestry
Abstract: *The integrated forest ecosystem model ForSAFE-Veg was used to simulate soil processes and understory vegetation composition at three—sugar maple, beech, yellow birch—hardwood forest sites in the Northeastern United States (one at Hubbard Brook, NH, and two at Bear Brook, ME). Input data were pooled from a variety of sources and proved coherent and consistent. While the biogeochemical component ForSAFE*

was used with limited calibration, the ground vegetation composition module Veg was calibrated to field relevés. Evaluating different simulated ecosystem indicators (soil solution chemistry, tree biomass, ground vegetation composition) showed that the model performed comparably well regardless of the site's soil condition, climate, and amounts of nitrogen (N) and sulfur (S) deposition, with the exception of failing to capture tree biomass decline at Hubbard Brook. The model performed better when compared with annual observation than monthly data. The results support the assumption that the biogeochemical model ForSAFE can be used with limited calibration and provide reasonable confidence, while the vegetation community composition module Veg requires calibration if the individual plant species are of interest. The study welcomes recent advances in empirically explaining the responses of hardwood forests to nutrient imbalances and points to the need for more research.

BenDor, T. K., Shandas, V., Miles, B., Belt, K., & Olander, L. (2018). Ecosystem services and U.S. stormwater planning: An approach for improving urban stormwater decisions. *Environmental Science and Policy, 88*, 92-103. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049341315&doi=10.1016%2fj.envsci.2018.06.006&partnerID=40&md5=e4c943b7b6e867e20804535a763314ec. doi:10.1016/j.envsci.2018.06.006

Research Tags: Water

Abstract: *Green stormwater infrastructure (GI) is gaining traction as a viable complement to traditional "gray" infrastructure in cities across the United States. As cities struggle with decisions to replace deteriorating stormwater infrastructure in the face of looming issues such as population growth and climate change, GI may offer a cost-effective, efficient, and sustainable approach. However, decision makers confront challenges when integrating GI within city plans, including uncertainties around GI capacity and maintenance, resistance to collaboration across city governance, increasingly inflexible financing, accounting practices that do not incorporate the multiple values of GI, and difficulties in incorporating ecological infrastructure into stormwater management. This paper presents an ecosystem services framework for assessing the context-specific needs of decision makers, while considering the strengths and limitations of GI use in urban stormwater management. We describe multiple dimensions of the planning system, identify points of intervention, and illustrate two applications of our framework – Durham, North Carolina and Portland, Oregon (USA). In these case studies, we apply our ecosystem services framework to explicitly consider tradeoffs to assist planning professionals who are considering implementation of GI. We conclude by offering a research agenda that explores opportunities for further evaluations of GI design, implementation, and maintenance in cities.*

Benjankar, R., Tonina, D., McKean, J. A., Sohrabi, M. M., Chen, Q., & Vidergar, D. (2018). Dam operations may improve aquatic habitat and offset negative effects of climate change. *Journal of Environmental Management, 213*, 126-134. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042354527&doi=10.1016%2fj.jenvman.2018.02.066&partnerID=40&md5=0b350d390cb222690b229499e6e71e13. doi:10.1016/j.jenvman.2018.02.066

Research Tags: Water

Abstract: *Dam operation impacts on stream hydraulics and ecological processes are well documented, but their effect depends on geographical regions and varies spatially and temporally. Many studies have quantified their effects on aquatic ecosystem based mostly on flow hydraulics overlooking stream water temperature and climatic conditions. Here, we used an integrated modeling framework, an ecohydraulics virtual watershed, that links catchment hydrology, hydraulics, stream water temperature and aquatic habitat models to test the hypothesis that reservoir management may help to mitigate some impacts caused by climate change on downstream flows and temperature. To address this hypothesis we applied the model to analyze the impact of reservoir operation (regulated flows) on Bull Trout, a cold water obligate salmonid, habitat, against unregulated flows for dry, average, and wet climatic conditions in the South Fork Boise River (SFBR), Idaho, USA.*

Benjankar, R., Tonina, D., McKean, J. A., Sohrabi, M. M., Chen, Q., & Vidergar, D. (2019). An ecohydraulics virtual watershed: Integrating physical and biological variables to quantify aquatic habitat quality. *Ecohydrology, 12*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058946424&doi=10.1002%2feco.2062&partnerID=40&md5=f9cb2b8edb865f5f964f95d46b4f471b. doi:10.1002/eco.2062

Research Tags: Water, Wildlife

Abstract: *Advances in remote sensing coupled with numerical modelling allow us to build a "virtual ecohydraulics watershed" at the micro-habitat scale. This approach is an integrated modelling framework with a cascade of models including physical (hydrologic, hydraulic, and stream water temperature) and biological (fish habitat) modelling at a resolution and extent important for aquatic and terrestrial organisms. We applied this approach to quantify the impacts of discharges and water temperature on habitat quality and spatial/temporal habitat use patterns of bull trout, a federally listed species along the South Fork Boise River. We coupled process-based snow melt and hydrologic models to predict water availability within the watershed. The model fed one- and two-dimensional hydrodynamic models to predict stream hydraulics and water temperature using high-resolution (meter scale) river bathymetric data. This information was then used in an aquatic habitat modelling to characterize habitat quality distribution as a function of discharges. Our results showed that the summer thermal regime of river system would alter available habitat. The high spatial resolution analysis allows modelling to predict the importance of lateral habitats, which serve as vital refugia during high-flow events for many fish species. The advances in remote sensing, numerical modelling, and understanding of physical-biological processes provide us an opportunity to conceptualize new process-based integrated modelling tools to analyse human impacts at a catchment scale, for example, dam operation and climatic variability on aquatic habitat and status, and further to develop restoration protocols in a virtual domain before field studies are developed and/or structures built.*

Bentz, B. J., & Hansen, E. M. (2018). Evidence for a Prepupal Diapause in the Mountain Pine Beetle (Dendroctonus ponderosae). *Environmental Entomology, 47*(1), 175-183. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042207967&doi=10.1093%2fee%2fnvx192&partnerID=40&md5=16c1fc15ef2c27fe35acd2bcf71b0573. doi:10.1093/ee/nvx192

Research Tags: Wildlife, Forestry

Abstract: *Dormancy strategies, including diapause and quiescence, enable insects to evade adverse conditions and ensure seasonally appropriate life stages. A mechanistic understanding of a species' dormancy is necessary to predict population response in a changing climate. Climate change is influencing distribution patterns and population success of many species, including Dendroctonus ponderosae Hopkins (Coleoptera: Curculionidae: Scolytinae), the most important mortality agent of pines in western North America. Diapause is considered absent in D. ponderosae, and quiescence in the final larval stage prior to pupation (i.e., prepupal) is considered the main dormancy strategy. We evaluated if a facultative diapause in the prepupal stage, rather than a pupation threshold ~15°C (i.e., quiescence), could describe pupation patterns in two latitudinally separated D. ponderosae populations in the western United States. We hypothesized that if pupation occurs at lower temperatures than previously described, and if significant prepupal developmental delays occur, diapause is a likely physiological mechanism. Although there was considerable variation within and between populations, pupation occurred below the previously established threshold suggesting a prepupal facultative diapause that is induced when late instars experience cool temperatures. Individuals that pupated at temperatures below 15°C also had developmental delays, relative to development at warmer temperatures, consistent with diapause development. Pupation patterns differed between populations wherein diapause was induced at cooler temperatures and diapause development was shorter in southern compared with northern D. ponderosae. Recognition of a facultative diapause that varies among and between populations is critical for making predictions about future population response and range expansion in a changing climate.*

Bentz, B. J., Hood, S. M., Hansen, E. M., Vandygriff, J. C., & Mock, K. E. (2017). Defense traits in the long-lived Great Basin bristlecone pine and resistance to the native herbivore mountain pine beetle. *New Phytologist, 213*(2), 611-624. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84987624103&doi=10.1111%2fnph.14191&partnerID=40&md5=bdb23691a349c36ed8a046e747a1e265. doi:10.1111/nph.14191

Research Tags: Forestry, Wildlife

Abstract: *Mountain pine beetle (MPB, Dendroctonus ponderosae) is a significant mortality agent of Pinus, and climate-driven range expansion is occurring. Pinus defenses in recently invaded areas, including high elevations, are predicted to be lower than in areas with longer term MPB presence. MPB was recently observed in high-elevation forests of the Great Basin (GB) region, North America. Defense and susceptibility in two*

long-lived species, GB bristlecone pine (Pinus longaeva) and foxtail pine (P. balfouriana), are unclear, although they are sympatric with a common MPB host, limber pine (P. flexilis).
We surveyed stands with sympatric GB bristlecone–limber pine and foxtail–limber pine to determine relative MPB attack susceptibility and constitutive defenses.
MPB-caused mortality was extensive in limber, low in foxtail and absent in GB bristlecone pine. Defense traits, including constitutive monoterpenes, resin ducts and wood density, were higher in GB bristlecone and foxtail than in limber pine.
GB bristlecone and foxtail pines have relatively high levels of constitutive defenses which make them less vulnerable to climate-driven MPB range expansion relative to other high-elevation pines. Long-term selective herbivore pressure and exaptation of traits for tree longevity are potential explanations, highlighting the complexity of predicting plant–insect interactions under climate change.

Berger, J., Hartway, C., Gruzdev, A., & Johnson, M. (2018). Climate Degradation and Extreme Icing Events Constrain Life in Cold-Adapted Mammals. *Scientific Reports, 8*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040774273&doi=10.1038%2fs41598-018-19416-9&partnerID=40&md5=b602f5d856610434e10cc8d1a761f8f5. doi:10.1038/s41598-018-19416-9
Research Tags: Weather, Wildlife
Abstract: *Despite the growth in knowledge about the effects of a warming Arctic on its cold-adapted species, the mechanisms by which these changes affect animal populations remain poorly understood. Increasing temperatures, declining sea ice and altered wind and precipitation patterns all may affect the fitness and abundance of species through multiple direct and indirect pathways. Here we demonstrate previously unknown effects of rain-on-snow (ROS) events, winter precipitation, and ice tidal surges on the Arctic's largest land mammal. Using novel field data across seven years and three Alaskan and Russian sites, we show arrested skeletal growth in juvenile muskoxen resulting from unusually dry winter conditions and gestational ROS events, with the inhibitory effects on growth from ROS events lasting up to three years post-partum. Further, we describe the simultaneous entombment of 52 muskoxen in ice during a Chukchi Sea winter tsunami (ivuniq in Iñupiat), and link rapid freezing to entrapment of Arctic whales and otters. Our results illustrate how once unusual, but increasingly frequent Arctic weather events affect some cold-adapted mammals, and suggest that an understanding of species responses to a changing Arctic can be enhanced by coalescing groundwork, rare events, and insights from local people.*

Bergman, R. D., & Alanya-Rosenbaum, S. (2017). Cradle-to-gate life-cycle assessment of composite I-joist production in the United States. *Forest Products Journal, 67*(5-6), 355-367. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043698900&doi=10.13073%2fFPJ-D-16-00047&partnerID=40&md5=09b8ffa194d99568af77dc61f3c0f426. doi:10.13073/FPJ-D-16-00047
Research Tags: Economics, Forestry
Abstract: *Transparency of environmental impacts for building products is of increasing concern. For wood building products, updating life-cycle assessment (LCA) data are critical to ensure that the corresponding environmental product declarations are of the proper recency to maintain this transparency. This study focused on the developing up-to-date life-cycle inventory (LCI) and associated life-cycle impact assessment (LCIA) data for composite I-joist production in the Southeast (SE) and Pacific Northwest (PNW) regions of the United States. Components of the I-joist production system included in the analysis were laminated veneer lumber (LVL), finger-jointed lumber (FJL), and oriented strandboard (OSB), while the study itself considered five life-cycle stages, including forestry operations and I-joist manufacturing, in addition to the production of the components. Primary 2012 production data were collected and analyzed, and the resultant LCI flow and LCIA results were modeled on a declared unit of 1 km. The cradle-to-gate primary energy consumption was 82.0 and 74.2 GJ/km for all five life-cycle stages in the SE and PNW, respectively. The LVL stage had the highest share at 55 percent (SE) and 51 percent (PNW), followed by OSB and I-joist, while the contribution of forestry operations was minor. The global warming (GW) impact from gate-to-gate I-joist production in the SE, about 59 percent, was attributed to resin inputs and electricity consumption. The main reasons for relatively high GW impacts for LVL and I-joist production were that little wood fuel was available on-site to provide thermal energy for processing and the consumption of natural gas and electricity to aid in emission control.*

Berihu, T., Girmay, G., Sebhatleab, M., Berhane, E., Zenebe, A., & Sigua, G. C. (2017). Soil carbon and nitrogen losses following deforestation in Ethiopia. *Agronomy for Sustainable Development, 37*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006942675&doi=10.1007%2fs13593-016-0408-4&partnerID=40&md5=f81cd08c73a1eaa7902e434438eaccb9. doi:10.1007/s13593-016-0408-4

Research Tags: Soil, Crops

Abstract: *Ethiopia faces high risk of soil carbon depletion for nearly half of its total land mass largely due to forest clearing and continuous cultivation. Conversion of natural ecosystems to cultivated agriculture resulted in losses of between 20 and 50% of the soil C stocks in the first meter of the soil depth. Dry Afromontane forests of northern Ethiopia have faced vast exploitation, and almost all these forests have been converted to agricultural lands affecting the functionality and stability of agroecosystem. Here, we studied the effect of land use-land cover changes on soil organic C, total N, and soil C sequestration. Specifically, (a) we characterized major soils of the Desa'a Dry Afromontane forest, northern Ethiopia, and (b) we analyzed the organic C and total N contents of soils with varying land use-land cover types of the Desa'a Dry Afromontane forest. Results show that soil organic C (1.9%) and total N (0.3%) were higher for the middle landscape position than that observed for the upper and lower landscape positions. Soil organic C that ranged from 1.2 in farmland to 2.3% in dense forest also varied with land use-land cover types. Concentration of soil organic C was different among dense forest (2.3%), open forest (1.7%), grazing land (1.6%), and farmland (1.2%). Due to the effect of land use-land cover types, soil total N varied from 0.2% in the farmland to 0.3% in the dense forest. The soil organic C and total nitrogen of the top and lower layer soils were 2.0 and 1.5 and 0.2 and 0.3%, respectively. The soil organic C sequestration for dense forest was significantly higher (48.5 t ha−1) than that of grassland, open forest, and farm land. The top soil sequestered higher soil organic C (44.9 t ha−1) than the lower soil layer. Thus, the top soil layers of dense forest at the middle landscape positions stored significant amount of soil organic carbon.*

Berryman, E. M., Vanderhoof, M. K., Bradford, J. B., Hawbaker, T. J., Henne, P. D., Burns, S. P., . . . Ryan, M. G. (2018). Estimating Soil Respiration in a Subalpine Landscape Using Point, Terrain, Climate, and Greenness Data. *Journal of Geophysical Research: Biogeosciences, 123*(10), 3231-3249. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054792596&doi=10.1029%2f2018JG004613&partnerID=40&md5=a0f62316bb16c39bc67f54f99e329fa1. doi:10.1029/2018JG004613

Research Tags: Soil, Emissions, Forestry

Abstract: *Soil respiration returns carbon dioxide back to the atmosphere and is an important part of the carbon cycle, but estimates of soil respiration across large landscapes are difficult to come by. Soil respiration is sensitive to changes in climate and vegetation, which are available as mapped data products, thanks to remote sensing and geospatial technology. We developed a statistical model that mapped soil respiration across three forests and an entire region based on climate and vegetation spatial data. While this work was limited to subalpine forests in the Southern Rocky Mountains, our method can be used in other ecosystems to better understand how ecosystems interact with atmospheric carbon dioxide.*

Berti, M., Johnson, B., Ripplinger, D., Gesch, R., & Aponte, A. (2017). Environmental impact assessment of double- and relay-cropping with winter camelina in the northern Great Plains, USA. *Agricultural Systems, 156*, 1-12. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019739305&doi=10.1016%2fj.agsy.2017.05.012&partnerID=40&md5=b260b17edb9e06e525638113e1fe0771. doi:10.1016/j.agsy.2017.05.012

Research Tags: Crops, Emissions

Abstract: *Recent findings indicate that double- or relay-cropping winter camelina (Camelina sativa L. Crantz.) with, forage, or food crops can increase yield per area, improve energy balance, and provide several ecosystem services. Double-cropping can help balance food and energy production. The objective of this study was to determine the environmental impact of double- and relay-cropping systems as compared with monocultured maize (Zea mays L.) and soybean [Glycine max (L.) Merr.] in the Midwest, USA. Ten crop sequences composed of double- and relay-cropped forage sorghum [Sorghum bicolor (L.) Moench.] and soybean with winter camelina were evaluated and compared with their monoculture counterparts. The environmental aspects evaluated included global warming potential (GWP), abiotic depletion, acidification, eutrophication, ecotoxicity, and human toxicity. Additionally, provisioning and regulating ecosystem services were estimated, including:*

primary aboveground productivity, soil erosion, and biodiversity in each crop sequence. The analysis was conducted from 'cradle-to-gate', including only the agricultural phase. Global warming potential estimated by three different methods indicated that winter camelina as a monocrop had a GWP of 579 to 922 kg CO_2e ha^{-1}. Maize in monoculture had higher GWP than all other double- and relay-cropping systems studied. The higher emissions of double- and relay-cropping systems and maize can be explained by higher N fertilizer application, which led to greater field N_2O emissions. Also, the additional sowing and harvesting of the double- or relay-crop increased CO_2 emissions due to increased diesel use. Winter camelina as a monocrop had the lowest values in all impact categories, indicating camelina agricultural production phase has low environmental impact compared with maize and soybean in monoculture. Double- and relay- cropping systems increased primary productivity per unit area and biodiversity and reduced soil erosion potential. Increasing productivity with the additional environmental benefits of these systems may encourage more farmers to adopt sustainable agricultural practices.

Bertolet, B. L., Corman, J. R., Casson, N. J., Sebestyen, S. D., Kolka, R. K., & Stanley, E. H. (2018). Influence of soil temperature and moisture on the dissolved carbon, nitrogen, and phosphorus in organic matter entering lake ecosystems. *Biogeochemistry, 139*(3), 293-305. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050300516&doi=10.1007%2fs10533-018-0469-3&partnerID=40&md5=8f308408a74e664ecb705a9c183b31e9. doi:10.1007/s10533-018-0469-3

Research Tags: Soil, Water

Abstract: *Concentrations of terrestrially derived dissolved organic matter (DOM) have been increasing in many north temperate and boreal lakes for over two decades. The concentration of DOM in lakes is influenced by a number of environmental factors, but there is still considerable debate about how the availability of terrestrial DOM, and associated dissolved nitrogen and phosphorus, may be affected by drivers of climatic change. Using experimental and observational methods, we considered how changes in soil temperature and moisture affected the composition of carbon, nitrogen, and phosphorus entering freshwater lakes. In our experiment, organic soil cores were collected from the wetland shoreline of a darkly-stained seepage lake in northern Wisconsin, USA and manipulated in laboratory with temperature and moisture treatments. During the 28-day study, soil leachate was sampled and analyzed for optical properties of DOM via UV/Vis absorbance, as well as concentrations of dissolved organic carbon (DOC), total dissolved nitrogen, and total dissolved phosphorus (TDP). DOM optical properties were particularly sensitive to moisture, with drier scenarios resulting in DOM of lower molecular weight and aromaticity. Warmer temperatures led to lower DOC and TDP concentrations. To consider long-term relationships between climate and lake chemical properties, we analyzed long-term water chemistry data from two additional Wisconsin lakes from the long term ecological research (LTER) project in a cross correlation analysis with Palmer drought severity index data. Analysis of the LTER data supported our experimental results that soil moisture has a significant effect on the quality of DOM entering lakes and that climate may significantly affect lake chemical properties. Although unexpected in terms of DOM loading for climate change scenarios, these results are consistent with patterns of decomposition in organic soils and may be attributed to an increase in soil DOM processing.*

Betts, M. G., Illán, J. G., Yang, Z., Shirley, S. M., & Thomas, C. D. (2019). Synergistic effects of climate and land-cover change on long-term bird population trends of the Western USA: A test of modeled predictions. *Frontiers in Ecology and Evolution, 7*(May). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066814822&doi=10.3389%2ffevo.2019.186&partnerID=40&md5=6266167b3befc8b3178653514ea88f5c. doi:10.3389/fevo.2019.186

Research Tags: Wildlife, Research

Abstract: *Climate and land-use change are predicted to lead to widespread changes in population dynamics, but quantitative predictions on the relative effects of these stressors have not yet been examined empirically. We analyzed historical abundance data of 110 terrestrial bird species sampled from 1983 to 2010 along 406 Breeding Bird Survey (BBS) across the western USA. Using boosted-regression trees, we modeled bird abundance at the beginning of this interval as a function of (1) climate variables, (2) Landsat-derived landcover data, (3) the additive and interactive effects of climate and land-cover variables. We evaluated the capacity of each model set to predict observed 27-year bird population trends. On average, 45 species significantly declined over the period observed and only 8 increased (mean trend = −0.84%/year). Climate change alone*

significantly predicted observed abundance trends for 44/108 species (mean 0.37 ± 0.09 [SD]), land-cover changes alone predicted trends for 47/108 species (mean r = 0.36 ± 0.09), and the synergistic effects predicted 59/108 species (mean r = 0.37 ± 0.11). However, for 37 of these species, including information on land-cover change increased prediction success over climate data alone. Across stressors, species with trends that were predicted accurately were more likely to be in decline across the western USA. For instance, species with high correlations between predicted and observed abundances (>r = 0.6) were declining at rates that were on average >2%/year. We provide the first empirical evidence that abundance models based on land cover and climate have the capacity to predict the species most likely to be at risk from climate and land-use change. However, for many species there were substantial discrepancies between modeled and observed trends. Nevertheless, our results highlight that climate change is already influencing bird populations of the western U.S. and that such effects often operate synergistically with land-cover change to affect population declines.

Bhatkoti, R., Triantis, K., Moglen, G. E., & Sabounchi, N. S. (2018). Performance assessment of a water supply system under the impact of climate change and droughts: Case study of the Washington Metropolitan Area. *Journal of Infrastructure Systems, 24*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049649166&doi=10.1061%2f%28ASCE%29IS.1943-555X.0000435&partnerID=40&md5=7fe18f938916b4a2ad5f5d22852b537f. doi:10.1061/(ASCE)IS.1943-555X.0000435

Research Tags: Water, Weather

Abstract: *Fresh water demand is rising due to factors such as population growth, economic development, and land use changes. At the same time, climate change is rendering the water supply even more uncertain for the future. Due to recurring water restrictions and increasing water-related fees triggered by droughts and water shortages, there is a widespread, growing discomfort with respect to future water availability. Among key stakeholders and local policy makers, this has led to an increased interest in modeling the availability of water resources, with the aim of developing and implementing the appropriate water resource infrastructure and management strategies. This paper examines the Washington metropolitan area (WMA) water supply system and uses a system dynamics approach as a planning tool to make an exploratory assessment of the adequacy of the study area's water supply system to meet future water demand under the influence of substantial droughts and climate change. This assessment finds that the study area is self-sufficient under normal climate conditions during the entire planning horizon but that it will be strained under moderately severe droughts. On the basis of the temperature, streamflow and precipitation projections made by climate change models specific to the WMA region, climate change is expected to improve the water supply reliability. However, climate change has uncertainty associated with it. One of the four climate models for the Potomac River basin projects a decrease in the precipitation and streamflow, which may result in a reduction in the water supply and the system's reliability. Regulating the price and the system losses are valuable tools that can be leveraged. But these policy interventions require stakeholder participation (price regulation) and capital investments (reduction of distribution losses). Finally, system reliability can also be improved by increasing water supplies.*

Bian, H., Lü, H., Sadeghi, A. M., Zhu, Y., Yu, Z., Ouyang, F., . . . Chen, R. (2017). Assessment on the effect of climate change on streamflow in the source region of the Yangtze River, China. *Water (Switzerland), 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011292087&doi=10.3390%2fw9010070&partnerID=40&md5=ac34d80a1fd8ae9b4200cbd63b559c07. doi:10.3390/w9010070

Research Tags: Water

Abstract: *Tuotuo River basin, known as the source region of the Yangtze River, is the key area where the impact of climate change has been observed on many of the hydrological processes of this central region of the Tibetan Plateau. In this study, we examined six Global Climate Models (GCMs) under three Representative Concentration Pathways (RCPs) scenarios. First, the already impacted climate change was analyzed, based on the historical data available and then, the simulation results of the GCMs and RCPs were used for future scenario assessments. Results indicated that the annual mean temperature will likely be increased, ranging from −0.66 °C to 6.68 °C during the three future prediction periods (2020s, 2050s and 2080s), while the change in the annual precipitation ranged from −1.18% to 66.14%. Then, a well-known distributed hydrological soil vegetation model (DHSVM) was utilized to evaluate the effects of future climate change on the streamflow* *dynamics. The seasonal mean streamflows, predicted by the six GCMs and the three RCPs scenarios, were also shown to likely increase, ranging from −0.52% to 22.58%. Watershed managers and regulators can use the findings from this study to better implement their conservation practices in the face of climate change.*

Biederman, L., Mortensen, B., Fay, P., Hagenah, N., Knops, J., La Pierre, K., . . . Tognetti, P. (2017). Nutrient addition shifts plant community composition towards earlier flowering species in some prairie ecoregions in the U.S. Central Plains. *PLoS ONE, 12*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019683807&doi=10.1371%2fjournal.pone.0178440&partnerID=40&md5=2b9145c14382d40452e17ad72ad79d1b. doi:10.1371/journal.pone.0178440
Research Tags: Grassland, Soil
Abstract: *The distribution of flowering across the growing season is governed by each species' evolutionary history and climatic variability. However, global change factors, such as eutrophication and invasion, can alter plant community composition and thus change the distribution of flowering across the growing season. We examined three ecoregions (tall-, mixed, and short-grass prairie) across the U.S. Central Plains to determine how nutrient (nitrogen (N), phosphorus, and potassium (+micronutrient)) addition alters the temporal patterns of plant flowering traits. We calculated total community flowering potential (FP) by distributing peak-season plant cover values across the growing season, allocating each species' cover to only those months in which it typically flowers. We also generated separate FP profiles for exotic and native species and functional group. We compared the ability of the added nutrients to shift the distribution of these FP profiles (total and sub-groups) across the growing season. In all ecoregions, N increased the relative cover of both exotic species and C3 graminoids that flower in May through August. The cover of C4 graminoids decreased with added N, but the response varied by ecoregion and month. However, these functional changes only aggregated to shift the entire community's FP profile in the tall-grass prairie, where the relative cover of plants expected to flower in May and June increased and those that flower in September and October decreased with added N. The relatively low native cover in May and June may leave this ecoregion vulnerable to disturbance-induced invasion by exotic species that occupy this temporal niche. There was no change in the FP profile of the mixed and short-grass prairies with N addition as increased abundance of exotic species and C3 graminoids replaced other species that flower at the same time. In these communities a disturbance other than nutrient addition may be required to disrupt phenological patterns.*

Bielecki, C. D., & Wingenbach, G. (2019). Using a livelihoods framework to analyze farmer identity and decision making during the Central American coffee leaf rust outbreak: implications for addressing climate change and crop diversification. *Agroecology and Sustainable Food Systems, 43*(4), 457-480. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060249791&doi=10.1080%2f21683565.2019.1566191&partnerID=40&md5=f08245b6b1993581043a53141362b540. doi:10.1080/21683565.2019.1566191
Research Tags: Crops, Economics
Abstract: *This qualitative study of one Guatemalan coffee cooperative examined the decision making process of smallholder farmers as they struggled to preserve their livelihoods during an outbreak of coffee leaf rust (CLR). The results revealed that although the cooperative members viewed the CLR as a threat to livelihoods, it was no greater a threat than other crises such as low coffee prices, extreme weather events, and persistent food insecurity. In response, members suspended organic coffee production, borrowed money to purchase food, sought off-farm employment, and grew limited subsistence crops. Yet most interestingly, for the long-term, they remained fully committed to producing high quality arabica coffee even though the cooperative was aware a future CLR outbreak could again devastate production. These findings question the underlying assumption of crop diversification initiatives which rarely consider the importance of farmer identity. Crop diversification and off-farm employment schemes seek to mitigate environmental threats (e.g., climate change) that smallholder farmers face, however this research shows that farmer identity can be just as, if not more, important than crop yields or even income generation. The authors propose a three-stage smallholder producer vulnerability framework to better understand and analyze future livelihoods disruptions of smallholder producers.*

Bigelow, D. P., & Zhang, H. (2018). Supplemental irrigation water rights and climate change adaptation. *Ecological Economics, 154*, 156-167. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051410643&doi=10.1016%2fj.ecolecon.2018.07.01

5&partnerID=40&md5=db0437d5b29fe6f191f1a0bf8d10cb06. doi:10.1016/j.ecolecon.2018.07.015
Research Tags: Livestock,
Abstract: *Adaptation to water scarcity induced by future climate change will be crucial for the viability of agricultural economies in many areas of the world. In this paper, we study the acquisition of supplemental irrigation water rights as an adaptation strategy undertaken by irrigation-dependent farmers in response to historical climate change. By exploiting the panel structure of a unique dataset of farm-level supplemental right adoption decisions in the state of Oregon, we establish a relationship between climate conditions, competition for local water resources, and the acquisition of supplemental rights. Our results indicate that a warmer, drier climate increases the likelihood that irrigated farms acquire supplemental rights, suggesting that farmers in Oregon have used supplemental rights to adapt to historical climate change. We also find evidence of heterogeneous effects suggesting that junior irrigators, groundwater-dependent irrigators, and farmers with access to a relatively lower volume of water have been most affected by historical climate change with respect to their supplemental water right acquisition decisions.*

Birdsey, R., Duffy, P., Smyth, C., Kurz, W. A., Dugan, A. J., & Houghton, R. (2018). Climate, economic, and environmental impacts of producing wood for bioenergy. *Environmental Research Letters, 13*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048071271&doi=10.1088%2f1748-9326%2faab9d5&partnerID=40&md5=0586bfe3717d822aca53b123abeacbf5. doi:10.1088/1748-9326/aab9d5
Research Tags: Emissions, Forestry, Energy
Abstract: *Increasing combustion of woody biomass for electricity has raised concerns and produced conflicting statements about impacts on atmospheric greenhouse gas (GHG) concentrations, climate, and other forest values such as timber supply and biodiversity. The purposes of this concise review of current literature are to (1) examine impacts on net GHG emissions and climate from increasing bioenergy production from forests and exporting wood pellets to Europe from North America, (2) develop a set of science-based recommendations about the circumstances that would result in GHG reductions or increases in the atmosphere, and (3) identify economic and environmental impacts of increasing bioenergy use of forests. We find that increasing bioenergy production and pellet exports often increase net emissions of GHGs for decades or longer, depending on source of feedstock and its alternate fate, time horizon of analysis, energy emissions associated with the supply chain and fuel substitution, and impacts on carbon cycling of forest ecosystems. Alternative uses of roundwood often offer larger reductions in GHGs, in particular long-lived wood products that store carbon for longer periods of time and can achieve greater substitution benefits than bioenergy. Other effects of using wood for bioenergy may be considerable including induced land-use change, changes in supplies of wood and other materials for construction, albedo and non-radiative effects of land-cover change on climate, and long-term impacts on soil productivity. Changes in biodiversity and other ecosystem attributes may be strongly affected by increasing biofuel production, depending on source of material and the projected scale of biofuel production increases.*

Biskaborn, B. K., Smith, S. L., Noetzli, J., Matthes, H., Vieira, G., Streletskiy, D. A., . . . Lantuit, H. (2019). Permafrost is warming at a global scale. *Nature Communications, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060159099&doi=10.1038%2fs41467-018-08240-4&partnerID=40&md5=c06ce3e733a88201e60bdaac0d6e7dc8. doi:10.1038/s41467-018-08240-4
Research Tags:
Abstract: *Permafrost warming has the potential to amplify global climate change, because when frozen sediments thaw it unlocks soil organic carbon. Yet to date, no globally consistent assessment of permafrost temperature change has been compiled. Here we use a global data set of permafrost temperature time series from the Global Terrestrial Network for Permafrost to evaluate temperature change across permafrost regions for the period since the International Polar Year (2007–2009). During the reference decade between 2007 and 2016, ground temperature near the depth of zero annual amplitude in the continuous permafrost zone increased by 0.39 ± 0.15 °C. Over the same period, discontinuous permafrost warmed by 0.20 ± 0.10 °C. Permafrost in mountains warmed by 0.19 ± 0.05 °C and in Antarctica by 0.37 ± 0.10 °C. Globally, permafrost temperature increased by 0.29 ± 0.12 °C. The observed trend follows the Arctic amplification of air temperature increase in the Northern Hemisphere. In the discontinuous zone, however, ground warming occurred due to increased snow thickness while air temperature remained statistically unchanged.*

Bista, D. R., Heckathorn, S. A., Jayawardena, D. M., Mishra, S., & Boldt, J. K. (2018). Effects of drought on nutrient uptake and the levels of nutrient-uptake proteins in roots of drought-sensitive and -tolerant grasses. *Plants, 7*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047394181&doi=10.3390%2fplants7020028&partnerID=40&md5=d59f56db80f9f71757858d6992d249d7. doi:10.3390/plants7020028

Research Tags: Grassland, Weather

Abstract: *Climate change will increase drought in many regions of the world. Besides decreasing productivity, drought also decreases the concentration (%) of nitrogen (N) and phosphorous (P) in plants. We investigated if decreases in nutrient status during drought are correlated with decreases in levels of nutrient-uptake proteins in roots, which has not been quantified. Drought-sensitive (Hordeum vulgare, Zea mays) and -tolerant grasses (Andropogon gerardii) were harvested at mid and late drought, when we measured biomass, plant %N and P, root N- and P-uptake rates, and concentrations of major nutrient-uptake proteins in roots (NRT1 for NO3, AMT1 for NH4, and PHT1 for P). Drought reduced %N and P, indicating that it reduced nutrient acquisition more than growth. Decreases in P uptake with drought were correlated with decreases in both concentration and activity of P-uptake proteins, but decreases in N uptake were weakly correlated with levels of N-uptake proteins. Nutrient-uptake proteins per gram root decreased despite increases per gram total protein, because of the larger decreases in total protein per gram. Thus, drought-related decreases in nutrient concentration, especially %P, were likely caused, at least partly, by decreases in the concentration of root nutrient-uptake proteins in both drought-sensitive and -tolerant species.*

Bjorkman, A. D., Myers-Smith, I. H., Elmendorf, S. C., Normand, S., Rüger, N., Beck, P. S. A., . . . Weiher, E. (2018). Plant functional trait change across a warming tundra biome. *Nature, 562*(7725), 57-62. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054332128&doi=10.1038%2fs41586-018-0563-7&partnerID=40&md5=7253ae03855ba0d82a94aeae654b167c. doi:10.1038/s41586-018-0563-7

Research Tags: Grassland

Abstract: *The tundra is warming more rapidly than any other biome on Earth, and the potential ramifications are far-reaching because of global feedback effects between vegetation and climate. A better understanding of how environmental factors shape plant structure and function is crucial for predicting the consequences of environmental change for ecosystem functioning. Here we explore the biome-wide relationships between temperature, moisture and seven key plant functional traits both across space and over three decades of warming at 117 tundra locations. Spatial temperature–trait relationships were generally strong but soil moisture had a marked influence on the strength and direction of these relationships, highlighting the potentially important influence of changes in water availability on future trait shifts in tundra plant communities. Community height increased with warming across all sites over the past three decades, but other traits lagged far behind predicted rates of change. Our findings highlight the challenge of using space-for-time substitution to predict the functional consequences of future warming and suggest that functions that are tied closely to plant height will experience the most rapid change. They also reveal the strength with which environmental factors shape biotic communities at the coldest extremes of the planet and will help to improve projections of functional changes in tundra ecosystems with climate warming.*

Black, B. A., van der Sleen, P., Di Lorenzo, E., Griffin, D., Sydeman, W. J., Dunham, J. B., . . . Bograd, S. J. (2018). Rising synchrony controls western North American ecosystems. *Global Change Biology, 24*(6), 2305-2314. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044954558&doi=10.1111%2fgcb.14128&partnerID=40&md5=68eece83dbb3d6b92cbbf60026e4d482. doi:10.1111/gcb.14128

Research Tags: Weather, Forestry

Abstract: *Along the western margin of North America, the winter expression of the North Pacific High (NPH) strongly influences interannual variability in coastal upwelling, storm track position, precipitation, and river discharge. Coherence among these factors induces covariance among physical and biological processes across adjacent marine and terrestrial ecosystems. Here, we show that over the past century the degree and spatial extent of this covariance (synchrony) has substantially increased, and is coincident with rising variance in the winter NPH. Furthermore, centuries-long blue oak (Quercus douglasii) growth chronologies sensitive to the winter NPH provide robust evidence that modern levels of synchrony are among the highest observed in the*

context of the last 250 years. These trends may ultimately be linked to changing impacts of the El Niño Southern Oscillation on midlatitude ecosystems of North America. Such a rise in synchrony may destabilize ecosystems, expose populations to higher risks of extinction, and is thus a concern given the broad biological relevance of winter climate to biological systems.

Black, C. K., Davis, S. C., Hudiburg, T. W., Bernacchi, C. J., & DeLucia, E. H. (2017). Elevated CO<inf>2</inf> and temperature increase soil C losses from a soybean–maize ecosystem. *Global Change Biology, 23*(1), 435-445. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84978101099&doi=10.1111%2fgcb.13378&partnerID=40&md5=8e5ca7a4aa050dab427e00b4c16730a5. doi:10.1111/gcb.13378

Research Tags: Soil, Emissions, Crops

Abstract: *Warming temperatures and increasing CO2 are likely to have large effects on the amount of carbon stored in soil, but predictions of these effects are poorly constrained. We elevated temperature (canopy: +2.8 °C; soil growing season: +1.8 °C; soil fallow: +2.3 °C) for 3 years within the 9th–11th years of an elevated CO2 (+200 ppm) experiment on a maize–soybean agroecosystem, measured respiration by roots and soil microbes, and then used a process-based ecosystem model (DayCent) to simulate the decadal effects of warming and CO2 enrichment on soil C. Both heating and elevated CO2 increased respiration from soil microbes by ~20%, but heating reduced respiration from roots and rhizosphere by ~25%. The effects were additive, with no heat × CO2 interactions. Particulate organic matter and total soil C declined over time in all treatments and were lower in elevated CO2 plots than in ambient plots, but did not differ between heat treatments. We speculate that these declines indicate a priming effect, with increased C inputs under elevated CO2 fueling a loss of old soil carbon. Model simulations of heated plots agreed with our observations and predicted loss of ~15% of soil organic C after 100 years of heating, but simulations of elevated CO2 failed to predict the observed C losses and instead predicted a ~4% gain in soil organic C under any heating conditions. Despite model uncertainty, our empirical results suggest that combined, elevated CO2 and temperature will lead to long-term declines in the amount of carbon stored in agricultural soils.*

Blanco-Canqui, H., Wienhold, B. J., Jin, V. L., Schmer, M. R., & Kibet, L. C. (2017). Long-term tillage impact on soil hydraulic properties. *Soil and Tillage Research, 170*, 38-42. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014847827&doi=10.1016%2fj.still.2017.03.001&partnerID=40&md5=f6617985c91f1ced725ededee72db882. doi:10.1016/j.still.2017.03.001

Research Tags: Soil, Water, Crops

Abstract: *An improved understanding of the impact of tillage systems on soil hydraulic properties is necessary to conserve and manage soil water under a changing climate. The objective of this study was to specifically measure soil hydraulic properties (total porosity, water infiltration, saturated hydraulic conductivity, and water retention characteristics) in no-till, chisel plow, disk, and moldboard plow systems under rainfed continuous corn (Zea mays L.) after 35 yr on silty clay loam soils in eastern Nebraska. We measured ponded water infiltration (positive soil water pressure) and tension (−1 kPa matric potential) infiltration to exclude macropore (>125 μm diameter) flow. Tillage treatments affected ponded infiltration only. Moldboard plow significantly increased ponded infiltration rate by 21.6 cm h−1 at 5 min and by 8.8 cm h−1 at 60 min compared with no-till. However, when compared with disk and chisel, moldboard plow increased ponded infiltration rates at all measurements times, which lasted 3 h. Regarding cumulative infiltration, moldboard plow increased cumulative infiltration by 26.9 cm to 39.0 cm after 3 h compared with other tillage systems. Similarities in tension infiltration suggest that the higher ponded infiltration for moldboard plow was most likely due to the presence of voids or fractures (>125 μm) created by full inversion tillage. Total porosity, saturated hydraulic conductivity, and water retention among the treatments did not differ. Overall, soil hydraulic properties did not differ among tillage systems except water infiltration in these silty clay loam soils after 35 yr of management.*

Blankinship, J. C., Berhe, A. A., Crow, S. E., Druhan, J. L., Heckman, K. A., Keiluweit, M., . . . Wieder, W. R. (2018). Improving understanding of soil organic matter dynamics by triangulating theories, measurements, and models. *Biogeochemistry, 140*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050994810&doi=10.1007%2fs10533-018-0478-2&partnerID=40&md5=7993d1855d941d2e53877e5ed1265d23. doi:10.1007/s10533-018-0478-2

Research Tags: Soil, Research
Abstract: *Soil organic matter (SOM) turnover increasingly is conceptualized as a tension between accessibility to microorganisms and protection from decomposition via physical and chemical association with minerals in emerging soil biogeochemical theory. Yet, these components are missing from the original mathematical models of belowground carbon dynamics and remain underrepresented in more recent compartmental models that separate SOM into discrete pools with differing turnover times. Thus, a gap currently exists between the emergent understanding of SOM dynamics and our ability to improve terrestrial biogeochemical projections that rely on the existing models. In this opinion paper, we portray the SOM paradigm as a triangle composed of three nodes: conceptual theory, analytical measurement, and numerical models. In successful approaches, we contend that the nodes are connected—models capture the essential features of dominant theories while measurement tools generate data adequate to parameterize and evaluate the models—and balanced—models can inspire new theories via emergent behaviors, pushing empiricists to devise new measurements. Many exciting advances recently pushed the boundaries on one or more nodes. However, newly integrated triangles have yet to coalesce. We conclude that our ability to incorporate mechanisms of microbial decomposition and physicochemical protection into predictions of SOM change is limited by current disconnections and imbalances among theory, measurement, and modeling. Opportunities to reintegrate the three components of the SOM paradigm exist by carefully considering their linkages and feedbacks at specific scales of observation.*

Block, A., Vaughan, M. M., Christensen, S. A., Alborn, H. T., & Tumlinson, J. H. (2017). Elevated carbon dioxide reduces emission of herbivore-induced volatiles in Zea mays. *Plant Cell and Environment, 40*(9), 1725-1734. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021336728&doi=10.1111%2fpce.12976&partnerID=40&md5=4b5c123edb3f01224e49e0705f789b5d. doi:10.1111/pce.12976
Research Tags: Crops, Wildlife
Abstract: *Terpene volatiles produced by sweet corn (Zea mays) upon infestation with pests such as beet armyworm (Spodoptera exigua) function as part of an indirect defence mechanism by attracting parasitoid wasps; yet little is known about the impact of climate change on this form of plant defence. To investigate how a central component of climate change affects indirect defence, we measured herbivore-induced volatile emissions in plants grown under elevated carbon dioxide (CO_2). We found that S. exigua infested or elicitor-treated Z. mays grown at elevated CO_2 had decreased emission of its major sesquiterpene, (E)-β-caryophyllene and two homoterpenes, (3E)-4,8-dimethyl-1,3,7-nonatriene and (3E,7E)-4,8,12-trimethyl-1,3,7,11-tridecatetraene. In contrast, inside the leaves, elicitor-induced (E)-β-caryophyllene hyper-accumulated at elevated CO_2, while levels of homoterpenes were unaffected. Furthermore, gene expression analysis revealed that the induction of terpene synthase genes following treatment was lower in plants grown at elevated CO_2. Our data indicate that elevated CO_2 leads both to a repression of volatile synthesis at the transcriptional level and to limitation of volatile release through effects of CO_2 on stomatal conductance. These findings suggest that elevated CO_2 may alter the ability of Z. mays to utilize volatile terpenes to mediate indirect defenses.*

Blumenthal, D. M., Mueller, K. E., Kray, J. A., LeCain, D. R., Pendall, E., Duke, S., . . . Morgan, J. A. (2018). Warming and Elevated CO <inf>2</inf> Interact to Alter Seasonality and Reduce Variability of Soil Water in a Semiarid Grassland. *Ecosystems, 21*(8), 1533-1544. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043392486&doi=10.1007%2fs10021-018-0237-1&partnerID=40&md5=b834f93533da439e023b28760f40a9a7. doi:10.1007/s10021-018-0237-1
Research Tags: Grassland, Weather, Soil, Water
Abstract: *Global changes that alter soil water availability may have profound effects on semiarid ecosystems. Although both elevated CO_2 (eCO_2) and warming can alter water availability, often in opposite ways, few studies have measured their combined influence on the amount, timing, and temporal variability of soil water. Here, we ask how free air CO_2 enrichment (to 600 ppmv) and infrared warming (+ 1.5 °C day, + 3 °C night) effects on soil water vary within years and across wet-dry periods in North American mixed-grass prairie. We found that eCO_2 and warming interacted to influence soil water and that those interactions varied by season. In the spring, negative effects of warming on soil water largely offset positive effects of eCO_2. As the growing season progressed, however, warming reduced soil water primarily (summer) or only (autumn) in plots treated*

with eCO2. These interactions constrained the combined effect of eCO2 and warming on soil water, which ranged from neutral in spring to positive in autumn. Within seasons, eCO2 increased soil water under drier conditions, and warming decreased soil water under wetter conditions. By increasing soil water under dry conditions, eCO2 also reduced temporal variability in soil water. These temporal patterns explain previously observed plant responses, including reduced leaf area with warming in summer, and delayed senescence with eCO2 plus warming in autumn. They also suggest that eCO2 and warming may favor plant species that grow in autumn, including winter annuals and C3 graminoids, and species able to remain active under the dry conditions moderated by eCO2.

Board, D. I., Chambers, J. C., Miller, R. F., & Weisberg, P. J. (2018). Fire patterns in piñon and juniper land cover types in the semiarid western united states from 1984 through 2013. *USDA Forest Service - General Technical Report RMRS-GTR, 2018*(372). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065720816&partnerID=40&md5=c01c7d87ef24091648bf32f5db9ae4bf.

Research Tags: Weather, Forestry

Abstract: *Increases in area burned and fire size have been reported across a wide range of forest and shrubland types in the Western United States in recent decades, but little is known about potential changes in fire regimes of piñon and juniper land cover types. We evaluated spatio-temporal patterns of fire in piñon and juniper land cover types from the National Gap Analysis Program using Monitoring Trends in Burn Severity (MTBS 2016) data (1984 through 2013) for Northern and Southern Intermountain and Central and Southern Rocky Mountain geographic regions. We examined differences in total area burned, fire rotation, fire size, fire number, and fire season among: (1) the four geographic regions; (2) the EPA level III ecoregions that occur within each geographic region; and (3) the piñon and juniper land cover types (woodlands, savannas, and shrublands) and other land cover types that occur within each geographic region and level III ecoregion. We found that area burned during the 30-year period, number of fires each year, and fire size followed a strong geographic pattern: Northern Intermountain > Southern Intermountain > Southern Rocky Mountain > Central Rocky Mountain. Area burned within piñon and juniper land cover types increased significantly during the 30-year period across the study area overall and for each geographic region, except the Southern Intermountain. Fire rotations were within reported historical ranges for sagebrush ecosystems and decreased over time. Also, fire number or fire size increased for the Southern Rocky Mountain and Southern Intermountain geographic regions. Across the study area, spatio-temporal patterns in fire regimes for piñon and juniper land cover types were similar to those for other land cover types. Careful monitoring of longer term trends in fire activity and the interacting effects of invasive annual grasses, bark beetles, and climate change is needed to access the dynamics of piñon and juniper land cover types and evaluate the efficacy of management treatments in piñon and juniper land cover types.*

Boehm, R., Ver Ploeg, M., Wilde, P. E., & Cash, S. B. (2019). Greenhouse gas emissions, total food spending and diet quality by share of household food spending on red meat: results from a nationally representative sample of US households. *Public Health Nutrition, 22*(10), 1794-1806. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063614654&doi=10.1017%2fS136898001800407X&partnerID=40&md5=e1004710ceb950479db922bc3574fd0f. doi:10.1017/S136898001800407X

Research Tags: Economics, Livestock, Emissions

Abstract: *Objective*
To determine if US household food purchases with lower levels of red meat spending generate lower life-cycle greenhouse gas emissions (GHGE), greater nutritional quality and improved alignment with the Dietary Guidelines for Americans. Affordability of purchasing patterns by red meat spending levels was also assessed.
Design
Household food purchase and acquisition data were linked to an environmentally extended input–output life-cycle assessment model to calculate food GHGE. Households (n 4706) were assigned to quintiles by the share of weekly food spending on red meat. Average weekly kilojoule-adjusted GHGE, total food spending, nutrients purchased and 2010 Healthy Eating Index (HEI-2010) were evaluated using ANOVA and linear regression.
Setting

USA.
Participants
Households participating in the 2012–2013 National Household Food Acquisition and Purchase Survey.
Results
There was substantial variation in the share of the household food budget spent on red meat and total spending on red meat. The association between red meat spending share and total food spending was mixed. Lower red meat spending share was mostly advantageous from a nutritional perspective. Average GHGE were significantly lower and HEI-2010 scores were significantly higher for households spending the least on red meat as a share of total food spending.
Conclusions
Only very low levels of red meat spending as a share of total food spending had advantages for food affordability, lower GHGE, nutrients purchased and diet quality. Further studies assessing changes in GHGE and other environmental burdens, using more sophisticated analytical techniques and accounting for substitution towards non-red meat animal proteins, are needed.

Boehm, R., Wilde, P. E., Ver Ploeg, M., Costello, C., & Cash, S. B. (2018). A Comprehensive Life Cycle Assessment of Greenhouse Gas Emissions from U.S. Household Food Choices. *Food Policy, 79*, 67-76. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047787975&doi=10.1016%2fj.foodpol.2018.05.004&partnerID=40&md5=d65976d371e4c4619a661fc4bc754d91. doi:10.1016/j.foodpol.2018.05.004
Research Tags: Emissions, Economics
Abstract: *Changes in diet have been proposed as one way to reduce carbon emissions from the food system. But evidence on the implications of changing to low carbon food choices for both diet quality and food affordability are limited in the U.S. The objective of this study was to (a) estimate greenhouse gas emissions (GHGEs) from U.S. household food purchases; (b) examine the source of GHGEs across U.S. food production industries and stages of the supply chain; and (c) show the association between GHGEs and spending by food categories and household sociodemographics. GHGEs from food expenditures made by households participating in the National Household Food Acquisition and Purchase Survey were calculated using Economic Input-Output Life Cycle Assessment. Results indicate that food purchases accounted for 16% of U.S. GHGEs in 2013 and average weekly household GHGEs were 71.8 kg carbon dioxide equivalents per standard adult. 68% of average weekly household GHGEs from food spending came from agriculture and food manufacturing stages of the food supply chain. Industries that produce animal proteins accounted for 30% of average weekly household GHGEs, the largest share of any food industry. Households generating the highest levels of GHGEs spent a significantly larger share of their food budget on protein foods compared to households generating lower levels of GHGEs. White households and those with higher education levels generated more GHGEs from food spending compared to non-white and less educated households. Overall these findings inform the ongoing debate about which diets or food spending patterns in the U.S. are best for mitigating GHGEs in the food system and if they are feasible for consumers to purchase.*

Bonnot, T. W., Cox, W. A., Thompson, F. R., & Millspaugh, J. J. (2018). Threat of climate change on a songbird population through its impacts on breeding. *Nature Climate Change, 8*(8), 718-722. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050516012&doi=10.1038%2fs41558-018-0232-8&partnerID=40&md5=71b679dac1f4bbf1337a826848e8d289. doi:10.1038/s41558-018-0232-8
Research Tags: Wildlife
Abstract: *Understanding global change processes that threaten species viability is critical for assessing vulnerability and deciding on appropriate conservation actions1. Here we combine individual-based2 and metapopulation models to estimate the effects of climate change on annual breeding productivity and population viability up to 2100 of a common forest songbird, the Acadian flycatcher (Empidonax virescens), across the Central Hardwoods ecoregion, a 39.5-million-hectare area of temperate and broadleaf forests in the USA. Our approach integrates local-scale, individual breeding productivity, estimated from empirically derived demographic parameters that vary with landscape and climatic factors (such as forest cover, daily temperature)3, into a dynamic-landscape metapopulation model4 that projects growth of the regional population over time. We show that warming temperatures under a worst-case scenario with unabated climate change could reduce breeding productivity to an extent that this currently abundant species will suffer*

population declines substantial enough to pose a significant risk of quasi-extinction from the region in the twenty-first century. However, we also show that this risk is greatly reduced for scenarios where emissions and warming are curtailed. These results highlight the importance of considering both direct and indirect effects of climate change when assessing the vulnerability of species.

Bonnot, T. W., Thompson, F. R., & Millspaugh, J. J. (2017). Dynamic-landscape metapopulation models predict complex response of wildlife populations to climate and landscape change. *Ecosphere, 8*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026895690&doi=10.1002%2fecs2.1890&partnerID=40&md5=070fc7f795d2a6aab4e1e31c7286c0fe. doi:10.1002/ecs2.1890

Research Tags: Wildlife, Research

Abstract: *The increasing need to predict how climate change will impact wildlife species has exposed limitations in how well current approaches model important biological processes at scales at which those processes interact with climate. We used a comprehensive approach that combined recent advances in landscape and population modeling into dynamic-landscape metapopulation models (DLMPs) to predict responses of two declining songbird species in the central hardwoods region of the United States to changes in forest conditions from climate change. We modeled wood thrush (Hylocichla mustelina) and prairie warbler (Setophaga discolor) population dynamics and distribution throughout the central hardwoods based on estimates of habitat and demographics derived from landscapes projected through 2100 under a current climate scenario and two future climate change scenarios. Climate change, natural forest succession, and forest management interacted to change forest structure and composition over time, variably affecting the distribution and amount of habitat of the two birds. The resulting changes in habitat and metapopulation processes produced contrasting predictions for future populations. Wood thrush, a forest generalist, showed little response to climate-driven forest change but declined by >25% due to reduced productivity associated with existing forest fragmentation across much of the region. Prairie warblers initially declined due to loss of habitat resulting from current land management; however, after 2050 cumulative effects of climate change on forest structure created enough habitat in source landscapes to restore population growth. These species-specific responses were the result of interactions among climate, landscape, and population processes. We suggest relationships between climate change, succession, and land management are species specific and important determinants of future wildlife populations and that DLMPs are a comprehensive approach that can capture such processes to generate more realistic predictions of populations under climate change.*

Boote, K. J., Prasad, V., Allen, L. H., Singh, P., & Jones, J. W. (2018). Modeling sensitivity of grain yield to elevated temperature in the DSSAT crop models for peanut, soybean, dry bean, chickpea, sorghum, and millet. *European Journal of Agronomy, 100*, 99-109. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035063034&doi=10.1016%2fj.eja.2017.09.002&partnerID=40&md5=19c2446b55f24647a0f2c1cfe20db1f6. doi:10.1016/j.eja.2017.09.002

Research Tags: Crops, Research, Weather

Abstract: *Crop models are increasingly being used as tools to simulate climate change effects or effects of virtual heat-tolerant cultivars; therefore it is important that upper temperature thresholds for seed-set, seed growth, phenology, and other processes affecting yield be developed and parameterized from elevated temperature experiments whether field or controlled-environment chambers. In this paper, we describe the status of crop models for dry bean (Phaseolus vulgaris L.), peanut (Arachis hypogaea L.), soybean (Glycine max L.), chickpea (Cicer arietinum L.), sorghum (Sorghum bicolor (L.) Moench), and millet (Pennisetum glaucum L. (R.) Br) in the Decision Support System for Agrotechnology Transfer (DSSAT) for response to elevated temperature by comparison to observed data, and we review where changes have been made or where needed changes remain. Temperature functions for phenology and photosynthesis of the CROPGRO-Dry Bean model were modified in 2006 for DSSAT V4.5, based on observed growth and yield of Montcalm cultivar grown in sunlit, controlled-environment chambers. Temperature functions for soybean and peanut models were evaluated against growth and yield data in the same chambers and found to adequately predict growth and yield, thus have not been modified since 1998 release of V3.5. The temperature functions for the chickpea model were substantially modified for many processes, and are updated for V4.6. The millet model was re-coded and modified for its temperature sensitivities, with a new function to allow the 8–10 day period prior to anthesis to affect grain set, as parameterized from field observations. For the sorghum model, the*

temperature effect on grain growth rate was modified to improve yield and grain size response to elevated temperature by comparison to data in controlled-environment chambers. For reliable assessments of climate change impact, it is critically important to gather additional temperature response data and to update parameterization and code of all crop models including DSSAT.

Borchard, N., Schirrmann, M., Cayuela, M. L., Kammann, C., Wrage-Mönnig, N., Estavillo, J. M., . . . Novak, J. (2019). Biochar, soil and land-use interactions that reduce nitrate leaching and N<inf>2</inf>O emissions: A meta-analysis. *Science of the Total Environment, 651*, 2354-2364. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054859188&doi=10.1016%2fj.scitotenv.2018.10.060&partnerID=40&md5=c4e4fb6dee5d59d6fee8e663dd1317cd. doi:10.1016/j.scitotenv.2018.10.060

Research Tags: Soil, Emissions

Abstract: *Biochar can reduce both nitrous oxide (N2O) emissions and nitrate (NO3−) leaching, but refining biochar's use for estimating these types of losses remains elusive. For example, biochar properties such as ash content and labile organic compounds may induce transient effects that alter N-based losses. Thus, the aim of this meta-analysis was to assess interactions between biochar-induced effects on N2O emissions and NO3− retention, regarding the duration of experiments as well as soil and land use properties. Data were compiled from 88 peer-reviewed publications resulting in 608 observations up to May 2016 and corresponding response ratios were used to perform a random effects meta-analysis, testing biochar's impact on cumulative N2O emissions, soil NO3− concentrations and leaching in temperate, semi-arid, sub-tropical, and tropical climate. The overall N2O emissions reduction was 38%, but N2O emission reductions tended to be negligible after one year. Overall, soil NO3− concentrations remained unaffected while NO3− leaching was reduced by 13% with biochar; greater leaching reductions (>26%) occurred over longer experimental times (i.e. >30 days). Biochar had the strongest N2O-emission reducing effect in paddy soils (Anthrosols) and sandy soils (Arenosols). The use of biochar reduced both N2O emissions and NO3− leaching in arable farming and horticulture, but it did not affect these losses in grasslands and perennial crops. In conclusion, the time-dependent impact on N2O emissions and NO3− leaching is a crucial factor that needs to be considered in order to develop and test resilient and sustainable biochar-based N loss mitigation strategies. Our results provide a valuable starting point for future biochar-based N loss mitigation studies.*

Bothwell, H. M., Cushman, S. A., Woolbright, S. A., Hersch-Green, E. I., Evans, L. M., Whitham, T. G., & Allan, G. J. (2017). Conserving threatened riparian ecosystems in the American West: Precipitation gradients and river networks drive genetic connectivity and diversity in a foundation riparian tree (Populus angustifolia). *Molecular Ecology, 26*(19), 5114-5132. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028743689&doi=10.1111%2fmec.14281&partnerID=40&md5=ce81972f60adf4ed1abb4155726cf3f7. doi:10.1111/mec.14281

Research Tags: Water, Forestry

Abstract: *Gene flow is an evolutionary process that supports genetic connectivity and contributes to the capacity of species to adapt to environmental change. Yet, for most species, little is known about the specific environmental factors that influence genetic connectivity, or their effects on genetic diversity and differentiation. We used a landscape genetic approach to understand how geography and climate influence genetic connectivity in a foundation riparian tree (Populus angustifolia), and their relationships with specieswide patterns of genetic diversity and differentiation. Using multivariate restricted optimization in a reciprocal causal modelling framework, we quantified the relative contributions of riparian network connectivity, terrestrial upland resistance and climate gradients on genetic connectivity. We found that (i) all riparian corridors, regardless of river order, equally facilitated connectivity, while terrestrial uplands provided 2.5× more resistance to gene flow than riparian corridors. (ii) Cumulative differences in precipitation seasonality and precipitation of the warmest quarter were the primary climatic factors driving genetic differentiation; furthermore, maximum climate resistance was 45× greater than riparian resistance. (iii) Genetic diversity was positively correlated with connectivity (R2 = 0.3744, p = .0019), illustrating the utility of resistance models for identifying landscape conditions that can support a species' ability to adapt to environmental change. From these results, we present a map highlighting key genetic connectivity corridors across P. angustifolia's range that if disrupted could have long-term ecological and evolutionary consequences. Our*

findings provide recommendations for conservation and restoration management of threatened riparian ecosystems throughout the western USA and the high biodiversity they support.

Bottero, A., D'Amato, A. W., Palik, B. J., Kern, C. C., Bradford, J. B., & Scherer, S. S. (2017). Influence of repeated prescribed fire on tree growth and mortality in pinus resinosa forests, northern minnesota. *Forest Science, 63*(1), 94-100. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032346661&doi=10.5849%2fforsci.16-035&partnerID=40&md5=0e42762414d87b14f0ce8274fafaad22. doi:10.5849/forsci.16-035

Research Tags: Forestry

Abstract: *Prescribed fire is widely used for ecological restoration and fuel reduction in fire-dependent ecosystems, most of which are also prone to drought. Despite the importance of drought in fire-adapted forests, little is known about the cumulative effects of repeated prescribed burning on tree growth and related response to drought. Using dendrochronological data in red pine (Pinus resinosa Ait.)-dominated forests in northern Minnesota, USA, we examined growth responses before and after understory prescribed fires between 1960 and 1970 to assess whether repeated burning influences growth responses of overstory trees and vulnerability of overstory tree growth to drought. We found no difference in tree-level growth vulnerability to drought, expressed as growth resistance, resilience, and recovery, between areas receiving prescribed fire treatments and untreated forests. Annual mortality rates during the period of active burning were also low (less than 2%) in all treatments. These findings indicate that prescribed fire can be effectively integrated into management plans and climate change adaptation strategies for red pine forest ecosystems without significant short- or long-term negative consequences for growth or mortality rates of overstory trees.*

Bottero, A., D'Amato, A. W., Palik, B. J., Bradford, J. B., Fraver, S., Battaglia, M. A., & Asherin, L. A. (2017). Density-dependent vulnerability of forest ecosystems to drought. *Journal of Applied Ecology, 54*(6), 1605-1614. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019404982&doi=10.1111%2f1365-2664.12847&partnerID=40&md5=cd6478f5e49854d0543093f506108035. doi:10.1111/1365-2664.12847

Research Tags: Weather, Forestry

Abstract: *Climate models predict increasing drought intensity and frequency for many regions, which may have negative consequences for tree recruitment, growth and mortality, as well as forest ecosystem services. Furthermore, practical strategies for minimizing vulnerability to drought are limited. Tree population density, a metric of tree abundance in a given area, is a primary driver of competitive intensity among trees, which influences tree growth and mortality. Manipulating tree population density may be a mechanism for moderating drought-induced stress and growth reductions, although the relationship between tree population density and tree drought vulnerability remains poorly quantified, especially across climatic gradients.*
In this study, we examined three long-term forest ecosystem experiments in two widely distributed North American pine species, ponderosa pine Pinus ponderosa (Lawson & C. Lawson) and red pine Pinus resinosa (Aiton), to better elucidate the relationship between tree population density, growth and drought. These experiments span a broad latitude and aridity range and include tree population density treatments that have been purposefully maintained for several decades. We investigated how tree population density influenced resistance (growth during drought) and resilience (growth after drought compared to pre-drought growth) of stand-level growth during and after documented drought events.
Our results show that relative tree population density was negatively related to drought resistance and resilience, indicating that trees growing at lower densities were less vulnerable to drought. This result was apparent in all three forest ecosystems, and was consistent across species, stand age and drought intensity.
Synthesis and applications. Our results highlighted that managing pine forest ecosystems at low tree population density represents a promising adaptive strategy for reducing the adverse impacts of drought on forest growth in coming decades. Nonetheless, the broader applicability of our findings to other types of forest ecosystems merits additional investigation.

Bouchard, J. R., Fernando, D. D., Bailey, S. W., Weber-Townsend, J., & Leopold, D. J. (2017). Contrasting patterns of genetic variation in central and peripheral populations of dryopteris fragrans (Fragrant wood fern) and implications for colonization dynamics and conservation. *International Journal of Plant Sciences, 178*(8),

607-617. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030116287&doi=10.1086%2f693109&partnerID=40&md5=f8c2570216beb00d2bab8528cd31afa5. doi:10.1086/693109
Research Tags: Forestry
Abstract: *Premise of research. Ferns are vital components of temperate and tropical ecosystems, but they have not been examined in the context of a central-peripheral hypothesis. Dryopteris fragrans is an ideal species to examine the genetic variation between central and peripheral populations because of its arctic north to temperate south distribution pattern. In addition to understanding colonization dynamics, our study also addresses the issue regarding the conservation value of peripheral plant populations.*
Methodology. We examined 82 individuals from 22 populations from northern Canada (N-CA) and the northeastern United States (NE-US), which represent central and peripheral populations of D. fragrans, respectively. Two-hundred two loci were resolved using inter–simple sequence repeat markers, allowing analyses of genetic diversity and population structure, insights into gene flow and mating system, and correlations of genetic diversity with geographical distance, population size, and air temperature.
Pivotal results. Dryopteris fragrans exhibits high genetic diversity at the species level, with most of its genetic variation due to differences between populations. At the regional level, however, there is a sharp contrast in the patterns of genetic variation between N-CA and NE-US populations, with the latter exhibiting low genetic diversity, high population differentiation, low gene flow, and a predominantly inbreeding mating system. The NE-US populations also exhibit several unique loci that indicate that they are not merely a reduced representative of the overall genetic diversity of the species.
Conclusions. Dryopteris fragrans in the NE-US are genetically distinct from those in N-CA, and this result may serve as justification for the species' conservation in the NE-US. Our results also indicate that D. fragrans in the NE-US may have originated from the Canadian populations through several instances of single-spore founding events facilitated by long-distance spore dispersal and self-fertilization.

Boussios, D., Preckel, P. V., Yigezu, Y. A., Dixit, P. N., Akroush, S., M'Hamed, H. C., . . . Ayad, J. (2019). Modeling producer responses with dynamic programming: a case for adaptive crop management. *Agricultural Economics (United Kingdom), 50*(1), 101-111. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055682233&doi=10.1111%2fagec.12469&partnerID=40&md5=8af00a38f9f687acba34155e1aed76c0. doi:10.1111/agec.12469
Research Tags: Research, Weather, Crops
Abstract: *Past research found agricultural producers' conditional responses during the growing season are important adaptations to weather and other stochastic events. Failing to recognize these responses overstates the risks confronting producers and understates their ability to respond to adverse circumstances. Dynamic programming (DP) provides a means for determining optimal long-term crop management plans. However, most applications in the literature base their analysis on annual time steps with fixed strategies within the year, effectively ignoring conditional responses during the year. We suggest an alternative approach that captures the strategic responses within a cropping season to random weather variables as they unfold, reflecting farmers' ability to adapt to weather realizations. We illustrate our approach by applying it to a typical cereal farm in Karak, Jordan. The results show that including conditional within-year responses to weather reduces the frequency of fallowing by 23% and increases expected income by 9%.*

Bovey, R. W. (2017). Weed management systems for rangeland. In *Handbook of Weed Management Systems* (pp. 519-552).
Research Tags: Grassland
No Abstract (Book):

Brabec, M. M., Germino, M. J., & Richardson, B. A. (2017). Climate adaption and post-fire restoration of a foundational perennial in cold desert: insights from intraspecific variation in response to weather. *Journal of Applied Ecology, 54*(1), 293-302. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84971231430&doi=10.1111%2f1365-2664.12679&partnerID=40&md5=b0cc6b342802699873b679064d04e7bb. doi:10.1111/1365-2664.12679
Research Tags: Weather, Forestry

Abstract: *The loss of foundational but fire-intolerant perennials such as sagebrush due to increases in fire size and frequency in semi-arid regions has motivated efforts to restore them, often with mixed or even no success. Seeds of sagebrush Artemisia tridentata and related species must be moved considerable distances from seed source to planting sites, but such transfers have not been guided by an understanding of local climate adaptation. Initial seedling establishment and its response to weather are a key demographic bottleneck that likely varies among subspecies and populations of sagebrush.*
We assessed differences in survival, growth and physiological responses of sagebrush seedlings to weather among eleven seed sources that varied in subspecies, cytotype and climates-of-origin over 18 months following outplanting. Diploid or polyploid populations of mountain, Wyoming and basin big sagebrush (A. tridentata ssp. vaseyana, A. tridentata ssp. wyomingensis and A. tridentata ssp. tridentata, respectively) were planted onto five burned sites that normally support A.t. wyomingensis with some A.t. tridentata.
A.t. wyomingensis had the most growth and survival, and tetraploid populations had greater survival and height than diploids. Seasonal timing of mortality varied among the subspecies/cytotypes and was more closely related to minimum temperatures than water deficit.
Temperatures required to induce ice formation were up to 6 °C more negative in 4n-A.t. tridentata and A.t. wyomingensis than in other subspecies/cytotypes, indicating greater freezing avoidance. In contrast, freezing resistance of photosynthesis varied only 1 °C among subspecies/cytotypes, being greatest in A.t. wyomingensis and least in the subspecies normally considered most cold-adapted, A.t. vaseyana. A large spectrum of reliance on freezing avoidance vs. freezing tolerance was observed and corresponded to differences in post-fire survivorship among subspecies/cytotypes. Differences in water deficit responses among subspecies/cytotypes were not as strong and did not relate to survival patterns.
Synthesis and applications. Low-temperature responses are a key axis defining climate adaptation in young sagebrush seedlings and vary more with cytotype than with subspecies, which contrasts with the traditional emphases on (i) water limitations to explain establishment in these deserts, and (ii) subspecies in selecting restoration seedings. These important and novel insights on climate adaptation are critical for seed selection and parameterizing seed transfer zones, and were made possible by incorporating weather data with survival statistics. The survival/weather statistics used here could be applied to any restoration planting or seeding to help elucidate factors contributing to success and enable adaptive management.

Bradford, J. B., & Bell, D. M. (2017). A window of opportunity for climate-change adaptation: easing tree mortality by reducing forest basal area. *Frontiers in Ecology and the Environment, 15*(1), 11-17. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007405645&doi=10.1002%2ffee.1445&partnerID=40&md5=b7361f8ab39f76385685e6259295a4d2. doi:10.1002/fee.1445
Research Tags: Forestry, Weather
Abstract: *Increasing aridity as a result of climate change is expected to exacerbate tree mortality. Reducing forest basal area – the cross-sectional area of tree stems within a given ground area – can decrease tree competition, which may reduce drought-induced tree mortality. However, neither the magnitude of expected mortality increases, nor the potential effectiveness of basal area reduction, has been quantified in dryland forests such as those of the drought-prone Southwest US. We used thousands of repeatedly measured forest plots to show that unusually warm and dry conditions are related to high tree mortality rates and that mortality is positively related to basal area. Those relationships suggest that while increasing high temperature extremes forecasted by climate models may lead to elevated tree mortality during the 21st century, future tree mortality might be partly ameliorated by reducing stand basal area. This adaptive forest management strategy may provide a window of opportunity for forest managers and policy makers to guide forest transitions to species and/or genotypes more suited to future climates.*

Brandt, L. A., Butler, P. R., Handler, S. D., Janowiak, M. K., Shannon, P. D., & Swanston, C. W. (2017). Integrating science and management to assess forest ecosystem vulnerability to climate change. *Journal of Forestry, 115*(3), 212-221. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019410528&doi=10.5849%2fjof.15-147&partnerID=40&md5=7003669f9d8b3691c3e64e13199e7cdd. doi:10.5849/jof.15-147
Research Tags: Forestry, Research
Abstract: *We developed the ecosystem vulnerability assessment approach (EVAA) to help inform potential*

adaptation actions in response to a changing climate. EVAA combines multiple quantitative models and expert elicitation from scientists and land managers. In each of eight assessment areas, a panel of local experts determined potential vulnerability of forest ecosystems to climate change over the next century using EVAA. Vulnerability and uncertainty ratings for forest community types in each assessment area were developed. The vulnerability of individual forest types to climate change varied by region due to regional differences in how climate change is expected to affect system drivers, stressors, and dominant species and the capacity of a forest community to adapt. This assessment process is a straightforward and flexible approach to addressing the key components of vulnerability in a collaborative setting and can easily be applied to a range of forest ecosystems at local to regional scales.
Management and Policy Implications Forest managers can use vulnerability assessments to help understand which species and ecosystems may be at greatest risk in a changing climate. Vulnerability assessments explain what systems are the most (and least) vulnerable, and, more important, why they are vulnerable. We developed the ecosystem vulnerability assessment approach (EVAA) for forest managers and scientists to collaboratively assess forest ecosystem vulnerability. We applied EVAA to eight regions in the Midwest and Northeast totaling 252 million acres. Although we have applied EVAA at the ecoregional scale, it is flexible enough to be used at larger or smaller scales, depending on the needs of managers. Results from assessments using EVAA have been successfully applied to forest management decisions across the Midwest and Northeast by nongovernmental, private, and government forest managers. How this information is applied depends on the specific goals and objectives of different places and ownerships.

Branham, S. E., Stansell, Z. J., Couillard, D. M., & Farnham, M. W. (2017). Quantitative trait loci mapping of heat tolerance in broccoli (Brassica oleracea var. italica) using genotyping-by-sequencing. *Theoretical and Applied Genetics, 130*(3), 529-538. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85000402102&doi=10.1007%2fs00122-016-2832-x&partnerID=40&md5=b4ee37bc6e58cc6b13597d8958bb91b1. doi:10.1007/s00122-016-2832-x
Research Tags: Crops, Weather
Abstract: *Predicted rising global temperatures due to climate change have generated a demand for crops that are resistant to yield and quality losses from heat stress. Broccoli (Brassica oleracea var. italica) is a cool weather crop with high temperatures during production decreasing both head quality and yield. Breeding for heat tolerance in broccoli has potential to both expand viable production areas and extend the growing season but breeding efficiency is constrained by limited genetic information. A doubled haploid (DH) broccoli population segregating for heat tolerance was evaluated for head quality in three summer fields in Charleston, SC, USA. Multiple quantitative trait loci (QTL) mapping of 1,423 single nucleotide polymorphisms developed through genotyping-by-sequencing identified five QTL and one positive epistatic interaction that explained 62.1% of variation in heat tolerance. The QTL identified here can be used to develop markers for marker-assisted selection and to increase our understanding of the molecular mechanisms underlying plant response to heat stress.*

Branson, D. H. (2017). Effects of altered seasonality of precipitation on grass production and grasshopper performance in a northern mixed prairie. *Environmental Entomology, 46*(3), 589-594. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020868618&doi=10.1093%2fee%2fnvx053&partnerID=40&md5=4758edfded6b04b70a0172ee8ec58cf9. doi:10.1093/ee/nvx053
Research Tags: Weather, Wildlife, Grassland
Abstract: *Climatic changes are leading to differing patterns and timing of precipitation in grassland ecosystems, with the seasonal timing of precipitation affecting plant biomass and plant composition. No previous studies have examined how drought seasonality affects grasshopper performance and the impact of herbivory on vegetation. We modified seasonal patterns of precipitation and grasshopper density in a manipulative experiment to examine if seasonality of drought combined with herbivory affected plant biomass, nitrogen content, and grasshopper performance. Grass biomass was affected by both precipitation and grasshopper density treatments, while nitrogen content of grass was higher with early-season drought. Proportional survival was negatively affected by initial density, while survival was higher with early drought than with full-season drought. Drought timing affected the outcome, with early summer drought increasing grass nitrogen content and grasshopper survival, while season-long and late-season drought did not. The*

results support arguments that our knowledge of plant responses to seasonal short-term variation in climate is limited and illustrate the importance of experiments manipulating precipitation phenology. The results confirm that understanding the season of drought is critical for predicting grasshopper population dynamics, as extreme early summer drought may be required to strongly affect Melanoplus sanguinipes (F.) performance.

Brantley, S. L., McDowell, W. H., Dietrich, W. E., White, T. S., Kumar, P., Anderson, S. P., . . . Gaillardet, J. (2017). Designing a network of critical zone observatories to explore the living skin of the terrestrial Earth. *Earth Surface Dynamics, 5*(4), 841-860. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034602972&doi=10.5194%2fesurf-5-841-2017&partnerID=40&md5=4657d18b51f9d5a47d79540709b90d5c. doi:10.5194/esurf-5-841-2017

Research Tags: Research

Abstract: *The critical zone (CZ), the dynamic living skin of the Earth, extends from the top of the vegetative canopy through the soil and down to fresh bedrock and the bottom of the groundwater. All humans live in and depend on the CZ. This zone has three co-evolving surfaces: the top of the vegetative canopy, the ground surface, and a deep subsurface below which Earth's materials are unweathered. The network of nine CZ observatories supported by the US National Science Foundation has made advances in three broad areas of CZ research relating to the co-evolving surfaces. First, monitoring has revealed how natural and anthropogenic inputs at the vegetation canopy and ground surface cause subsurface responses in water, regolith structure, minerals, and biotic activity to considerable depths. This response, in turn, impacts aboveground biota and climate. Second, drilling and geophysical imaging now reveal how the deep subsurface of the CZ varies across landscapes, which in turn influences aboveground ecosystems. Third, several new mechanistic models now provide quantitative predictions of the spatial structure of the subsurface of the CZ.*
Many countries fund critical zone observatories (CZOs) to measure the fluxes of solutes, water, energy, gases, and sediments in the CZ and some relate these observations to the histories of those fluxes recorded in landforms, biota, soils, sediments, and rocks. Each US observatory has succeeded in (i) synthesizing research across disciplines into convergent approaches; (ii) providing long-term measurements to compare across sites; (iii) testing and developing models; (iv) collecting and measuring baseline data for comparison to catastrophic events; (v) stimulating new process-based hypotheses; (vi) catalyzing development of new techniques and instrumentation; (vii) informing the public about the CZ; (viii) mentoring students and teaching about emerging multidisciplinary CZ science; and (ix) discovering new insights about the CZ. Many of these activities can only be accomplished with observatories. Here we review the CZO enterprise in the United States and identify how such observatories could operate in the future as a network designed to generate critical scientific insights. Specifically, we recognize the need for the network to study network-level questions, expand the environments under investigation, accommodate both hypothesis testing and monitoring, and involve more stakeholders. We propose a driving question for future CZ science and a hubs-and-campaigns model to address that question and target the CZ as one unit. Only with such integrative efforts will we learn to steward the life-sustaining critical zone now and into the future.

Brantley, S. T., Vose, J. M., Wear, D. N., & Band, L. (2017). Planning for an uncertain future: Restoration to mitigate water scarcity and sustain carbon sequestration. In *Ecological Restoration and Management of Longleaf Pine Forests* (pp. 291-310).

Research Tags:

No Abstract (Book):

Breed, M. F., Harrison, P. A., Bischoff, A., Durruty, P., Gellie, N. J. C., Gonzales, E. K., . . . Bucharova, A. (2018). Priority actions to improve provenance decision-making. *BioScience, 68*(7), 510-516. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050921707&doi=10.1093%2fbiosci%2fbiy050&partnerID=40&md5=283576fbd587f9fe3944fa4ff3547e08. doi:10.1093/biosci/biy050

Research Tags: Research

Abstract: *Selecting the geographic origin—the provenance—of seed is a key decision in restoration. The last decade has seen a vigorous debate on whether to use local or nonlocal seed. The use of local seed has been the preferred approach because it is expected to maintain local adaptation and avoid deleterious population effects (e.g., maladaptation and outbreeding depression). However, the impacts of habitat fragmentation and climate* *change on plant populations have driven the debate on whether the local-is-best standard needs changing. This debate has largely been theoretical in nature, which hampers provenance decision-making. Here, we detail cross-sector priority actions to improve provenance decision-making, including embedding provenance trials into restoration projects; developing dynamic, evidence-based provenance policies; and establishing stronger research–practitioner collaborations to facilitate the adoption of research outcomes. We discuss how to tackle these priority actions in order to help satisfy the restoration sector's requirement for appropriately provenanced seed.*

Bremer, L. L., Mandle, L., Trauernicht, C., Pascua, P., McMillen, H. L., Burnett, K., . . . Ticktin, T. (2018). Bringing multiple values to the table: Assessing future land-use and climate change in North Kona, Hawai'i. *Ecology and Society*, *23*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044938836&doi=10.5751%2fES-09936-230133&partnerID=40&md5=c974f9dde3331a39409f990f8cbf656f. doi:10.5751/ES-09936-230133

Research Tags: Economics

Abstract: *As ecosystem service assessments increasingly contribute to decisions about managing Earth's lands and waters, there is a growing need to understand the diverse ways that people use and value landscapes. However, these assessments rarely incorporate the value of landscapes to communities with strong cultural and generational ties to place, precluding inclusion of these values—alongside others—into planning processes. We developed a process to evaluate trade-offs and synergies in ecosystem services across land-use scenarios and under climate change in North Kona, Hawai'i, a tropical dry ecosystem where water, fire, biodiversity, and cultural values are all critical considerations for land management decisions. Specifically, we combined participatory deliberative methods, ecosystem service models, vegetation surveys, and document analysis to evaluate how cultural services, regulating services (groundwater recharge, landscape flammability reduction), biodiversity, and revenue: (1) vary across four land-use scenarios (pasture, coffee, agroforestry, and native forest restoration) and (2) are expected to vary with climate change (representative concentration pathway (RCP) 8.5 mid-century scenario). The native forest restoration scenario provided high cultural, biodiversity, and ecosystem service value, whereas coffee's strongest benefit was monetary return. The agroforestry scenario offered the greatest potential in terms of maximizing multiple services. Pasture had relatively low ecological and economic value but, as with native forest and agroforestry, held high value in terms of local knowledge and cultural connection to place. Climate change amplified existing vulnerabilities for groundwater recharge and landscape flammability, but resulted in few shifts in the ranking of land-use scenarios. Our results demonstrate that cultural services need not be sacrificed at the expense of other management objectives if they are deliberately included in land-use planning from the start. Meaningfully representing what matters most to diverse groups of people, now and under a changing climate, requires greater integration of participatory methods into ecosystem service analyses.*

Brennan, E. B. (2017). Can we grow organic or conventional vegetables sustainably without cover crops? *HortTechnology*, *27*(2), 151-161. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014116771&doi=10.21273%2fHORTTECH03358-16&partnerID=40&md5=21e89dde8d71983e7a80da4eff977e30. doi:10.21273/HORTTECH03358-16

Research Tags: Crops, Soil

Abstract: *Vegetable and fruit consumption patterns in the United States indicate that most people need to eat far more fruits and vegetables to meet the current nutritional guidelines for a healthy diet. Following these guidelines would require more than doubling the harvested acreage for fruits and vegetables and could have serious environmental implications if unsustainable production practices were used. This situation will likely intensify with population growth and climate change. To answer the title question (can we grow organic or conventional vegetables sustainably without cover crops?), this paper focuses on the high-input, tillage-intensive vegetable production practices in the Salinas Valley of California, a region often called "the Salad Bowl of America." This region has a serious problem of nitrate contamination of the groundwater that occurred as the agricultural systems here shifted from agronomic to high-value horticultural crops [primarily vegetables and strawberries (Fragaria ×ananassa)] over the past several decades. This raises questions about the sustainability of past and current vegetable production practices and indicates the need for a radical paradigm shift in nutrient management. Cover cropping is well recognized as a "best management practice" in* *vegetable production systems, but is still relatively uncommon in many of the most important vegetable production regions in the United States, including the Salinas Valley. It is argued that cover crops are an essential part of sustainable vegetable production because they provide a complex suite of unique ecosystem services during fallow periods that complement best management practices during cash crop periods. The reasons that cover crops are uncommon here are discussed and three alternative cover cropping strategies are described to potentially increase adoption of cover cropping in vegetable rotations. These strategies are focused on reducing residue management challenges and include a novel strategy to extract the juice from nitrogen-rich, immature cover crops for use as a liquid organic fertilizer in subsequent cash crops.*

Briones-Herrera, C. I., Vega-Nieva, D. J., Monjarás-Vega, N. A., Flores-Medina, F., Lopez-Serrano, P. M., Corral-Rivas, J. J., . . . Jolly, W. M. (2019). Modeling and mapping forest fire occurrence from aboveground carbon density in Mexico. *Forests, 10*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066851953&doi=10.3390%2ff10050402&partnerID=40&md5=e7a72392848590ba790be224ff9b7184. doi:10.3390/f10050402

Research Tags: Forestry, Weather

Abstract: *Understanding the spatial patterns of fire occurrence is key for improved forest fires management, particularly under global change scenarios. Very few studies have attempted to relate satellite-based aboveground biomass maps of moderate spatial resolution to spatial fire occurrence under a variety of climatic and vegetation conditions. This study focuses on modeling and mapping fire occurrence based on fire suppression data from 2005–2015 from aboveground biomass—expressed as aboveground carbon density (AGCD)—for the main ecoregions in Mexico. Our results showed that at each ecoregion, unimodal or humped relationships were found between AGCD and fire occurrence, which might be explained by varying constraints of fuel and climate limitation to fire activity. Weibull equations successfully fitted the fire occurrence distributions from AGCD, with the lowest fit for the desert shrub-dominated north region that had the lowest number of observed fires. The models for predicting fire occurrence from AGCD were significantly different by region, with the exception of the temperate forest in the northwest and northeast regions that could be modeled with a single Weibull model. Our results suggest that AGCD could be used to estimate spatial fire occurrence maps; those estimates could be integrated into operational GIS tools for assistance in fire danger mapping and fire and fuel management decision-making. Further investigation of anthropogenic drivers of fire occurrence and fuel characteristics should be considered for improving the operational spatial planning of fire management. The modeling strategy presented here could be replicated in other countries or regions, based on remote-sensed measurements of aboveground biomass and fire activity or fire suppression records.*

Bronson, K. F., Hunsaker, D. J., Williams, C. F., Thorp, K. R., Rockholt, S. M., Del Grosso, S. J., . . . Barnes, E. M. (2018). Nitrogen management affects nitrous oxide emissions under varying cotton irrigation systems in the Desert Southwest, USA. *Journal of Environmental Quality, 47*(1), 70-78. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040453789&doi=10.2134%2fjeq2017.10.0389&partnerID=40&md5=ad913374ae311339204b85699e4504b9. doi:10.2134/jeq2017.10.0389

Research Tags: Emissions, Crops, Water

Abstract: *Irrigation of food and fiber crops worldwide continues to increase. Nitrogen (N) from fertilizers is a major source of the potent greenhouse gas nitrous oxide (N2O) in irrigated cropping systems. Nitrous oxide emissions data are scarce for crops in the arid western United States. The objective of these studies was to assess the effect of N fertilizer management on N2O emissions from furrow-irrigated, overhead sprinkler-irrigated, and subsurface drip-irrigated cotton (Gossypium hirsutum L.) in Maricopa, AZ, on Trix and Casa Grande sandy clay loam soils. Soil test- and canopy-reflectance-based N fertilizer management were compared. In the furrow- and overhead sprinkler-irrigated fields, we also tested the enhanced efficiency N fertilizer additive Agrotain Plus as a N2O mitigation tool. Nitrogen fertilizer rates as liquid urea ammonium nitrate ranged from 0 to 233 kg N ha−1. Two applications of N fertilizer were made with furrow irrigation, three applications under overhead sprinkler irrigation, and 24 fertigations with subsurface drip irrigation. Emissions were measured weekly from May through August with 1-L vented chambers. N2O emissions were not agronomically significant, but increased as much as 16-fold following N fertilizer addition compared to zero-N controls. Emission factors ranged from 0.10 to 0.54% of added N fertilizer emitted as N2O-N with furrow irrigation, 0.15 to 1.1% with overhead sprinkler irrigation, and <0.1% with subsurface drip irrigation. The*

reduction of N2O emissions due to addition of Agrotain Plus to urea ammonium nitrate was inconsistent. This study provides unique data on N2O emissions in arid-land irrigated cotton and illustrates the advantage of subsurface drip irrigation as a low N2O source system.

Brooks, B. G. J., Lee, D. C., Pomara, L. Y., Hargrove, W. W., & Desai, A. R. (2017). *Quantifying Seasonal Patterns in Disparate Environmental Variables Using the PolarMetrics R Package.* Paper presented at the IEEE International Conference on Data Mining Workshops, ICDMW.

Research Tags: Research

Abstract: *Certain environmental processes, while influential, are inherently difficult to quantify and detect using traditional time series analyses, particularly among variables with different seasonal progressions. Disturbances that only manifest in part of a season (e.g., spring defoliation) or subtle climate shifts can pose detection challenges when they occur in the presence of other variability. Increasing sampling rates or even adding new sensors may not reveal the anticipated patterns. Eddy covariance tower data are a useful example for which various environmental drivers influence the overall signal, contributing noise and seemingly discordant variation. While eddy flux data are a rich representation of information, distinguishing expected seasonal responses within a signal can be challenging, especially where drivers may have either fast or lagged responses. A conventional solution might be to analyze and effectively smooth the data over daily to monthly intervals. However, such smoothed data will not exhibit the same variance, and subsequent regressions may not isolate relationships and anomalies to specific seasons. This paper introduces and demonstrates the use of a newly developed R software package, PolarMetrics, which is used to analyze 20 years of data from one AmeriFlux tower using a polar (circular) approach that reduces data volume to a smaller set of derived seasonal timing and magnitude metrics. Polar metrics quantify the annual cycle of input variables, and permit direct comparison of the strength and timing of seasonality. While performing the analysis over all years produces a synoptic result, analyzing year-by-year characterizes interannual variability.*

Broughton, K. J., Bange, M. P., Duursma, R. A., Payton, P., Smith, R. A., Tan, D. K. Y., & Tissue, D. T. (2017). The effect of elevated atmospheric [CO<inf>2</inf>] and increased temperatures on an older and modern cotton cultivar. *Functional Plant Biology, 44*(12), 1207-1218. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034059783&doi=10.1071%2fFP17165&partnerID=40&md5=8753416b36165159ddd3b5c409f57bfd. doi:10.1071/FP17165

Research Tags: Crops, Weather

Abstract: *Changes in atmospheric [CO2], temperature and precipitation under projected climate change scenarios may have significant impacts on the physiology and yield of cotton. Understanding the implications of integrated environmental impacts on cotton is critical for developing cotton systems that are resilient to stresses induced by climate change. The objective of this study was to quantify the physiological and growth capacity of two cotton cultivars under current and future climate regimes. This experiment compared the early-season growth and physiological response of an older (DP16, released in the 1970s) and a modern (Sicot 71BRF, released in 2008) cotton cultivar grown in ambient and elevated atmospheric [CO2] (CA, 400 μL L−1 and CE, 640 μL L−1 respectively) and two temperature (TA, 28/17°C and TE, 32/21°C, day/night, respectively) treatments under well-watered conditions. CE increased biomass and photosynthetic rates compared with CA, and TE increased plant biomass. Although limited by the comparison of one older and one modern cultivar, our results suggest that substantial potential may exist to increase breeding selection of cotton cultivars that are responsive to both TE and CE.*

Broughton, K. J., Smith, R. A., Duursma, R. A., Tan, D. K. Y., Payton, P., Bange, M. P., & Tissue, D. T. (2017). Warming alters the positive impact of elevated CO<inf>2</inf> concentration on cotton growth and physiology during soil water deficit. *Functional Plant Biology, 44*(2), 267-278. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009228894&doi=10.1071%2fFP16189&partnerID=40&md5=09a442f32ad255e69b2fbdcc0e085536. doi:10.1071/FP16189

Research Tags: Crops, Weather

Abstract: *Alterations in climate factors such as rising CO2 concentration ([CO2]), warming and reduced precipitation may have significant impacts on plant physiology and growth. This research investigated the interactive effects of elevated [CO2], warming and soil water deficit on biomass production, leaf-level*

physiological responses and whole-plant water use efficiency (WUEP) in cotton (Gossypium hirsutum L.). Cotton was grown in the glasshouse under two [CO2] treatments (CA, 400 µL L−1; CE, 640 µL L−1) and two temperature treatments (TA, 28°C : 17°C day : night; TE, 32°C : 21°C day : night). Plants were subjected to two progressive water deficit cycles, with a 5-day recovery period between the water deficit periods. CE increased vegetative biomass and photosynthetic rates, and decreased stomatal conductance in TA; however, these responses to CE were not evident under TE. CE increased whole-plant water loss under TA, but increased WUEp, whereas increased whole-plant water loss in TE decreased WUEp regardless of atmospheric [CO2]. CE may provide some positive growth and physiological benefits to cotton at TA if sufficient water is available but CE will not mitigate the negative effects of rising temperature on cotton growth and physiology in future environments.

Brown, J., Alvarez, P., Byrd, K., Deswood, H., Elias, E., & Spiegal, S. (2017). Coping With Historic Drought in California Rangelands: Developing a More Effective Institutional Response. *Rangelands, 39*(2), 73-78. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013856662&doi=10.1016%2fj.rala.2017.01.002&partnerID=40&md5=3b826c3bfb5065e614eca29a544f972f. doi:10.1016/j.rala.2017.01.002

Research Tags: Weather, Grassland

Abstract: *Drought response is widely varied depending on both the characteristics of the drought and the ability of individual ranchers to respond.*

Assistance from institutions during drought has not typically considered preemptive, during, and post-drought response as a strategic approach, which recognizes biophysical, sociological, and economic complexities of drought.

A USDA Southwest Climate Hub-sponsored workshop brought together a range of representatives from public and private institutions with drought response responsibilities to examine how those institutions could better support drought decision-making.

Institutions can greatly improve their support for individual land managers by doing more systematic collecting and organizing of drought-related information as a basis for programs, and by collaborating to enhance both institutional and individual learning.

Brown, P. M., Gannon, B., Battaglia, M. A., Fornwalt, P. J., Huckaby, L. S., Cheng, A. S., & Baggett, L. S. (2019). Identifying old trees to inform ecological restoration in montane forests of the central rocky mountains, USA. *Tree-Ring Research, 75*(1), 34-48. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062414734&doi=10.3959%2f1536-1098-75.1.34&partnerID=40&md5=d975983c979b8ef5372398c995a32cc1. doi:10.3959/1536-1098-75.1.34

Research Tags: Forestry

Abstract: *Old trees (defined here as ≥150 years old) can be rare in many forests because of past timber harvest, uncharacteristically severe wildfires, and – increasingly – climate change. Old trees provide unique structural, ecological, scientific, and aesthetic values missing in forests containing only younger trees. Here we compile crossdated ages from over 10,000 living and dead trees sampled in montane forests of the central Rocky Mountains in Colorado and southern Wyoming, USA, to examine changes in age structure of the oldest trees since Euro-American settlement and to provide guidelines to aid in identification of old trees for retention during ecological restoration treatments. Eroded stumps (containing only heartwood) were found in over 93% of 179 randomly sampled plots. Number of stumps found in each plot was proportional to reconstructed historical (1860 C.E.) stand basal area. The regional median date of maximum plot tree recruitment was over 150 years older when including stumps versus only living trees, suggesting that if all those harvested trees had survived to the present, the ages of oldest trees would be substantially greater than it is today. However, the regional median age of oldest trees in 1860 before harvesting was not different from the median age of oldest living trees in the current forest (246 vs. 248 years), which alternatively suggests that the regional population of oldest trees has recovered to near historical levels in the time since early Euro-American harvests. Each living tree at the time of sampling was assigned to one of three potential age classes based on a subjective assessment of tree morphology: old (likely ≥150 years old), young (likely <150 years old), or transitional (containing a mixture of young and old tree characteristics). Trees assigned to the old and young morphology categories were classified correctly 88% to 96% of the time depending on species as confirmed by their crossdated ages. Regression tree analysis revealed that tree diameter at breast height was not as reliable a predictor of tree age as were morphological characteristics. A measure of site productivity was a significant* *variable to use to separate transitional morphology trees into old and young age classes, but classification accuracy was not high because of large variability in ages of these trees. Our results suggest that residual live old trees in the current forest, although perhaps not rare compared to historical age distributions, should be retained during restoration treatments, and that using simple morphological and environmental criteria to identify old trees is more reliable than tree size alone.*

Brown, S., & Lugo, A. E. (2017). Trailblazing the carbon cycle of tropical forests from puerto rico. *Forests, 8*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017356725&doi=10.3390%2ff8040101&partnerID=40&md5=833aa363834ffea1cab2fd6f44663443. doi:10.3390/f8040101
Research Tags: Forestry, Research
Abstract: *We review the literature that led to clarifying the role of tropical forests in the global carbon cycle from a time when they were considered sources of atmospheric carbon to the time when they were found to be atmospheric carbon sinks. This literature originates from work conducted by US Forest Service scientists in Puerto Rico and their collaborators. It involves the classification of forests by life zones, estimation of carbon density by forest type, assessing carbon storage changes with ecological succession and land use/land cover type, describing the details of the carbon cycle of forests at stand and landscape levels, assessing global land cover by forest type and the complexity of land use change in tropical regions, and assessing the ecological fluxes and storages that contribute to net carbon accumulation in tropical forests. We also review recent work that couples field inventory data, remote sensing technology such as LIDAR, and GIS analysis in order to more accurately determine the role of tropical forests in the global carbon cycle and point out new avenues of carbon research that address the responses of tropical forests to environmental change.*

Brown, T. C., & Kroll, S. (2017). Avoiding an uncertain catastrophe: climate change mitigation under risk and wealth heterogeneity. *Climatic Change, 141*(2), 155-166. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008217230&doi=10.1007%2fs10584-016-1889-5&partnerID=40&md5=a4c346aaa02356e8835f4ec7bdf2fdf5. doi:10.1007/s10584-016-1889-5
Research Tags: Economics
Abstract: *For environmental problems such as climate change, uncertainty about future conditions makes it difficult to know what the goal of mitigation efforts should be, and inequality among the affected parties makes it hard for them to know how much they each should do toward reaching the goal. We examine the effects of scientific uncertainty and wealth inequality in experiments where subjects decide how much to contribute toward reducing a common threat. We also explore how the framing of uncertainty affects collective action. Our results suggest that uncertainty lowers contributions, but contributions remain surprisingly high even in treatments with a variable loss probability, where such behavior is individually suboptimal (and where the underlying game is a prisoner's dilemma). Further, we find that the characterization of uncertainty is crucial and that inequality need not lower contributions at all.*

Brown, T. C., Mahat, V., & Ramirez, J. A. (2019). Adaptation to Future Water Shortages in the United States Caused by Population Growth and Climate Change. *Earth's Future, 7*(3), 219-234. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062344910&doi=10.1029%2f2018EF001091&partnerID=40&md5=3432494d30a1a381de951b20ba85f7d6. doi:10.1029/2018EF001091
Research Tags: Water, Economics
Abstract: *Population growth and climate change will combine to pose substantial challenges for water management in the United States. Projections of water supply and demand over the 21st century show that in the absence of further adaptation efforts, serious water shortages are likely in some regions. Continued improvements in water use efficiency are likely but will be insufficient to avoid future shortages. Some adaptation measures that have been effective in the past, most importantly large additions to reservoir storage, have little promise. Other major adaptations commonly used in the past, especially instream flow removals and groundwater mining, can substantially lower shortages but have serious external costs. If those costs are to be avoided, transfers from irrigated agriculture probably will be needed and could be substantial.*

Brown, T. T., Lee, C. M., Kruger, C. E., Reganold, J. P., & Huggins, D. R. (2017). Comparison of greenhouse gas offset

quantification protocols for nitrogen management in dryland wheat cropping systems of the Pacific Northwest. *Frontiers in Environmental Science, 5*(NOV). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034842695&doi=10.3389%2ffenvs.2017.00072&partnerID=40&md5=9d51e224aed5eeec527ad6bdfa4d0979. doi:10.3389/fenvs.2017.00072

Research Tags: Crops, Economics, Emissions

Abstract: *In the carbon market, greenhouse gas (GHG) offset protocols need to ensure that emission reductions are of high quality, quantifiable, and real. Lack of consistency across protocols for quantifying emission reductions compromise the credibility of offsets generated. Thus, protocol quantification methodologies need to be periodically reviewed to ensure emission offsets are credited accurately and updated to support practical climate policy solutions. Current GHG emission offset credits generated by agricultural nitrogen (N) management activities are based on reducing the annual N fertilizer application rate for a given crop without reducing yield. We performed a "road test" of agricultural N management protocols to evaluate differences among protocol components and quantify nitrous oxide (N2O) emission reductions under sample projects relevant to N management in dryland, wheat-based cropping systems of the inland Pacific Northwest (iPNW). We evaluated five agricultural N management offset protocols applicable to North America: two methodologies of American Carbon Registry (ACR1 and ACR2), Verified Carbon Standard (VCS), Climate Action Reserve (CAR), and Alberta Offset Credit System (Alberta). We found that only two protocols, ACR2 and VCS, were suitable for this study, in which four sample projects were developed representing feasible N fertilizer rate reduction activities. The ACR2 and VCS protocols had identical baseline and project emission quantification methodologies resulting in identical emission reduction values. Reducing N fertilizer application rate by switching to variable rate N (sample projects 1–3) or split N application (sample project 4) management resulted in a N2O emission reduction ranging from 0.07 to 0.16, and 0.26 Mg CO2e ha−1, respectively. Across the range of C prices considered ($5, $10, and $50 per metric ton of CO2 equivalent), we concluded that the N2O emission offset payment alone ($0.35–$13.0 ha−1) was unlikely to encourage a change in fertilizer N management; however, the fertilizer cost savings from adopting variable or split N management would incentivize adopting these practices. Therefore, the monetary incentive of adopting agricultural N management BMPs for reducing N2O emission should be tied to other co-benefits and existing conservation programs to encourage N rate reductions that do not limit yield, crop quality, or economic stability.*

Browning, D. M., Crimmins, T. M., James, D. K., Spiegal, S., Levi, M. R., Anderson, J. P., & Peters, D. P. C. (2018). Synchronous species responses reveal phenological guilds: implications for management. *Ecosphere, 9*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054881303&doi=10.1002%2fecs2.2395&partnerID=40&md5=909b5c76db2ee0c817b2293286a4b839. doi:10.1002/ecs2.2395

Research Tags: Grassland, Research

Abstract*: Phenological studies are critical for understanding the ability of terrestrial ecosystems to respond to changes in climate. Monitoring seasonal transitions at the species or community level across large areas is challenging and expensive. One approach for lowering costs is to identify phenological guilds—groups of species that exhibit similar timing of seasonal transitions—and limit monitoring to a smaller number of species within a guild. In this study, we evaluated 23 consecutive years of monthly observations of individual species at 15 long-term study sites at the Jornada Basin USDA-Long-Term Ecological Research site to identify patterns in the onset of three phenophases—leaf-out, flower, and fruit—of 16 widely occurring species in the arid southwestern United States and to investigate the existence of phenological guilds. We conducted univariate analyses of distributions in the timing of leaf, flower, and fruit production across time and space and multivariate cluster analysis of the time series to identify coherent groups of species–site instances that exhibit coherence in timing of phenophase onsets (i.e., guilds). The six species of C3 shrubs demonstrated greater consistency in timing of all phenophases relative to C4 grasses. Further, we found that in all species, leaf-out occurred prior to the onset of the summer monsoon rains. Cluster analysis revealed six groups of species–site observations demonstrating high within-year concordance in timing of leaf-out and first fruit across variable site conditions and rainfall years. The six groups for timing of first fruit differed from those for first leaf in that they exhibited greater multi-species membership and within-year variability in timing. We propose that use of phenological guilds can improve the efficiency of ecosystem monitoring, predictive models of ecosystem cues driving phenological events, and land management outcomes.*

Browning, D. M., Maynard, J. J., Karl, J. W., & Peters, D. C. (2017). Breaks in MODIS time series portend vegetation change: Verification using long-term data in an arid grassland ecosystem: Verification. *Ecological Applications, 27*(5), 1677-1693. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019623969&doi=10.1002%2feap.1561&partnerID=40&md5=276ed8f983f7cbb13026a6514f9d9ff0. doi:10.1002/eap.1561

Research Tags: Grassland, Weather

Abstract: *Frequency and severity of extreme climatic events are forecast to increase in the 21st century. Predicting how managed ecosystems may respond to climatic extremes is intensified by uncertainty associated with knowing when, where, and how long effects of extreme events will be manifest in an ecosystem. In water-limited ecosystems with high inter-annual variability in rainfall, it is important to be able to distinguish responses that result from seasonal fluctuations in rainfall from long-term directional increases or decreases in precipitation. A tool that successfully distinguishes seasonal from directional biomass responses would allow land managers to make informed decisions about prioritizing mitigation strategies, allocating human resource monitoring efforts, and mobilizing resources to withstand extreme climatic events. We leveraged long-term observations (2000–2013) of quadrat-level plant biomass at multiple locations across a semiarid landscape in southern New Mexico to verify the use of Normalized Difference Vegetation Index (NDVI) time series derived from 250-m Moderate Resolution Imaging Spectroradiometer (MODIS) data as a proxy for changes in aboveground productivity. This period encompassed years of sustained drought (2000–2003) and record-breaking high rainfall (2006 and 2008) followed by subsequent drought years (2011 through 2013) that resulted in a restructuring of plant community composition in some locations. Our objective was to decompose vegetation patterns derived from MODIS NDVI over this period into contributions from (1) the long-term trend, (2) seasonal cycle, and (3) unexplained variance using the Breaks for Additive Season and Trend (BFAST) model. BFAST breakpoints in NDVI trend and seasonal components were verified with field-estimated biomass at 15 sites that differed in species richness, vegetation cover, and soil properties. We found that 34 of 45 breaks in NDVI trend reflected large changes in mean biomass and 16 of 19 seasonal breaks accompanied changes in the contribution to biomass by perennial and/or annual grasses. The BFAST method using satellite imagery proved useful for detecting previously reported ground-based changes in vegetation in this arid ecosystem. We demonstrate that time series analysis of NDVI data holds potential for monitoring landscape condition in arid ecosystems at the large spatial scales needed to differentiate responses to a changing climate from responses to seasonal variability in rainfall.*

Bugmann, H., Seidl, R., Hartig, F., Bohn, F., Brůna, J., Cailleret, M., . . . Reyer, C. P. O. (2019). Tree mortality submodels drive simulated long-term forest dynamics: assessing 15 models from the stand to global scale. *Ecosphere, 10*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062691972&doi=10.1002%2fecs2.2616&partnerID=40&md5=6796b3442f0fd4c96b21cea4048a8b15. doi:10.1002/ecs2.2616

Research Tags: Forestry, Research

Abstract: *Models are pivotal for assessing future forest dynamics under the impacts of changing climate and management practices, incorporating representations of tree growth, mortality, and regeneration. Quantitative studies on the importance of mortality submodels are scarce. We evaluated 15 dynamic vegetation models (DVMs) regarding their sensitivity to different formulations of tree mortality under different degrees of climate change. The set of models comprised eight DVMs at the stand scale, three at the landscape scale, and four typically applied at the continental to global scale. Some incorporate empirically derived mortality models, and others are based on experimental data, whereas still others are based on theoretical reasoning. Each DVM was run with at least two alternative mortality submodels. Model behavior was evaluated against empirical time series data, and then, the models were subjected to different scenarios of climate change. Most DVMs matched empirical data quite well, irrespective of the mortality submodel that was used. However, mortality submodels that performed in a very similar manner against past data often led to sharply different trajectories of forest dynamics under future climate change. Most DVMs featured high sensitivity to the mortality submodel, with deviations of basal area and stem numbers on the order of 10–40% per century under current climate and 20–170% under climate change. The sensitivity of a given DVM to scenarios of climate change, however, was typically lower by a factor of two to three. We conclude that (1) mortality is one of the most uncertain processes* *when it comes to assessing forest response to climate change, and (2) more data and a better process understanding of tree mortality are needed to improve the robustness of simulated future forest dynamics. Our study highlights that comparing several alternative mortality formulations in DVMs provides valuable insights into the effects of process uncertainties on simulated future forest dynamics.*

Bulla, M., Reneerkens, J., Weiser, E. L., Sokolov, A., Taylor, A. R., Sittler, B., . . . Kempenaers, B. (2019). Comment on "Global pattern of nest predation is disrupted by climate change in shorebirds". *Science*, *364*(6445). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067619129&doi=10.1126%2fscience.aaw8529&partnerID=40&md5=57bf97851fccc3f6e52a2551416664db. doi:10.1126/science.aaw8529

Research Tags: Wildlife

Abstract: *Kubelka et al. (Reports, 9 November 2018, p. 680) claim that climate change has disrupted patterns of nest predation in shorebirds. They report that predation rates have increased since the 1950s, especially in the Arctic. We describe methodological problems with their analyses and argue that there is no solid statistical support for their claims.*

Buma, B., Batllori, E., Bisbing, S., Holz, A., Saunders, S. C., Bidlack, A. L., . . . Zaret, K. (2019). Emergent freeze and fire disturbance dynamics in temperate rainforests. *Austral Ecology*, *44*(5), 812-826. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063642556&doi=10.1111%2faec.12751&partnerID=40&md5=c17db013210a139ce2afaef3ddea08bb. doi:10.1111/aec.12751

Research Tags: Forestry, Weather

Abstract: *The coastal temperate rainforests of South and North America are part of the most biomass dense forest biome on the planet. They are also subject to rapid climatic shifts and, subsequently, new disturbance processes – snow loss-driven mortality and the emergence of fire in historically non-fire-exposed areas. Here, we compare and contrast Southern and Northern Hemisphere coastal temperate rainforests of the Americas, two of the largest examples of the biome, via synthesis of current literature, future climate expectations and new downscaling of a global fire model. In terms of snow loss, a rapid decline in winter snow is leading to mass mortality of certain conifer species in the Northern Hemisphere rainforests. High-elevation Southern Hemisphere forests, which are beginning to see similar declines in snow, may be vulnerable in the future, especially bogs and high-water content soils. Southern Hemisphere forests are seeing the invasion of fire as an ecological force at mid-to-high latitudes, a shift not yet observed in the north but which may become more prominent with ongoing climate change. We suggest that research should focus on the flammability of seral vegetation and bogs under future climate scenarios in both regions. By comparing these two drivers of change across similar gradients in the Northern and Southern Hemispheres, this work points to the potential for emerging change in unexpected places in both regions. There is a clear benefit to conceptualising the coastal temperate rainforests of the Americas as two examples of the biome which can inform the other, as change is proceeding in similar directions but at different rates in each region.*

Buma, B., Hennon, P. E., Harrington, C. A., Popkin, J. R., Krapek, J., Lamb, M. S., . . . Zeglen, S. (2017). Emerging climate-driven disturbance processes: widespread mortality associated with snow-to-rain transitions across 10° of latitude and half the range of a climate-threatened conifer. *Global Change Biology*, *23*(7), 2903-2914. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85005870364&doi=10.1111%2fgcb.13555&partnerID=40&md5=d6b69281e97bdee78301c9c40eab84bc. doi:10.1111/gcb.13555

Research Tags: Forestry, Weather

Abstract: *Climate change is causing rapid changes to forest disturbance regimes worldwide. While the consequences of climate change for existing disturbance processes, like fires, are relatively well studied, emerging drivers of disturbance such as snow loss and subsequent mortality are much less documented. As the climate warms, a transition from winter snow to rain in high latitudes will cause significant changes in environmental conditions such as soil temperatures, historically buffered by snow cover. The Pacific coast of North America is an excellent test case, as mean winter temperatures are currently at the snow–rain threshold and have been warming for approximately 100 years post-Little Ice Age. Increased mortality in a widespread tree species in the region has been linked to warmer winters and snow loss. Here, we present the first* *high-resolution range map of this climate-sensitive species, Callitropsis nootkatensis (yellow-cedar), and document the magnitude and location of observed mortality across Canada and the United States. Snow cover loss related mortality spans approximately 10° latitude (half the native range of the species) and 7% of the overall species range and appears linked to this snow–rain transition across its range. Mortality is commonly >70% of basal area in affected areas, and more common where mean winter temperatures is at or above the snow–rain threshold (>0 °C mean winter temperature). Approximately 50% of areas with a currently suitable climate for the species (< −2 °C) are expected to warm beyond that threshold by the late 21st century. Regardless of climate change scenario, little of the range which is expected to remain suitable in the future (e.g., a climatic refugia) is in currently protected landscapes (< 1–9%). These results are the first documentation of this type of emerging climate disturbance and highlight the difficulties of anticipating novel disturbance processes when planning for conservation and management.*

Bunce, J. A. (2017). Variation in yield responses to elevated CO<inf>2</inf> and a brief high temperature treatment in quinoa. *Plants, 6*(3), 442-453. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022001089&doi=10.3390%2fplants6030026&partnerID=40&md5=668b0c15198fdc9b84698cb1ea767f51. doi:10.3390/plants6030026
Research Tags: Crops
Abstract: *Intraspecific variation in crop responses to global climate change conditions would provide opportunities to adapt crops to future climates. These experiments explored intraspecific variation in response to elevated CO2 and to high temperature during anthesis in Chenopodium quinoa Wild. Three cultivars of quinoa were grown to maturity at 400 ("ambient") and 600 ("elevated") μmol·mol−1 CO2 concentrations at 20/14 °C day/night ("control") temperatures, with or without exposure to day/night temperatures of 35/29 °C ("high" temperatures) for seven days during anthesis. At control temperatures, the elevated CO2 concentration increased the total aboveground dry mass at maturity similarly in all cultivars, but by only about 10%. A large down-regulation of photosynthesis at elevated CO2 occurred during grain filling. In contrast to shoot mass, the increase in seed dry mass at elevated CO2 ranged from 12% to 44% among cultivars at the control temperature. At ambient CO2, the week-long high temperature treatment greatly decreased (0.30 × control) or increased (1.70 × control) seed yield, depending on the cultivar. At elevated CO2, the high temperature treatment increased seed yield moderately in all cultivars. These quinoa cultivars had a wide range of responses to both elevated CO2 and to high temperatures during anthesis, and much more variation in harvest index responses to elevated CO2 than other crops that have been examined.*

Buntgen, U., Greuter, L., Bollmann, K., Jenny, H., Liebhold, A., Galván, J. D., . . . Mysterud, A. (2017). Elevational range shifts in four mountain ungulate species from the Swiss Alps. *Ecosphere, 8*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018949685&doi=10.1002%2fecs2.1761&partnerID=40&md5=d43388f6dec544c9cbaf31bbc3675369. doi:10.1002/ecs2.1761
Research Tags: Wildlife
Abstract: *Warming-induced range shifts along elevational and latitudinal gradients have been observed in several species from various taxa. The mobility and behavioral plasticity of large endothermic mammals, however, complicate the detection of climatic effects on their spatial distributions. Here, we analyzed 230,565 hunting locations of the four most abundant ungulate species in the European Alps: ibex, chamois, red deer, and roe deer. Year-to-year and inter-decadal range shifts toward higher elevations in Switzerland coincided with warmer, snow-free, and thus more favorable autumn conditions in the same area. The average harvest elevation of ibex, chamois, and red deer significantly increased between 1991 and 2013. Although this trend is anticipated to continue, behavioral plasticity may allow the Alpine ibex and other mountain ungulates to buffer some of the associated consequences of climate change. Our results demonstrate the utility of well-replicated hunting archives to supplement shorter but more precise monitoring data. This study also provides independent evidence of animal range shifts in response to environmental change at interannual and multi-decadal time-scales.*

Buotte, P. C., Hicke, J. A., Preisler, H. K., Abatzoglou, J. T., Raffa, K. F., & Logan, J. A. (2017). Recent and future climate suitability for whitebark pine mortality from mountain pine beetles varies across the western US. *Forest Ecology and Management, 399*, 132-142. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019700094&doi=10.1016%2fj.foreco.2017.05.032&partnerID=40&md5=b1615efe1bcf82c368c34f5c74ded9ba. doi:10.1016/j.foreco.2017.05.032

Research Tags: Wildlife, Forestry

Abstract: *Recent mountain pine beetle outbreaks in whitebark pine forests have been extensive and severe. Understanding the climate influences on these outbreaks is essential for developing management plans that account for potential future mountain pine beetle outbreaks, among other threats, and informing listing decisions under the Endangered Species Act. Prior research has focused on one geographic region, but geographic variability in beetle and tree physiological responses to climate conditions have been documented. Here we evaluate geographic variability in climate influences on recent beetle outbreaks in whitebark pine and estimate future climate suitability for outbreaks across much of the range of whitebark pine in the western US. To accomplish these objectives, we developed and analyzed statistical models for three different geographic regions as well as a Westwide model, then applied the Westwide model to a suite of climate projections. The general patterns of climate-tree mortality relationships were similar across the three regions of our study. However, the relative importance of individual climate metrics preceding and during the recent outbreaks varied geographically because of the different climates in the regions. Winter minimum temperatures appeared to be limiting prior to outbreaks in the colder regions. All regions experienced low summer precipitation prior to or during outbreak initiation. Future climate suitability for beetle outbreaks is estimated to increase or remain stable in the coldest regions and decline slightly in the warmest region by the end of this century. Across the study area, projections of higher winter temperatures and decreased summer precipitation (with lower confidence than for temperatures) contribute to increased climate suitability for outbreaks, while projected higher fall/spring/summer temperatures contribute to decreased suitability. Some regional variability exists; in particular, the effect of winter warming is muted in the warmest region (Cascades) where winter temperatures appear to be less limiting. However, all regions are projected to experience fewer years with very low suitability, which commonly occurred prior to the recent outbreaks and may have limited beetle populations. Given the inherent uncertainty in climate projections and ecological responses to novel climates, management plans that incorporate sites that are expected to experience a range of expected future climate conditions might increase the chances of whitebark pine persistence in a warmer future.*

Burke, J., & Ulloa, M. (2019). Assessment of cotton leaf and yield responses to water-deficit stress during flowering and boll development. *Journal of Cotton Science, 23*(1), 109-117. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070227676&partnerID=40&md5=46532ed8e0742d134b5e20a4f249f924.

Research Tags: Crops, Weather

Abstract: *Rainfall future events are predicted to decline to 30 to 127 mm in the majority of counties of the Texas High Plains and Rolling Plains because of climate change. Cotton (Gossypium hirsutum L.) is the major crop grown on the High Plains of Texas, and the lower humidity associated with the predicted reduction in rain raises the possibility of increased vegetative water-deficit stress and reproductive dehydration stress. This study assesses the vegetative and reproductive developmental processes of commercial cotton cultivar-response following water-deficit stress, specifically during flowering and boll development. Cultivars showed a significant relationship between the leaf water-deficit stress levels during boll development and final seed cotton yields. However, the cultivar Phytogen 72 (PHY72) was an exception to this observation. PHY72 exhibited excellent leaf water-deficit stress tolerance yet had reduced seed cotton yields compared with the other cultivars evaluated. Genetic analysis of the sensitivity of the PHY 72 pollen suggested a maternal deficiency in the tapetum development of the PHY 72 pollen coat resulting in increased dehydration sensitivity. Structural differences in pollen coat development in two cultivars (PHY 72 and NM67) were observed under both scanning electron and transmission electron microscopy. Predicted reduced rainfall and higher temperatures in the future, may necessitate approaches to improve not only vegetation tolerance to stress but also reproductive tolerance both of which may be important for breeding the new generation of crops.*

Burkle, L. A., & Runyon, J. B. (2017). The Smell of Environmental Change: Using Floral Scent to Explain Shifts in Pollinator Attraction. *Applications in Plant Sciences, 5*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020292466&doi=10.3732%2fapps.1600123&partnerID=40&md5=5cff8a068581c07b3547d63b0ca6c539. doi:10.3732/apps.1600123

Research Tags: Research, Wildlife
Abstract: *As diverse environmental changes continue to influence the structure and function of plant–pollinator interactions across spatial and temporal scales, we will need to enlist numerous approaches to understand these changes. Quantitative examination of floral volatile organic compounds (VOCs) is one approach that is gaining popularity, and recent work suggests that floral VOCs hold substantial promise for better understanding and predicting the effects of environmental change on plant–pollinator interactions. Until recently, few ecologists were employing chemical approaches to investigate mechanisms by which components of environmental change may disrupt these essential mutualisms. In an attempt to make these approaches more accessible, we summarize the main field, laboratory, and statistical methods involved in capturing, quantifying, and analyzing floral VOCs in the context of changing environments. We also highlight some outstanding questions that we consider to be highly relevant to making progress in this field.*

Burt, D. M., Roloff, G. J., & Etter, D. R. (2017). Climate factors related to localized changes in snowshoe hare (Lepus Americanus) occupancy. *Canadian Journal of Zoology, 95*(1), 15-22. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009804782&doi=10.1139%2fcjz-2016-0180&partnerID=40&md5=d256def50ce368d8e326b5df7afb5375. doi:10.1139/cjz-2016-0180
Research Tags: Wildlife
Abstract: *Information on climate that influences snowshoe hares (Lepus americanus Erxleben, 1777) can inform adaptation strategies. We identified climate factors correlated with localized changes in occupancy of snowshoe hares in Michigan, USA. A change in occupancy occurred if a site (~7.5 ha) knowingly occupied by hares sometime in the past became unoccupied. We used local ecological knowledge to map sites where hares historically occurred and to assign a year of last-known occupancy. At 134 historically occupied sites, we conducted snow track surveys in 2013 to determine current occupancy status. We identified climate variables having relevance to hare population demographics and modeled the likelihood that those variables influenced current occupancy status. The top-ranking model included maximum temperature from 15 May to 19 January; as maximum temperature increased, the likelihood of a site becoming unoccupied increased. The second-ranked model included total number of days with measurable snow on the ground; as days with snow on the ground decreased, the likelihood of a site becoming unoccupied increased. Our data indicated that site occupancy status of hares can be described by climate variables and that the southern edge of snowshoe hare distribution in Michigan shifted northward by ~45 km over the last 20 years.*

Burt, T. P., Ford Miniat, C., Laseter, S. H., & Swank, W. T. (2018). Changing patterns of daily precipitation totals at the Coweeta Hydrologic Laboratory, North Carolina, USA. *International Journal of Climatology, 38*(1), 94-104. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021255468&doi=10.1002%2fjoc.5163&partnerID=40&md5=6d77db7824e2b87bb26eabe07c775b3d. doi:10.1002/joc.5163
Research Tags: Weather
Abstract: *A pattern of increasing frequency and intensity of heavy rainfall over land has been documented for several temperate regions and is associated with climate change. This study examines the changing patterns of daily precipitation at the Coweeta Hydrologic Laboratory, North Carolina, USA, since 1937 for four rain gauges across a range of elevations. We analyse seasonal total rainfall, number of rain days and the frequency of heavy rainfall. We compare these with several teleconnections, including the Bermuda High Index (BHI), the West BHI, the North Atlantic Oscillation (NAO) and the El Niño-Southern Oscillation. Our data show a tendency for increased variability, including major periods of drought, with fewer rain days recently, especially in summer. Only autumn tended to have increases in rainfall frequency and magnitude; this is the season when orographic enhancement is at its strongest. The major driver of precipitation at Coweeta is the strength of the Bermuda High. The strength of the NAO is important in summer. The results are relevant to the southeast United States in general, given that the region comes under the influence of similar air masses during the year. The findings are applicable to the wider Appalachian Mountains and to other mountainous regions where there is significant orographic enhancement.*

Butnor, J. R., Samuelson, L. J., Johnsen, K. H., Anderson, P. H., González Benecke, C. A., Boot, C. M., . . . Zarnoch, S. J. (2017). Vertical distribution and persistence of soil organic carbon in fire-adapted longleaf pine forests.

Forest Ecology and Management, 390, 15-26. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85010403104&doi=10.1016%2fj.foreco.2017.01.014&partnerID=40&md5=1daf04a68a718b9151adeb0d5bf483da. doi:10.1016/j.foreco.2017.01.014
Research Tags: Forestry, Soil
Abstract: *Longleaf pine (Pinus palustris Miller) forests in the southern United States are being restored and actively managed for a variety of goals including: forest products, biodiversity, C sequestration and forest resilience in the face of repeated disturbances from hurricanes and climate change. Managed southern pine forests can be sinks for atmospheric CO2 in forest biomass; however, the persistence of biomass in the environment or in forest products is limited, thus making soil C the primary long-term pool. Little is known about the size of extant soil C pools, residence time of soil C or the role that frequent burning plays in C stabilization in longleaf pine ecosystems. We sampled soil from a chronosequence of longleaf pine stands ranging in age from 5 to 87 years to quantify the vertical distribution of soil organic carbon (SOC) stocks; both oxidizable (SOCOX) and oxidation resistant (SOCR) fractions, pyrogenic carbon (PyC) and the mean residence time (MRT) of SOC and its associated fractions. SOC stocks (0–1 m) ranged from 44.1 to 98.1 ($\bar{x}$= 77.0) Mg C ha−1, and no effect of stand age or biomass accumulation on SOC stocks was detected. Soil C accumulation was associated with elevated clay and extractable Fe contents. While SOC concentration declined with soil depth, the proportion of SOCR in SOC increased with depth. PyC was a minor component of soil C, representing 5–7% of SOC and the proportion was not depth dependent. The MRT of SOC was hundreds of years near the surface and many thousands of years at depth. Though SOCR was less abundant than SOCOX, SOCR MRT was an order of magnitude greater than SOCOX MRT and had a strong influence on bulk SOC MRT. The majority of the PyC was in the less persistent SOCox and not associated with long-term C storage in soil. Despite the flow of C from biomass in the form of decay products, litter fall, root turnover and pulses of PyC, these soils preserve little of recent inputs, which may be rapidly oxidized, lost to the atmosphere from periodic fires or, in the case of PyC, may be transported out of the system via erosion. Our results indicate that these soils were not strong sinks for atmospheric CO2, especially when compared to C accumulation in biomass.*

Byrnes, R., Eviner, V., Kebreab, E., Horwath, W. R., Jackson, L., Jenkins, B. M., . . . Wheeler, S. (2017). Review of research to inform California's climate scoping plan: Agriculture and working lands. *California Agriculture, 71*(3), 160-168. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029490885&doi=10.3733%2fca.2017a0031&partnerID=40&md5=b1deae502e2b9083bbb51419e9bdd915. doi:10.3733/ca.2017a0031
Research Tags: Economics
Abstract: *Agriculture in California contributes 8% of the state's greenhouse gas (GHG) emissions. To inform the state's policy and program strategy to meet climate targets, we review recent research on practices that can reduce emissions, sequester carbon and provide other co-benefits to producers and the environment across agriculture and rangeland systems. Importantly, the research reviewed here was conducted in California and addresses practices in our specific agricultural, socioeconomic and biophysical environment. Farmland conversion and the dairy and intensive livestock sector are the largest contributors to GHG emissions and offer the greatest opportunities for avoided emissions. We also identify a range of other opportunities including soil and nutrient management, integrated and diversified farming systems, rangeland management, and biomass-based energy generation. Additional research to replicate and quantify the emissions reduction or carbon sequestration potential of these practices will strengthen the evidence base for California climate policy.*

Bystriakova, N., Griswold, T., Ascher, J. S., & Kuhlmann, M. (2018). Key environmental determinants of global and regional richness and endemism patterns for a wild bee subfamily. *Biodiversity and Conservation, 27*(2), 287-309. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029543316&doi=10.1007%2fs10531-017-1432-7&partnerID=40&md5=24bafef1d71c9cd897a313b990faab27. doi:10.1007/s10531-017-1432-7
Research Tags: Wildlife
Abstract: *Reports of world-wide decline of pollinators, and of bees in particular, raise increasing concerns about maintenance of pollination interactions. While local factors of bee decline are relatively well known and potential mitigation strategies at the landscape scale have been outlined, the regional and continental-scale threats to bee diversity have only been marginally explored. Here we document large-scale spatial patterns for*

a representative bee subfamily, the determinants of its species richness, and assess major threats to these pollinators. Using a comprehensive global dataset of Colletinae (genera Colletes, also called "polyester" or "cellophane" bees for their underground nests lined with a polyester secretion, and Mourecotelles), a species-rich subfamily whose organismal and physiological ecology is representative of many bees, we measured species richness and endemism on global to continental scales. We explored the relationships between bee species richness and potential environmental stress factors grouped into three categories: contemporary climate, habitat heterogeneity, and anthropogenic pressure. Bees of the subfamily Colletinae demonstrate the reversed latitudinal gradient in species richness and endemism suggested for bees; the highest species richness of Colletinae was found between 30° and 50° latitude in both the northern and southern hemispheres. Centres of endemism largely overlapped with those of species richness. The importance of the Greater Cape Floristic Region, previously identified as a centre of richness and endemism of bees, was confirmed for Colletinae. On the global scale, present-day climate was a significant predictor of species richness as was flowering plant diversity represented by vascular plant species richness and centres of plant diversity. Our main conclusion is that climate change constitutes a potential threat to bee diversity, as does declining diversity of vascular plants. However, a significant overlap between centres of bee richness and plant diversity might increase chances for developing conservation strategies.

Cade, B. S., Noon, B. R., Scherer, R. D., & Keane, J. J. (2017). Logistic quantile regression provides improved estimates for bounded avian counts: A case study of California Spotted Owl fledgling production. *Auk, 134*(4), 783-801. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85024104402&doi=10.1642%2fAUK-16-195.1&partnerID=40&md5=29955bd7e0714d9776b03b4868d17cd3. doi:10.1642/AUK-16-195.1

Research Tags: Wildlife, Research

Abstract: *Counts of avian fledglings, nestlings, or clutch size that are bounded below by zero and above by some small integer form a discrete random variable distribution that is not approximated well by conventional parametric count distributions such as the Poisson or negative binomial. We developed a logistic quantile regression model to provide estimates of the empirical conditional distribution of a bounded discrete random variable. The logistic quantile regression model requires that counts are randomly jittered to a continuous random variable, logit transformed to bound them between specified lower and upper values, then estimated in conventional linear quantile regression, repeating the 3 steps and averaging estimates. Back-transformation to the original discrete scale relies on the fact that quantiles are equivariant to monotonic transformations. We demonstrate this statistical procedure by modeling 20 years of California Spotted Owl fledgling production (0−3 per territory) on the Lassen National Forest, California, USA, as related to climate, demographic, and landscape habitat characteristics at territories. Spotted Owl fledgling counts increased nonlinearly with decreasing precipitation in the early nesting period, in the winter prior to nesting, and in the prior growing season; with increasing minimum temperatures in the early nesting period; with adult compared to subadult parents; when there was no fledgling production in the prior year; and when percentage of the landscape surrounding nesting sites (202 ha) with trees ≥25 m height increased. Changes in production were primarily driven by changes in the proportion of territories with 2 or 3 fledglings. Average variances of the discrete cumulative distributions of the estimated fledgling counts indicated that temporal changes in climate and parent age class explained 18% of the annual variance in owl fledgling production, which was 34% of the total variance. Prior fledgling production explained as much of the variance in the fledgling counts as climate, parent age class, and landscape habitat predictors. Our logistic quantile regression model can be used for any discrete response variables with fixed upper and lower bounds.*

Cahoon, S. M. P., Sullivan, P. F., Brownlee, A. H., Pattison, R. R., Andersen, H. E., Legner, K., & Hollingsworth, T. N. (2018). Contrasting drivers and trends of coniferous and deciduous tree growth in interior Alaska. *Ecology, 99*(6), 1284-1295. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046159710&doi=10.1002%2fecy.2223&partnerID=40&md5=b3e6aba3db716a76fcc85d550e13afe2. doi:10.1002/ecy.2223

Research Tags: Forestry

Abstract: *The boreal biome represents approximately one third of the world's forested area and plays an important role in global biogeochemical and energy cycles. Numerous studies in boreal Alaska have concluded* *that growth of black and white spruce is declining as a result of temperature-induced drought stress. The combined evidence of declining spruce growth and changes in the fire regime that favor establishment of deciduous tree species has led some investigators to suggest the region may be transitioning from dominance by spruce to dominance by deciduous forests and/or grasslands. Although spruce growth trends have been extensively investigated, few studies have evaluated long-term radial growth trends of the dominant deciduous species (Alaska paper birch and trembling aspen) and their sensitivity to moisture availability. We used a large and spatially extensive sample of tree cores from interior Alaska to compare long-term growth trends among contrasting tree species (white and black spruce vs. birch and aspen). All species showed a growth peak in the mid-1940s, although growth following the peak varied strongly across species. Following an initial decline from the peak, growth of white spruce showed little evidence of a trend, while black spruce and birch growth showed slight growth declines from ~1970 to present. Aspen growth was much more variable than the other species and showed a steep decline from ~1970 to present. Growth of birch, black and white spruce was sensitive to moisture availability throughout most of the tree-ring chronologies, as evidenced by negative correlations with air temperature and positive correlations with precipitation. However, a positive correlation between previous July precipitation and aspen growth disappeared in recent decades, corresponding with a rise in the population of the aspen leaf miner (Phyllocnistis populiella), an herbivorous moth, which may have driven growth to a level not seen since the early 20th century. Our results provide important historical context for recent growth and raise questions regarding competitive interactions among the dominant tree species and exchanges of carbon and energy in the warming climate of interior Alaska.*

Cai, X., Pan, M., Chaney, N. W., Colliander, A., Misra, S., Cosh, M. H., . . . Wood, E. F. (2017). Validation of SMAP soil moisture for the SMAPVEX15 field campaign using a hyper-resolution model. *Water Resources Research, 53*(4), 3013-3028. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017562860&doi=10.1002%2f2016WR019967&partnerID=40&md5=52569c79446e1571ed065ce372cb67ab. doi:10.1002/2016WR019967

Research Tags: Soil, Research

Abstract: *Accurate global mapping of soil moisture is the goal of the Soil Moisture Active Passive (SMAP) mission, which is expected to improve the estimation of water, energy, and carbon exchanges between the land and the atmosphere. Like other satellite products, the SMAP soil moisture retrievals need to be validated, with the validation relying heavily on in situ measurements. However, a one-to-one comparison is ill advised due to the spatial mismatch of the large SMAP footprint (~40 km) and the point scale in situ measurements. This study uses a recently developed hyper-resolution land surface model—HydroBlocks—as a tool to upscale in situ soil moisture measurements for the SMAPVEX15 (SMAP Validation Experiment 2015) field campaign during 2–18 August 2015. Calibrated against in situ observation, HydroBlocks shows a satisfactory Kling-Gupta efficiency (KGE) of 0.817 and RMSE of 0.019 m3/m3 for the calibration period. These results indicate that HydroBlocks can be used to upscale in situ measurements for this site. Different from previous studies, here in situ measurements are upscaled using a land surface model without bias correction. The upscaled soil moisture is then used to evaluate SMAP (passive) soil moisture products. The comparison of the upscaled network to SMAP shows that the retrievals are generally able to capture the areal-averaged soil moisture temporal variations. However, SMAP appears to be oversensitive to summer precipitation. We expect these findings can be used to improve the SMAP soil moisture product and thus facilitate its usage in studying the water, energy, and carbon cycles.*

Cailleret, M., Dakos, V., Jansen, S., Robert, E. M. R., Aakala, T., Amoroso, M. M., . . . Martínez-Vilalta, J. (2019). Early-warning signals of individual tree mortality based on annual radial growth. *Frontiers in Plant Science, 9*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062726358&doi=10.3389%2ffpls.2018.01964&partnerID=40&md5=29c960a0fcb733c6b96947d9dc0d8347. doi:10.3389/fpls.2018.01964

Research Tags: Forestry

Abstract: *Tree mortality is a key driver of forest dynamics and its occurrence is projected to increase in the future due to climate change. Despite recent advances in our understanding of the physiological mechanisms leading to death, we still lack robust indicators of mortality risk that could be applied at the individual tree scale. Here, we build on a previous contribution exploring the differences in growth level between trees that* *died and survived a given mortality event to assess whether changes in temporal autocorrelation, variance, and synchrony in time-series of annual radial growth data can be used as early warning signals of mortality risk. Taking advantage of a unique global ring-width database of 3065 dead trees and 4389 living trees growing together at 198 sites (belonging to 36 gymnosperm and angiosperm species), we analyzed temporal changes in autocorrelation, variance, and synchrony before tree death (diachronic analysis), and also compared these metrics between trees that died and trees that survived a given mortality event (synchronic analysis). Changes in autocorrelation were a poor indicator of mortality risk. However, we found a gradual increase in inter-annual growth variability and a decrease in growth synchrony in the last ∼20 years before mortality of gymnosperms, irrespective of the cause of mortality. These changes could be associated with drought-induced alterations in carbon economy and allocation patterns. In angiosperms, we did not find any consistent changes in any metric. Such lack of any signal might be explained by the relatively high capacity of angiosperms to recover after a stress-induced growth decline. Our analysis provides a robust method for estimating early-warning signals of tree mortality based on annual growth data. In addition to the frequently reported decrease in growth rates, an increase in inter-annual growth variability and a decrease in growth synchrony may be powerful predictors of gymnosperm mortality risk, but not necessarily so for angiosperms.*

Caldwell, P. V., Jackson, C. R., Miniat, C. F., Younger, S. E., Vining, J. A., McDonnell, J. J., & Aubrey, D. P. (2018). Woody bioenergy crop selection can have large effects on water yield: A southeastern United States case study. *Biomass and Bioenergy, 117*, 180-189. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050970700&doi=10.1016%2fj.biombioe.2018.07.021&partnerID=40&md5=cf31521f1e94e35a5444f75c75d4a802. doi:10.1016/j.biombioe.2018.07.021

Research Tags: Energy, Forestry

Abstract: *Short-rotation woody crops in the southeastern United States will make a significant contribution to the growing renewable energy supply over the 21st century; however, there are few studies that investigate how species selection may affect water yield. Here we assessed the impact of species selection on annual and seasonal water budgets in unvegetated plots and late-rotation 14–15-year-old intensively managed loblolly pine (Pinus taeda L.) and sweetgum (Liquidambar styraciflua L.) stands in South Carolina USA. We found that while annual aboveground net primary productivity and bioenergy produced was similar between species, sweetgum transpiration was 53% higher than loblolly pine annually and 92% greater during the growing season. Canopy interception was 10.5% of annual precipitation and was not significantly different between the two species. Soil evaporation was less than 1.3% of annual precipitation and did not differ between species, but was 26% of precipitation in unvegetated plots. Annual water yield was 69% lower for sweetgum than loblolly pine, with water yield to precipitation ratios of 0.13 and 0.39 for sweetgum and loblolly pine, respectively. If planted at a large scale, the high transpiration and low water yield in sweetgum could result in declines in downstream water availability relative to loblolly pine by the end of the growing season when storage in groundwater, streams, and water supply reservoirs are typically at their lowest. Our results suggest that species selection is of critical importance when establishing forest plantations for woody bioenergy production due to potential impacts on downstream water yield.*

Cambaliza, M. O. L., Bogner, J. E., Green, R. B., Shepson, P. B., Harvey, T. A., Spokas, K. A., . . . Corcoran, M. (2017). Field measurements and modeling to resolve m 2 to km 2 CH <inf>4</inf> emissions for a complex urban source: An Indiana landfill study. *Elementa, 5*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061838269&doi=10.1525%2felementa.145&partnerID=40&md5=d2fd39910833bbae84baa494147336cd. doi:10.1525/elementa.145

Research Tags: Emissions

Abstract: *Large spatial and temporal uncertainties for landfill CH4 emissions remain unresolved by short-term field campaigns and historic greenhouse gas (GHG) inventory models. Using four field methods (aircraft-based mass balance, tracer correlation, vertical radial plume mapping, static chambers) and a new field-validated process-based model (California Landfill Methane Inventory Model, CALMIM 5.4), we investigated the total CH4 emissions from a central Indiana landfill as well as the partitioned emissions inclusive of methanotrophic oxidation for the various cover soils at the site. We observed close agreement between whole site emissions derived from the tracer correlation (8 to 13 mol s−1) and the aircraft mass balance approaches (7 and 17 mol s−1) that were statistically indistinguishable from the modeling result (12 ± 2 mol s−1 inclusive of oxidation).*

Our model calculations indicated that approximately 90% of the annual average CH4 emissions (11 ± 1 mol s–1; 2200 ± 250 g m–2 d–1) derived from the small daily operational area. Characterized by a thin overnight soil cover directly overlying a thick sequence of older methanogenic waste without biogas recovery, this area constitutes only 2% of the 0.7 km2 total waste footprint area. Because this Indiana landfill is an upwind source for Indianapolis, USA, the resolution of m2 to km2 scale emissions at various temporal scales contributes to improved regional inventories relevant for addressing GHG mitigation strategies. Finally, our comparison of measured to reported CH4 emissions under the US EPA National GHG Reporting program suggests the need to revisit the current IPCC (2006) GHG inventory methodology based on CH4 generation modeling. The reasonable prediction of emissions at individual U.S. landfills requires incorporation of both cover-specific landfill climate modeling (e.g., soil temperature/moisture variability over a typical annual cycle driving CH4 transport and oxidation rates) as well as operational issues (e.g., cover thickness/properties, extent of biogas recovery).

Campbell, J. L., Green, M. B., Yanai, R. D., Woodall, C. W., Fraver, S., Harmon, M. E., . . . Domke, G. M. (2019). Estimating uncertainty in the volume and carbon storage of downed coarse woody debris. *Ecological Applications, 29*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062283863&doi=10.1002%2feap.1844&partnerID=40&md5=fa6bf0e12f0d683ef53fbad762fc9c4a. doi:10.1002/eap.1844

Research Tags: Forestry

Abstract: *Downed coarse woody debris, also known as coarse woody detritus or downed dead wood, is challenging to estimate for many reasons, including irregular shapes, multiple stages of decay, and the difficulty of identifying species. In addition, some properties are commonly not measured, such as wood density and carbon concentration. As a result, there have been few previous evaluations of uncertainty in estimates of downed coarse woody debris, which are necessary for analysis and interpretation of the data. To address this shortcoming, we quantified uncertainties in estimates of downed coarse woody debris volume and carbon storage using data collected from permanent forest inventory plots in the northeastern United States by the Forest Inventory and Analysis program of the USDA Forest Service. Quality assurance data collected from blind remeasurement audits were used to quantify error in diameter measurements, hollowness of logs, species identification, and decay class determination. Uncertainty estimates for density, collapse ratio, and carbon concentration were taken from the literature. Estimates of individual sources of uncertainty were combined using Monte Carlo methods. Volume estimates were more reliable than carbon storage, with an average 95% confidence interval of 15.9 m3/ha across the 79 plots evaluated, which was less than the mean of 31.2 m3/ha. Estimates of carbon storage (and mass) were more uncertain, due to poorly constrained estimates of the density of wood. For carbon storage, the average 95% confidence interval was 11.1 Mg C/ha, which was larger than the mean of 4.6 Mg C/ha. Accounting for the collapse of dead wood as it decomposes would improve estimates of both volume and carbon storage. On the other hand, our analyses suggest that consideration of the hollowness of downed coarse woody debris pieces could be eliminated in this region, with little effect. This study demonstrates how uncertainty analysis can be used to quantify confidence in estimates and to help identify where best to allocate resources to improve monitoring designs.*

Campbell, J. L., Sessions, J., Smith, D., & Trippe, K. (2018). Potential carbon storage in biochar made from logging residue: Basic principles and Southern Oregon case studies. *PLoS ONE, 13*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053242513&doi=10.1371%2fjournal.pone.0203475&partnerID=40&md5=5b49362fe9630bbc5652ede45d3caba4. doi:10.1371/journal.pone.0203475

Research Tags: Forestry, Soil

Abstract: *The industrial production of long-lived charcoal products (commonly referred to as biochar) from otherwise shorter-lived logging resides (commonly referred to a slash) has been proposed as a means to increasing terrestrial carbon storage thus mitigating global warming caused by anthropogenic greenhouse gas emissions. We present a generalized model that describes the temporal dynamics of biochar carbon stocks, relative to carbon of unmodified logging residue, and evaluate the sensitivity of carbon storage to various biophysical and production parameters. Using this model, we then attribute net carbon storage to several potential biochar production scenarios, specifically engineered to use wood recovered from harvests prescribed to reduce fire hazard in mixed-conifer forests of South-central Oregon. Relative to a baseline scenario where*

logging residue is left to decay on site, the net carbon storage attributed to 20 years of biochar production is generally negative for the first several decades, then remains positive for several centuries at levels approximately one-fourth the total feedstock carbon processed. Positive net carbon storage and the time required for it to manifest is notably sensitive to biochar conversion efficiencies, logging residue decay rates, and alternate baseline fates of logging residue. The magnitude of net carbon storage, and the time required for it to become positive, is largely similar across range of production facility types. Moreover, the time required for net carbon storage to become positive, and its magnitude over the first 100 years is notably insensitive to biochar decomposition rates provided biochar decays at least ten-times slower than the logging residue it is made from.

Campos-Cerqueira, M., Arendt, W. J., Wunderle, J. M., & Aide, T. M. (2017). Have bird distributions shifted along an elevational gradient on a tropical mountain? *Ecology and Evolution, 7*(23), 9914-9924. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031674122&doi=10.1002%2fece3.3520&partnerID=40&md5=a1a26150a51bc8ffd45cd2ece11dcadc. doi:10.1002/ece3.3520

Research Tags: Wildlife

Abstract: *An upward shift in elevation is one of the most conspicuous species responses to climate change. Nevertheless, downward shifts and, apparently, the absences of response have also been recently reported. Given the growing evidence of multiple responses of species distributions due to climate change and the paucity of studies in the tropics, we evaluated the response of a montane bird community to climate change, without the confounding effects of land-use change. To test for elevational shifts, we compared the distribution of 21 avian species in 1998 and 2015 using occupancy models. The historical data set was based on point counts, whereas the contemporary data set was based on acoustic monitoring. We detected a similar number of species in historical (36) and contemporary data sets (33). We show an overall pattern of no significant change in range limits for most species, although there was a significant shift in the range limit of eight species (38%). Elevation limits shifted mostly upward, and this pattern was more common for upper than lower limits. Our results highlight the variability of species responses to climate change and illustrate how acoustic monitoring provides an easy and powerful way to monitor animal populations along elevational gradients.*

Canham, C. D., Murphy, L., Riemann, R., McCullough, R., & Burrill, E. (2018). Local differentiation in tree growth responses to climate. *Ecosphere, 9*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054061877&doi=10.1002%2fecs2.2368&partnerID=40&md5=5836a234d927add1bfbebe4abc1afb29. doi:10.1002/ecs2.2368

Research Tags: Forestry

Abstract: *Many temperate tree species have extraordinarily broad distributions along gradients of temperature and precipitation. But it is not clear in most species whether this reflects very broad tolerance of climate conditions, or a high degree of genetic differentiation or phenotypic acclimation in their responses to local climate. Provenance trials and common garden experiments indicate that at least some tree species of the temperate forests of eastern North America show genetic differentiation in growth as a function of climate, although these studies have been largely limited to measurements on growth of seedlings and saplings. To test for evidence of either adaptation or acclimation in adult response to local climatic conditions, we used data from over 23,000 tree cores collected by the U.S. Forest Inventory and Analysis program in the 1980s for 14 tree species distributed in states from Maine to Ohio. We tested a suite of alternate models for interannual variation in radial growth as a function of (1) tree age, (2) size, (3) temperature, and (4) precipitation. The models included climate variables from both the current and previous year. The alternate models allowed us to test whether growth was best predicted from absolute values of the climate variables, or from deviation of current or previous year climate from long-term average at the location of an individual tree core. In all 14 species, models that used deviation from local, long-term mean climate were superior, indicating that all 14 species showed strong adaptation or acclimation to local climate. In most of the species, growth was highest in years that were cooler and wetter than long-term average at a location. The analysis does not allow us to distinguish between genetic differentiation and phenotypic acclimation responses. If the results are genetically based, trees within a given location could be much more sensitive to climate change than indicated by the very broad geographic distributions of these temperate tree species, but if the results are phenotypic, this would represent local acclimation that could help buffer species in the face of climate change.*

Cano, A., Núñez, A., Acosta-Martinez, V., Schipanski, M., Ghimire, R., Rice, C., & West, C. (2018). Current knowledge and future research directions to link soil health and water conservation in the Ogallala Aquifer region. *Geoderma, 328*, 109-118. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047056122&doi=10.1016%2fj.geoderma.2018.04.027&partnerID=40&md5=f8acb76cc3a3cddac844c00b89ff8f2a. doi:10.1016/j.geoderma.2018.04.027

Research Tags: Water, Soil

Abstract: *The Ogallala Aquifer is one of the largest freshwater aquifers in the world. It acts as a valuable resource in agriculture, animal production, and public water supplies across eight Great Plains states. However, with high irrigation demand, low recharge rates across most of the region, and extreme climate variability, the Ogallala Aquifer has become an exhaustible resource. Some areas of the Ogallala Aquifer region (OAR) are challenged with the transition of irrigated crop systems to dryland production and how to select sustainable management practices to conserve water and soil health. The main goal of this review is to identify the role of soil health in adapting to extreme climate variability with reduced irrigated water. We will describe the OAR, define roles of microorganisms and soil organic matter (SOM) in soil health, outline potential soil health indicators and common methodology, and discuss the importance of soil health assessments and management challenges facing the OAR. Information on this arid to semiarid region will aid in future soil health assessments in regions facing similar challenges.*

Cao, B., Domke, G. M., Russell, M. B., & Walters, B. F. (2019). Spatial modeling of litter and soil carbon stocks on forest land in the conterminous United States. *Science of the Total Environment, 654*, 94-106. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056446361&doi=10.1016%2fj.scitotenv.2018.10.359&partnerID=40&md5=571e1c9a7184c2a9bb94983b6196c791. doi:10.1016/j.scitotenv.2018.10.359

Research Tags: Forestry, Soil

Abstract: *Forest ecosystems contribute substantially to carbon (C) storage. The dynamics of litter decomposition, translocation and stabilization into soil layers are essential processes in the functioning of forest ecosystems, as these processes control the cycling of soil organic matter and the accumulation and release of C to the atmosphere. Therefore, the spatial distribution of litter and soil C stocks are important in greenhouse gas estimation and reporting and inform land management decisions, policy, and climate change mitigation strategies. Here we explored the effects of spatial aggregation of climatic, biotic, topographic and soil variables on national estimates of litter and soil C stocks and characterized the spatial distribution of litter and soil C stocks in the conterminous United States (CONUS). Litter and soil variables were measured on permanent sample plots (n = 3303) from the National Forest Inventory (NFI) within the United States from 2000 to 2011. These data were used with vegetation phenology data estimated from LANDSAT imagery (30 m) and raster data describing environmental variables for the entire CONUS to predict litter and soil C stocks. The total estimated litter C stock was 2.07 ± 0.97 Pg with an average density of 10.45 ± 2.38 Mg ha−1, and the soil C stock at 0–20 cm depth was 14.68 ± 3.50 Pg with an average density of 62.68 ± 8.98 Mg ha−1. This study extends NFI data from points to pixels providing spatially explicit and continuous predictions of litter and soil C stocks on forest land in the CONUS. The approaches described illustrate the utility of harmonizing field measurements with remotely sensed data to facilitate modeling and prediction across spatial scales in support of inventory, monitoring, and reporting activities, particularly in countries with ready access to remotely sensed data but with limited observations of litter and soil variables.*

Carnwath, G., & Nelson, C. (2017). Effects of biotic and abiotic factors on resistance versus resilience of Douglas fir to drought. *PLoS ONE, 12*(10). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030463034&doi=10.1371%2fjournal.pone.0185604&partnerID=40&md5=0224ebad80acc0668247f596d49043de. doi:10.1371/journal.pone.0185604

Research Tags: Forestry, Weather

Abstract*: Significant increases in tree mortality due to drought-induced physiological stress have been documented worldwide. This trend is likely to continue with increased frequency and severity of extreme drought events in the future. Therefore, understanding the factors that influence variability in drought responses among trees will be critical to predicting ecosystem responses to climate change and developing effective management actions. In this study, we used hierarchical mixed-effects models to analyze drought*

responses of Pseudotsuga menziesii in 20 unmanaged forests stands across a broad range of environmental conditions in northeastern Washington, USA. We aimed to 1) identify the biotic and abiotic attributes most closely associated with the responses of individual trees to drought and 2) quantify the variability in drought responses at different spatial scales. We found that growth rates and competition for resources significantly affected resistance to a severe drought event in 2001: slow-growing trees and trees growing in subordinate canopy positions and/or with more neighbors suffered greater declines in radial growth during the drought event. In contrast, the ability of a tree to return to normal growth when climatic conditions improved (resilience) was unaffected by competition or relative growth rates. Drought responses were significantly influenced by tree age: older trees were more resistant but less resilient than younger trees. Finally, we found differences between resistance and resilience in spatial scale: a significant proportion (approximately 50%) of the variability in drought resistance across the study area was at broad spatial scales (i.e. among different forest types), most likely due to differences in the total amount of precipitation received at different elevations; in contrast, variation in resilience was overwhelmingly (82%) at the level of individual trees within stands and there was no difference in drought resilience among forest types. Our results suggest that for Pseudotsuga menziesii resistance and resilience to drought are driven by different factors and vary at different spatial scales.

Carrasco, D., Desurmont, G. A., Laplanche, D., Proffit, M., Gols, R., Becher, P. G., . . . Anderson, P. (2018). With or without you: Effects of the concurrent range expansion of an herbivore and its natural enemy on native species interactions. *Global Change Biology, 24*(2), 631-643. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028593502&doi=10.1111%2fgcb.13836&partnerID=40&md5=fa6a465e85f210c747819a9838f88170. doi:10.1111/gcb.13836

Research Tags:

Abstract: *Global climatic changes may lead to the arrival of multiple range-expanding species from different trophic levels into new habitats, either simultaneously or in quick succession, potentially causing the introduction of manifold novel interactions into native food webs. Unraveling the complex biotic interactions between native and range-expanding species is critical to understand the impact of climate change on community ecology, but experimental evidence is lacking. In a series of laboratory experiments that simulated direct and indirect species interactions, we investigated the effects of the concurrent arrival of a range-expanding insect herbivore in Europe, Spodoptera littoralis, and its associated parasitoid Microplitis rufiventris, on the native herbivore Mamestra brassicae, and its associated parasitoid Microplitis mediator, when co-occurring on a native plant, Brassica rapa. Overall, direct interactions between the herbivores were beneficial for the exotic herbivore (higher pupal weight than the native herbivore), and negative for the native herbivore (higher mortality than the exotic herbivore). At the third trophic level, both parasitoids were unable to parasitize the herbivore they did not coexist with, but the presence of the exotic parasitoid still negatively affected the native herbivore (increased mortality) and the native parasitoid (decreased parasitism rate), through failed parasitism attempts and interference effects. Our results suggest different interaction scenarios depending on whether S. littoralis and its parasitoid arrive to the native tritrophic system separately or concurrently, as the negative effects associated with the presence of the parasitoid were dependent on the presence of the exotic herbivore. These findings illustrate the complexity and interconnectedness of multitrophic changes resulting from concurrent species arrival to new environments, and the need for integrating the ecological effects of such arrivals into the general theoretical framework of global invasion patterns driven by climatic change.*

Carrillo, Y., Dijkstra, F., LeCain, D., Blumenthal, D., & Pendall, E. (2018). Elevated CO <inf>2</inf> and warming cause interactive effects on soil carbon and shifts in carbon use by bacteria. *Ecology Letters, 21*(11), 1639-1648. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053235043&doi=10.1111%2fele.13140&partnerID=40&md5=c7be0ed3d0a937ab6476c36bf4f8e1b5. doi:10.1111/ele.13140

Research Tags: Soil

Abstract: *Accurate predictions of soil C feedbacks to climate change depend on an improved understanding of responses of soil C pools and C use by soil microbial groups. We assessed soil and microbial C in a 7-year manipulation of CO2 and warming in a semi-arid grassland. Continuous field isotopic labelling under elevated CO2 further allowed us to study the dynamics of the existing C (Old C) in soil and microbes as affected by*

warming. Warming reduced soil C under elevated CO2 but had no impact under ambient CO2. Loss of soil C under warming and elevated CO2 was attributed to increased proportional loss of Old C. Warming also reduced the proportion of Old C in microbes, specifically the bacteria, but not the fungi. These findings highlight that warming impacts are C pool and microbial taxa dependent and demonstrate interactive effects of warming and atmospheric CO2 on soil C.

Carroll, C., Parks, S. A., Dobrowski, S. Z., & Roberts, D. R. (2018). Climatic, topographic, and anthropogenic factors determine connectivity between current and future climate analogs in North America. *Global Change Biology, 24*(11), 5318-5331. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052458003&doi=10.1111%2fgcb.14373&partnerID=40&md5=625f26f534615c2c7f6d73cef076e6eb. doi:10.1111/gcb.14373

Research Tags: Research

Abstract: *As climatic conditions shift in coming decades, persistence of many populations will depend on their ability to colonize habitat newly suitable for their climatic requirements. Opportunities for such range shifts may be limited unless areas that facilitate dispersal under climate change are identified and protected from land uses that impede movement. While many climate adaptation strategies focus on identifying refugia, this study is the first to characterize areas which merit protection for their role in promoting climate connectivity at a continental extent. We identified climate connectivity areas across North America by delineating paths between current climate types and their future analogs that avoided nonanalogous climates, and used centrality metrics to rank the contribution of each location to facilitating dispersal across the landscape. The distribution of connectivity areas was influenced by climatic and topographic factors at multiple spatial scales. Results were robust to uncertainty in the magnitude of future climate change arising from differing emissions scenarios and general circulation models, but sensitive to analysis extent and assumptions concerning dispersal behavior and maximum dispersal distance. Paths were funneled along north-south trending passes and valley systems and away from areas of novel and disappearing climates. Climate connectivity areas, where many potential dispersal paths overlapped, were distinct from refugia and thus poorly captured by many existing conservation strategies. Existing protected areas with high connectivity values were found in southern Mexico, the southwestern US, and western and arctic Canada and Alaska. Ecoregions within the Isthmus of Tehuantepec, Great Plains, eastern temperate forests, high Arctic, and western Canadian Cordillera hold important climate connectivity areas which merit increased conservation focus due to anthropogenic pressures or current low levels of protection. Our coarse-filter climate-type-based results complement and contextualize species-specific analyses and add a missing dimension to climate adaptation planning by identifying landscape features which promote connectivity among refugia.*

Carroll, R. W. H., Huntington, J. L., Snyder, K. A., Niswonger, R. G., Morton, C., & Stringham, T. K. (2017). Evaluating mountain meadow groundwater response to Pinyon-Juniper and temperature in a great basin watershed. *Ecohydrology, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85005980993&doi=10.1002%2feco.1792&partnerID=40&md5=8cd13f526678d6e22750de1a7bd942cb. doi:10.1002/eco.1792

Research Tags: Water, Grassland, Weather

Abstract: *This research highlights development and application of an integrated hydrologic model (GSFLOW) to a semiarid, snow-dominated watershed in the Great Basin to evaluate Pinyon-Juniper (PJ) and temperature controls on mountain meadow shallow groundwater. The work used Google Earth Engine Landsat satellite and gridded climate archives for model evaluation. Model simulations across three decades indicated that the watershed operates on a threshold response to precipitation (P) >400 mm/y to produce a positive yield (P-ET; 9%) resulting in stream discharge and a rebound in meadow groundwater levels during these wetter years. Observed and simulated meadow groundwater response to large P correlates with above average predicted soil moisture and with a normalized difference vegetation index threshold value >0.3. A return to assumed pre-expansion PJ conditions or an increase in temperature to mid-21st century shifts yielded by only ±1% during the multi-decade simulation period; but changes of approximately ±4% occurred during wet years. Changes in annual yield were largely dampened by the spatial and temporal redistribution of evapotranspiration across the watershed: Yet the influence of this redistribution and vegetation structural controls on snowmelt altered recharge to control water table depth in the meadow. Even a small-scale removal* *of PJ (0.5 km2) proximal to the meadow will promote a stable, shallow groundwater system resilient to droughts, while modest increases in temperature will produce a meadow susceptible to declining water levels and a community structure likely to move toward dry and degraded conditions.*

Carrollo, E. M., Johnson, H. E., Fischer, J. W., Hammond, M., Dorsey, P. D., Anderson, C., . . . Walter, W. D. (2017). Influence of precipitation and crop germination on resource selection by mule deer (odocoileus hemionus) in Southwest Colorado. *Scientific Reports, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033676223&doi=10.1038%2fs41598-017-15482-7&partnerID=40&md5=1ab4424ae9c2a5b04334163f4e3c2079. doi:10.1038/s41598-017-15482-7
Research Tags: Weather, Crops, Wildlife
Abstract: *Mule deer (Odocoileus hemionus) populations in the western United States provide many benefits to local economies but can also cause considerable damage to agriculture, particularly damage to lucrative crops. Limited information exists to understand resource selection of mule deer in response to annual variation in crop rotation and climatic conditions. We tested the hypothesis that mule deer select certain crops, and in particular sunflower, based on annual climatic variability. Our objective was to use movements, estimates of home range, and resource selection analysis to identify resources selected by mule deer. We used annually-derived crop-specific datasets along with Global Positioning System collars to monitor 14 mule deer in an agricultural area near public lands in southwestern Colorado, USA. We estimated home ranges for two winter seasons that ranged between 7.68 and 9.88 km2, and for two summer seasons that ranged between 5.51 and 6.24 km2. Mule deer selected areas closer to forest and alfalfa for most periods during 2012, but selected areas closer to sunflower in a majority of periods during 2013. Considerable annual variation in climate patterns and precipitation levels appeared to influence selection by mule deer because of variability in crop rotation and success of germination of specific crops.*

Carter, A. H., Jones, S. S., Balow, K. A., Shelton, G. B., Burke, A. B., Lyon, S., . . . Morris, C. F. (2017). Registration of 'Jasper' soft white winter wheat. *Journal of Plant Registrations, 11*(3), 263-268. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028988296&doi=10.3198%2fjpr2016.09.0051crc&partnerID=40&md5=e70c9af5defffca2d41942ff7ca318e0. doi:10.3198/jpr2016.09.0051crc
Research Tags: Crops
Abstract: *Many soft white winter (SWW) wheat (Triticum aestivum L.) cultivars with high yield potential in the US Pacific Northwest lack adequate resistance to stripe rust or are only adapted to specific regions defined by annual precipitation. The objective of this research was to develop a SWW wheat cultivar with improved resistance to current stripe rust races and high yield potential across a wider range of climates. 'Jasper' (Reg. No. CV-1124, PI 678442) SWW wheat was developed and released in September 2014 by the Agricultural Research Center of Washington State University. Jasper was tested under the experimental designations 5J061865-11 and WA8169, which were assigned through progressive generations of advancement. Jasper is a semidwarf cultivar adapted to intermediate to high rainfall (>300 mm of average annual precipitation) wheat production regions of Washington, with acceptable yield potential in the lower rainfall areas (<300 mm of average annual precipitation). It has high-temperature, adult-plant resistance to the current races of stripe rust, is intermediate in height, has midseason maturity, and has an average test weight and high grain yield potential. Jasper has end-use quality properties similar or superior to those of 'Stephens', 'Puma', and 'Otto'.*

Carter, E., Hain, C., Anderson, M., & Steinschneider, S. (2018). A water balance-based, spatiotemporal evaluation of terrestrial evapotranspiration products across the contiguous United States. *Journal of Hydrometeorology, 19*(5), 891-905. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047954522&doi=10.1175%2fJHM-D-17-0186.1&partnerID=40&md5=8fc921277427b0b44bc2f6702fa9ab47. doi:10.1175/JHM-D-17-0186.1
Research Tags: Water
Abstract: *Accurate gridded estimates of evapotranspiration (ET) are essential to the analysis of terrestrial water budgets. In this study, ET estimates from three gridded energy balance–based products (ETEB) with independent model formations and data forcings are evaluated for their ability to capture long-term climatology and interannual variability in ET derived from a terrestrial water budget (ETWB) for 671 gauged basins across the contiguous United States. All three ETEB products have low spatial bias and accurately capture interannual*

variability of ETWB in the central United States, where ETEB and ancillary estimates of change in total surface water storage (ΔTWS) from the GRACE satellite project appear to close terrestrial water budgets. In humid regions, ETEB products exhibit higher long-term bias, and the covariability of ETEB and ETWB decreases significantly. Several factors related to either failure of ETWB, such as errors in ΔTWS and precipitation, or failure of ETEB, such as treatment of snowfall and horizontal heat advection, explain some of these discrepancies. These results mirror and build on conclusions from other studies: on interannual time scales, ΔTWS and error in precipitation estimates are nonnegligible uncertainties in ET estimates based on a terrestrial water budget, and this confounds their comparison to energy balance ET models. However, there is also evidence that in at least some regions, climate and landscape features may also influence the accuracy and long-term bias of ET estimates from energy balance models, and these potential errors should be considered when using these gridded products in hydrologic applications.

Carter, S. K., Saenz, D., & Rudolf, V. H. W. (2018). Shifts in phenological distributions reshape interaction potential in natural communities. *Ecology Letters, 21*(8), 1143-1151. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049852692&doi=10.1111%2fele.13081&partnerID=40&md5=5e1601cc0c6feea9945cbf10a88d5b14. doi:10.1111/ele.13081

Research Tags: Wildlife

Abstract: *Climate change has changed the phenologies of species worldwide, but it remains unclear how these phenological changes will affect species interactions and the structure of natural communities. Using a novel approach to analyse long-term data of 66 amphibian species pairs across eight communities, we demonstrate that phenological shifts can significantly alter the interaction potential of coexisting competitors. Importantly, these changes in interaction potential were mediated by non-uniform, species-specific shifts in entire phenological distributions and consequently could not be captured by metrics traditionally used to quantify phenological shifts. Ultimately, these non-uniform shifts in phenological distributions increased the interaction potential for 25% of species pairs (and did not reduce interaction potential for any species pair), altering temporal community structure and potentially increasing interspecific competition. These results demonstrate the potential of phenological shifts to reshape temporal structure of natural communities, emphasising the importance of considering entire phenological distributions of natural populations.*

Carter, V. A., Brunelle, A., Minckley, T. A., Shaw, J. D., DeRose, R. J., & Brewer, S. (2017). Climate variability and fire effects on quaking aspen in the central Rocky Mountains, USA. *Journal of Biogeography, 44*(6), 1280-1293. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007613550&doi=10.1111%2fjbi.12932&partnerID=40&md5=e0e7006c8789ad5cdc34a2c5c4a5c7fe. doi:10.1111/jbi.12932

Research Tags: Weather, Forestry

Abstract: *Aim*

Our understanding of how climate and fire have impacted quaking aspen (Populus tremuloides Michx.) communities prior to the 20th century is fairly limited. This study analysed the period between 4500 and 2000 cal. yr bp to assess the pre-historic role of climate and fire on an aspen community during an aspen-dominated period.

Location

Long Lake, south-eastern Wyoming, central Rocky Mountains, USA.

Methods

Sedimentary pollen and charcoal were analysed to reconstruct the vegetation and fire history for a subalpine catchment currently dominated by lodgepole pine. Modern pollen-climate relationships were applied to the fossil pollen spectra to interpret past climate variability. Nonparametric ANOVA and Tukey HSD tests were used to determine whether the reconstructed climate and fire parameters were different throughout the study period.

Results

The modern pollen-climate data suggest a c. 150-year long drought centred on 4200 cal. yr bp, which caused the aspen ecotone to shift upslope. Between 3950 and 3450 cal. yr bp, an anomalous period of abundant quaking aspen pollen (Populus) occurred at the study site. Optimal climatic conditions coupled with frequent fires facilitated local quaking aspen dominance for roughly 500 years. After 3450 cal. yr bp, Populus pollen

declined coincident with a return to less frequent fires and conifer dominance. Reconstructed climate variables from 550 cal. yr bp to present suggest conditions were not favourable for quaking aspen establishment at Long Lake. The Tukey HSD test confirms that the period of abundant Populus pollen was significantly different than any other period during this study.
Main conclusions
Quaking aspen shifted upslope in response to warmer temperatures, and persisted for roughly 500 years as a result of optimal climatic conditions and frequent fire events.

Carter, Z. W., Sullivan, B. W., Qualls, R. G., Blank, R. R., Schmidt, C. A., & Verburg, P. S. J. (2018). Charcoal increases microbial activity in eastern sierra nevada forest soils. *Forests, 9*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042187169&doi=10.3390%2ff9020093&partnerID=40&md5=9e6008f8a098d94403b0b824aae11b01. doi:10.3390/f9020093

Research Tags: Forestry, Soil

Abstract: *Fire is an important component of forests in the western United States. Not only are forests subjected to wildfires, but fire is also an important management tool to reduce fuels loads. Charcoal, a product of fire, can have major impacts on carbon (C) and nitrogen (N) cycling in forest soils, but it is unclear how these effects vary by dominant vegetation. In this study, soils collected from Jeffrey pine (JP) or lodgepole pine (LP) dominated areas and amended with charcoal derived from JP or LP were incubated to assess the importance of charcoal on microbial respiration and potential nitrification. In addition, polyphenol sorption was measured in unamended and charcoal-amended soils. In general, microbial respiration was highest at the 1% and 2.5% charcoal additions, but charcoal amendment had limited effects on potential nitrification rates throughout the incubation. Microbial respiration rates decreased but potential nitrification rates increased over time across most treatments. Increased microbial respiration may have been caused by priming of native organic matter rather than the decomposition of charcoal itself. Charcoal had a larger stimulatory effect on microbial respiration in LP soils than JP soils. Charcoal type had little effect on microbial processes, but polyphenol sorption was higher on LP-derived than JP-derived charcoal at higher amendment levels despite surface area being similar for both charcoal types. The results from our study suggest that the presence of charcoal can increase microbial activity in soils, but the exact mechanisms are still unclear.*

Carver, A. R., Ross, J. D., Augustine, D. J., Skagen, S. K., Dwyer, A. M., Tomback, D. F., & Wunder, M. B. (2017). Weather radar data correlate to hail-induced mortality in grassland birds. *Remote Sensing in Ecology and Conservation, 3*(2), 90-101. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021383951&doi=10.1002%2frse2.41&partnerID=40&md5=ce1b503edcad5c45ff2db1c8c89ada2b. doi:10.1002/rse2.41

Research Tags: Wildlife, Weather, Grassland

Abstract: *Small-bodied terrestrial animals such as songbirds (Order Passeriformes) are especially vulnerable to hail-induced mortality; yet, hail events are challenging to predict, and they often occur in locations where populations are not being studied. Focusing on nesting grassland songbirds, we demonstrate a novel approach to estimate hail-induced mortality. We quantify the relationship between the probability of nests destroyed by hail and measured Level-III Next Generation Radar (NEXRAD) data, including atmospheric base reflectivity, maximum estimated size of hail and maximum estimated azimuthal wind shear. On 22 June 2014, a hailstorm in northern Colorado destroyed 102 out of 203 known nests within our research site. Lark bunting (Calamospiza melanocorys) nests comprised most of the sample (n = 186). Destroyed nests were more likely to be found in areas of higher storm intensity, and distributions of NEXRAD variables differed between failed and surviving nests. For 133 ground nests where nest-site vegetation was measured, we examined the ameliorative influence of woody vegetation, nest cover and vegetation density by comparing results for 13 different logistic regression models incorporating the independent and additive effects of weather and vegetation variables. The most parsimonious model used only the interactive effect of hail size and wind shear to predict the probability of nest survival, and the data provided no support for any of the models without this predictor. We conclude that vegetation structure may not mitigate mortality from severe hailstorms and that weather radar products can be used remotely to estimate potential for hail mortality of nesting grassland birds. These insights will improve the efficacy of grassland bird population models under predicted climate change scenarios.*

Cary, G. J., Davies, I. D., Bradstock, R. A., Keane, R. E., & Flannigan, M. D. (2017). Importance of fuel treatment for limiting moderate-to-high intensity fire: findings from comparative fire modelling. *Landscape Ecology, 32*(7), 1473-1483. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84982951909&doi=10.1007%2fs10980-016-0420-8&partnerID=40&md5=1adf817a39b38ee4ee9848ee81ff57dc. doi:10.1007/s10980-016-0420-8

Research Tags:

Abstract:

Castellanos-Acuña, D., Vance-Borland, K. W., St. Clair, J. B., Hamann, A., López-Upton, J., Gómez-Pineda, E., . . . Sáenz-Romero, C. (2018). Climate-based seed zones for Mexico: guiding reforestation under observed and projected climate change. *New Forests, 49*(3), 297-309. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035783363&doi=10.1007%2fs11056-017-9620-6&partnerID=40&md5=3ddbb3cf1781eb8f28f612b8e3e29066. doi:10.1007/s11056-017-9620-6

Research Tags: Forestry

Abstract: *Context*

Wildland fire intensity influences natural communities, soil properties, erosion, and sequestered carbon. Measuring effectiveness of fuel treatment for reducing area of higher intensity unplanned fire is argued to be more meaningful than determining effect on total unplanned area burned.

Objectives

To contrast the relative importance of fuel treatment effort, ignition management effort and weather for simulated total area burned and area burned by moderate-to-high intensity fire, and to determine the level of consensus among independent models.

Methods

Published and previously unreported data from simulation experiments using three landscape fire models, two incorporating weather from south-eastern Australia and one with weather from a Mediterranean location, were compared. The comparison explored variation in fuel treatment and ignition management effort across ten separate years of daily weather. Importance of these variables was measured by the Relative Sum of Squares in a Generalised Linear Model analysis of total pixels burned and pixels burned with moderate-to-high intensity fire.

Results

Variation in fuel treatment effort, from 0 to 30 % of landscape treated, explained less than 7 % of variation in both total area burned and area burned by moderate-to-high intensity fire. This was markedly less than that explained by variation in ignition management effort (0–75 % of ignitions prevented or extinguished) and weather year in all models.

Conclusions

Increased fuel treatment effort, within a range comparable to practical operational limits, was no more important in controlling simulated moderate-to-high intensity unplanned fire than it was for total unplanned area burned.

Castillo, A. C., Goldfarb, B., Johnsen, K. H., Roberds, J. H., & Nelson, C. D. (2018). Genetic variation in water-use efficiency (WUE) and growth in mature longleaf pine. *Forests, 9*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057000326&doi=10.3390%2ff9110727&partnerID=40&md5=a34a028ce11b4a2bbb9cf2cc8d1be207. doi:10.3390/f9110727

Research Tags: Forestry, Water

Abstract: *The genetic and physiological quality of seedlings is a critical component for longleaf pine (Pinus palustris Mill.) restoration, because planting genetic material that is adapted to environmental stress is required for long-term restoration success. Planting trees that exhibit high water-use efficiency (WUE) is a practice that could maximize this species' survival and growth in a changing climate. Our study evaluates genetic variation in WUE and growth, as well as WUE-growth relationships, a key step to determine potential for breeding and planting trees with high WUE. We measured carbon isotope discrimination (Δ)—a proxy for WUE—in 106 longleaf pine increment cores extracted from trees belonging to nine full-sib families. Tree diameter and total tree height were also measured at ages 7, 17, 30 and 40 years. Each increment core was divided into segments corresponding to ages 7–17, 18–30 and 31–40, representing early, intermediate and mature growth of the*

trees. We identified significant genetic variation in DBH and WUE among families that merit further exploration for identifying trees that can potentially withstand drought stress. Mean family growth rates were not associated with mean family values for carbon isotope discrimination. Family variation in both diameter growth and WUE but no relationship between family values for these traits, suggests it is possible to improve longleaf pines in both diameter growth and WUE through appropriate breeding.

Castillo, J. M., Gallego-Tévar, B., Figueroa, E., Grewell, B. J., Vallet, D., Rousseau, H., . . . Aïnouche, M. (2018). Low genetic diversity contrasts with high phenotypic variability in heptaploid Spartina densiflora populations invading the Pacific coast of North America. *Ecology and Evolution, 8*(10), 4992-5007. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047859349&doi=10.1002%2fece3.4063&partnerID=40&md5=9481137bc013aa1474e639abe436d49b. doi:10.1002/ece3.4063

Research Tags: Grassland

Abstract: *Species can respond to environmental pressures through genetic and epigenetic changes and through phenotypic plasticity, but few studies have evaluated the relationships between genetic differentiation and phenotypic plasticity of plant species along changing environmental conditions throughout wide latitudinal ranges. We studied inter- and intrapopulation genetic diversity (using simple sequence repeats and chloroplast DNA sequencing) and inter- and intrapopulation phenotypic variability of 33 plant traits (using field and common-garden measurements) for five populations of the invasive cordgrass Spartina densiflora Brongn. along the Pacific coast of North America from San Francisco Bay to Vancouver Island. Studied populations showed very low genetic diversity, high levels of phenotypic variability when growing in contrasted environments and high intrapopulation phenotypic variability for many plant traits. This intrapopulation phenotypic variability was especially high, irrespective of environmental conditions, for those traits showing also high phenotypic plasticity. Within-population variation represented 84% of the total genetic variation coinciding with certain individual plants keeping consistent responses for three plant traits (chlorophyll b and carotenoid contents, and dead shoot biomass) in the field and in common-garden conditions. These populations have most likely undergone genetic bottleneck since their introduction from South America; multiple introductions are unknown but possible as the population from Vancouver Island was the most recent and one of the most genetically diverse. S. densiflora appears as a species that would not be very affected itself by climate change and sea-level rise as it can disperse, establish, and acclimate to contrasted environments along wide latitudinal ranges.*

Cavigelli, M. A., Nash, P. R., Gollany, H. T., Rasmann, C., Polumsky, R. W., Le, A. N., & Conklin, A. E. (2018). Simulated soil organic carbon changes in Maryland are affected by tillage, climate change, and crop yield. *Journal of Environmental Quality, 47*(4), 588-595. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049469367&doi=10.2134%2fjeq2017.07.0291&partnerID=40&md5=09c3178bd769b52dd6cdd12ea863fbd7. doi:10.2134/jeq2017.07.0291

Research Tags: Soil, Crops

Abstract: *The impact of climate change on soil organic C (SOC) stocks in no-till (NT) and conventionally tilled (CT) agricultural systems is poorly understood. The objective of this study was to simulate the impact of projected climate change on SOC to 50-cm soil depth for grain cropping systems in the southern Mid-Atlantic region of the United States. We used SOC and other data from the long-term Farming Systems Project in Beltsville, MD, and CQESTR, a process-based soil C model, to predict the impact of cropping systems and climate (air temperature and precipitation) on SOC for a 40-yr period (2012–2052). Since future crop yields are uncertain, we simulated five scenarios with differing yield levels (crop yields from 1996–2014, and at 10 or 30% greater or lesser than these yields). Without change in climate or crop yields (baseline conditions) CQESTR predicted an increase in SOC of 0.014 and 0.021 Mg ha−1 yr−1 in CT and NT, respectively. Predicted climate change alone resulted in an SOC increase of only 0.002 Mg ha−1 yr−1 in NT and a decrease of 0.017 Mg ha−1 yr−1 in CT. Crop yield declines of 10 and 30% led to SOC decreases between 2 and 8% compared with 2012 levels. Increasing crop yield by 10 and 30% was sufficient to raise SOC 2 and 7%, respectively, above the climate-only scenario under both CT and NT between 2012 and 2052. Results indicate that under these simulated conditions, the negative impact of climate change on SOC levels could be mitigated by crop yield increases.*

Certano, A. K., Fernandez, C. W., Heckman, K. A., & Kennedy, P. G. (2018). The afterlife effects of fungal morphology: Contrasting decomposition rates between diffuse and rhizomorphic necromass. *Soil Biology and Biochemistry, 126*, 76-81. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054059298&doi=10.1016%2fj.soilbio.2018.08.002&partnerID=40&md5=db285d2cd88c908dbb7bccc88ece65ef. doi:10.1016/j.soilbio.2018.08.002

Research Tags: Soil

Abstract: *Microbial necromass is now recognized as an important input into stable soil organic matter pools in terrestrial ecosystems. While melanin and nitrogen content have been identified as factors that influence the decomposition rate of fungal necromass, the effects of mycelial morphology on necromass decomposition remain largely unknown. Using the fungus Armillaria mellea, which produces both diffuse and rhizomorphic biomass in pure culture, we assessed the effects of necromass morphology on decomposition in a 12 week field experiment in Pinus and Quercus dominated forests in Minnesota, USA. Diffuse and rhizomorphic necromass was incubated for 2, 4, 6, and 12 weeks to assess differences in decay rates and changes in residual necromass chemistry. Rhizomorphic necromass decomposed significantly slower than diffuse necromass in both forest types. This difference was correlated with initial necromass chemistry, particularly nitrogen content, but not with hydrophobicity. Over the course of the incubation, there was a greater change in the chemistry of diffuse versus rhizomorphic necromass, with both becoming more enriched in recalcitrant compounds. Given that many fungi with both saprotrophic and mycorrhizal ecologies produce rhizomorphs, these results suggest that mycelial morphology should be explicitly considered as an important functional trait influencing the rate of fungal necromass decomposition.*

Chambers, J. C., Beck, J. L., Bradford, J. B., Bybee, J., Campbell, S., Carlson, J., . . . Wuenschel, A. (2017). Science framework for conservation and restoration of the sagebrush biome: Linking the department of the interior's integrated rangeland fire management strategy to long-term strategic conservation actions. *USDA Forest Service - General Technical Report RMRS-GTR, 2017*(360), 1-217. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019017434&partnerID=40&md5=9d89c132faa65881f45b1f1f888d29a6.

Research Tags: Grassland

Abstract: *The Science Framework is intended to link the Department of the Interior's Integrated Rangeland Fire Management Strategy with long-term strategic conservation actions in the sagebrush biome. The Science Framework provides a multiscale approach for prioritizing areas for management and determining effective management strategies within the sagebrush biome. The emphasis is on sagebrush (Artemisia spp.) ecosystems and Greater sage-grouse (Centrocercus urophasianus). The approach provided in the Science Framework links sagebrush ecosystem resilience to disturbance and resistance to nonnative, invasive plant species to species habitat information based on the distribution and abundance of focal species. A geospatial process is presented that overlays information on ecosystem resilience and resistance, species habitats, and predominant threats and that can be used at the mid-scale to prioritize areas for management. A resilience and resistance habitat matrix is provided that can help decisionmakers evaluate risks and determine appropriate management strategies. Prioritized areas and management strategies can be refined by managers and stakeholders at the local scale based on higher resolution data and local knowledge. Decision tools are discussed for determining appropriate management actions for areas that are prioritized for management. Geospatial data, maps, and models are provided through the U.S. Geological Survey (USGS) ScienceBase and Bureau of Land Management (BLM) Landscape Approach Data Portal. The Science Framework is intended to be adaptive and will be updated as additional data become available on other values and species at risk. It is anticipated that the Science Framework will be widely used to: (1) inform emerging strategies to conserve sagebrush ecosystems, sagebrush dependent species, and human uses of the sagebrush system, and (2) assist managers in prioritizing and planning on-the-ground restoration and mitigation actions across the sagebrush biome.*

Chao, X., Yasarer, L., Bingner, R., & Jia, Y. (2018). *Numerical Modeling of the Lake Water Quality and Upland Watershed Loads.* Paper presented at the World Environmental and Water Resources Congress 2018: Watershed Management, Irrigation and Drainage, and Water Resources Planning and Management - Selected Papers from the World Environmental and Water Resources Congress 2018.

Research Tags:

Abstract:

Chappell, A., Lee, J. A., Baddock, M., Gill, T. E., Herrick, J. E., Leys, J. F., . . . Webb, N. P. (2018). A clarion call for aeolian research to engage with global land degradation and climate change. *Aeolian Research, 32*, A1-A3. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043526784&doi=10.1016%2fj.aeolia.2018.02.007&partnerID=40&md5=8cb21dd0510196eb4bd481f10d09b4fb. doi:10.1016/j.aeolia.2018.02.007

Research Tags: Water

Abstract: *This paper presents a technical approach to link the watershed model and surface water quality model to study the effect of pollutant loads from upland watershed on the water quality of the receiving water body. The AnnAGNPS watershed model, developed at the USDA ARS, National Sedimentation Laboratory (NSL), is applied to simulate the loads of water, sediment, and nutrients from upland watersheds. In this model, the effects of land use/land cover, soil properties, climate, agriculture management, etc. on the watershed loads are considered. The computed results are used as boundary conditions for CCHE_WQ, a water quality model developed at the National Center for Computational Hydroscience and Engineering (NCCHE), to simulate the water quality concentration in water bodies. In this model, the effects of sediment on the water quality constituents are considered, and the distributions of nutrients, chlorophyll, and dissolved oxygen in the water body can be obtained. This technical approach is tested using Beasley Lake watershed in the Mississippi Delta as a study site. The lake water quality is monitored by NSL, and the measured data is used to calibrate and validate the numerical model. In this lake, sediment concentration is relatively high, so the sediment-associated water quality processes need to be taken into account. This research provides a useful tool to assess long term impacts of watershed nutrient and sediment loads on the water quality of the receiving water bodies.*

Chappell, A., Webb, N. P., Leys, J. F., Waters, C. M., Orgill, S., & Eyres, M. J. (2019). Minimising soil organic carbon erosion by wind is critical for land degradation neutrality. *Environmental Science and Policy, 93*, 43-52. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058804510&doi=10.1016%2fj.envsci.2018.12.020&partnerID=40&md5=d63bb10c781b541aadafe117457a9ce3. doi:10.1016/j.envsci.2018.12.020

Research Tags: Soil

Abstract: The Land Degradation-Neutrality (LDN) framework of the United Nations Convention to Combat Desertification (UNCCD) is underpinned by three complementary interactive indicators (metrics: vegetation cover, net primary productivity; NPP and soil organic carbon; SOC) as proxies for change in land-based natural capital. The LDN framework assumes that SOC changes slowly, primarily by decomposition and respiration of CO2 to the atmosphere. However, there is growing evidence that soil erosion by wind, water and tillage also reduces SOC stocks rapidly after land use and cover change. Here, we modify a physically-based wind erosion sediment transport model to better represent the vegetation cover (using land surface aerodynamic roughness; that is the plant canopy coverage, stone cover, soil aggregates, etc. that protects the soil surface from wind erosion) and quantify the contribution of wind erosion to global SOC erosion (2001–2016). We use the wind erosion model to identify global dryland regions where SOC erosion by wind may be a significant problem for achieving LDN. Selected sites in global drylands also show SOC erosion by wind accelerating over time. Without targeting and reducing SOC erosion, management practices in these regions will fail to sequester SOC and reduce land degradation. We describe the interrelated nature of the LDN indicators, the importance of including SOC erosion by wind erosion and how by explicitly accounting for wind erosion processes, we can better represent the physical effects of changing land cover on land degradation. Our results for Earth's drylands show that modelling SOC stock reduction by wind erosion is better than using land cover and SOC independently. Furthermore, emphasising the role of wind erosion in UNCCD and Intergovernmental Panel on Climate Change (IPCC) reporting will better support LDN and climate change mitigation and adaptation globally.

Chater, J. M., Santiago, L. S., Merhaut, D. J., Jia, Z., Mauk, P. A., & Preece, J. E. (2018). Orchard establishment, precocity, and eco-physiological traits of several pomegranate cultivars. *Scientia Horticulturae, 235*, 221-227. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043374406&doi=10.1016%2fj.scienta.2018.02.032

&partnerID=40&md5=f43b5205a2fd243398eaddee53c309b2. doi:10.1016/j.scienta.2018.02.032
Research Tags: Crops
Abstract: *California faces many threats to food security, ranging from water limitations resulting from long-term drought to invasive pests and diseases. Major tree crops, such as citrus and avocado, are threatened by Citrus Greening and Fusarium Dieback, respectively, posing significant economic losses to growers and farm sustainability. Pomegranate (Punica granatum L.) was previously a minor tree crop in California, but has become an important specialty crop, with planted area increased by 10-fold during the last twenty years, and is currently a $200 million annual industry. Pomegranate is not threatened so far by any pest or disease and is a drought- and salt-tolerant crop that can be cultivated on marginal land, which makes it an attractive alternative crop for the growers facing water and disease issues. For this investigation, two pomegranate field trials were initiated and followed over four years to evaluate site effects on establishment, precocity, photosynthesis and water relations to assist in determining appropriate cultivars for coastal versus inland climates. Traits measured included orchard establishment, photosynthesis, water potential, and flowering and yield traits. There were significant site and cultivar effects on many traits as well as site-cultivar interactions. The coastal trial grew significantly faster than the semi-arid inland site, however, the inland site was more productive than the coastal site for the first three years. Production during year four of establishment was similar at both sites.*

Chen, D., Yu, M., González, G., Zou, X., & Gao, Q. (2017). Climate impacts on soil carbon processes along an elevation gradient in the tropical luquillo experimental forest. *Forests, 8*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015622077&doi=10.3390%2ff8030090&partnerID=40&md5=0faa8be1fbbce2c959d4ca84be56cad5. doi:10.3390/f8030090
Research Tags: Forestry, Soil
Abstract: *Tropical forests play an important role in regulating the global climate and the carbon cycle. With the changing temperature and moisture along the elevation gradient, the Luquillo Experimental Forest in Northeastern Puerto Rico provides a natural approach to understand tropical forest ecosystems under climate change. In this study, we conducted a soil translocation experiment along an elevation gradient with decreasing temperature but increasing moisture to study the impacts of climate change on soil organic carbon (SOC) and soil respiration. As the results showed, both soil carbon and the respiration rate were impacted by microclimate changes. The soils translocated from low elevation to high elevation showed an increased respiration rate with decreased SOC content at the end of the experiment, which indicated that the increased soil moisture and altered soil microbes might affect respiration rates. The soils translocated from high elevation to low elevation also showed an increased respiration rate with reduced SOC at the end of the experiment, indicating that increased temperature at low elevation enhanced decomposition rates. Temperature and initial soil source quality impacted soil respiration significantly. With the predicted warming climate in the Caribbean, these tropical soils at high elevations are at risk of releasing sequestered carbon into the atmosphere.*

Chen, G., Kolb, L., Cavigelli, M. A., Weil, R. R., & Hooks, C. R. R. (2018). Can conservation tillage reduce N<inf>2</inf>O emissions on cropland transitioning to organic vegetable production? *Science of the Total Environment, 618*, 927-940. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032378724&doi=10.1016%2fj.scitotenv.2017.08.296&partnerID=40&md5=1dc205afe62a59fc801d802e84292049. doi:10.1016/j.scitotenv.2017.08.296
Research Tags: Soil, Crops, Emissions
Abstract: *Nitrous oxide (N2O) is an important greenhouse gas and a catalyst of stratospheric ozone decay. Agricultural soils are the source of 75% of anthropogenic N2O emissions globally. Recently, significant attention has been directed at examining effects of conservation tillage on carbon sequestration in agricultural systems. However, limited knowledge is available regarding how these practices impact N2O emissions, especially for organic vegetable production systems. In this context, a three-year study was conducted in a well-drained sandy loam field transitioning to organic vegetable production in the Mid-Atlantic coastal plain of USA to investigate impacts of conservation tillage [strip till (ST) and no-till (NT)] and conventional tillage (CT) [with black plastic mulch (CT-BP) and bare-ground (CT-BG)] on N2O emissions. Each year, a winter cover crop mixture (forage radish: Raphanus sativus var. longipinnatus, crimson clover: Trifolium incarnatum L., and rye: Secale cereale L.) was grown and flail-mowed in the spring. Nearly 80% of annual N2O-nitrogen (N) emissions*

occurred during the vegetable growing season for all treatments. Annual N2O-N emissions were greater in CT-BP than in ST and NT, and greater in CT-BG than in NT, but not different between CT-BG and CT-BP, ST and NT, or CT-BG and ST. Conventional tillage promoted N mineralization and plastic mulch increased soil temperature, which contributed to greater N2O-N fluxes. Though water filled porosity in NT was higher and correlated well with N2O-N fluxes, annual N2O-N emissions were lowest in NT suggesting a lack of substrates for nitrification and denitrification processes. Crop yield was lowest in NT in Year 1 and CT-BP in Year 3 but yield-scaled N2O-N emissions were consistently greatest in CT-BP and lowest in NT each year. Our results suggest that for coarse-textured soils in the coastal plain with winter cover crops, conservation tillage practices may reduce N2O emissions in organic vegetable production systems.

Chen, J., Brissette, F. P., Zhang, X. J., Chen, H., Guo, S., & Zhao, Y. (2019). Bias correcting climate model multi-member ensembles to assess climate change impacts on hydrology. *Climatic Change, 153*(3), 361-377. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062153907&doi=10.1007%2fs10584-019-02393-x&partnerID=40&md5=17615a2c4db45e4b64eb47bd0db549fc. doi:10.1007/s10584-019-02393-x

Research Tags: Research, Water

Abstract: *Bias correction is usually applied to climate model outputs before they are used as inputs to environmental models for impact studies. Every climate model is post-processed independently of others to account for biases originating from model structure and internal variability. To better understand the role of internal variability, multi-member ensembles (multiple runs of a single climate model, with identical forcing but different initial conditions) have now become common in the modeling community. Bias correcting such ensembles requires specific considerations. Correcting all members of such an ensemble independently would force all of them to the target distribution, thus removing the signature of natural variability over the calibration period. How this undesirable effect would propagate onto subsequent time periods is unknown. This study proposes three bias correction variants of a multi-member ensemble and compares their performances against an independent correction of each individual member of the ensemble. The comparison is based on precipitation and temperature, as well as on resulting streamflows simulated by a hydrological model. Two multi-member ensembles (5-member CanESM2 and 10-member CSIRO-MK3.6) were used for a subtropical monsoon watershed in China. The results show that all bias correction methods reduce precipitation and temperature biases for all ensemble members. As expected, independent correction reduces the spread of each ensemble over the calibration period. This is, however, followed by an overestimation of the spread over the subsequent validation period. Pooling all members to calculate common bias correction factors produces the best results over the calibration period; however, the difference among three bias correction variants becomes less clear over the validation period due to internal variability, and even less so when considering streamflows, as the impact model adds its own uncertainty.*

Chen, J., Chopra, R., Hayes, C., Morris, G., Marla, S., Burke, J., . . . Burow, G. (2017). Genome-wide association study of developing leaves' heat tolerance during vegetative growth stages in a sorghum association panel. *Plant Genome, 10*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85024495931&doi=10.3835%2fplantgenome2016.09.0091&partnerID=40&md5=8c92e5b74c171bbd870205db0ae41cd1. doi:10.3835/plantgenome2016.09.0091

Research Tags: Crops, Weather, Energy

Abstract: *Heat stress reduces grain yield and quality worldwide. Enhancing heat tolerance of crops at all developmental stages is one of the essential strategies required for sustaining agricultural production especially as frequency of temperature extremes escalates in response to climate change. Although heat tolerance mechanisms have been studied extensively in model plant species, little is known about the genetic control underlying heat stress responses of crop plants at the vegetative stage under field conditions. To dissect the genetic basis of heat tolerance in sorghum [Sorghum bicolor (L.) Moench], we performed a genome-wide association study (GWAS) for traits responsive to heat stress at the vegetative stage in an association panel. Natural variation in leaf firing (LF) and leaf blotching (LB) were evaluated separately for 3 yr in experimental fields at three locations where sporadic heat waves occurred throughout the sorghum growing season. We identified nine single-nucleotide polymorphisms (SNPs) that were significantly associated with LF and five SNPs that were associated with LB. Candidate genes near the SNPs were investigated and 14 were directly linked to biological pathways involved in plant stress responses including heat stress response. The findings of this study*

provide new knowledge on the genetic control of leaf traits responsive to heat stress in sorghum, which could aid in elucidating the genetic and molecular mechanisms of vegetative stage heat tolerance in crops. The results also provide candidate markers for molecular breeding of enhanced heat tolerance in cereal and bioenergy crops.

Chen, J., John, R., Sun, G., Fan, P., Henebry, G. M., Fernández-Giménez, M. E., . . . Qi, J. (2018). Prospects for the sustainability of social-ecological systems (SES) on the Mongolian plateau: Five critical issues. *Environmental Research Letters, 13*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060137733&doi=10.1088%2f1748-9326%2faaf27b&partnerID=40&md5=aeb1e76d66fc87ffb591651ab4e44124. doi:10.1088/1748-9326/aaf27b
Research Tags: Grassland
Abstract: *The Mongolian Plateau hosts two different governments: the Mongolian People's Republic and the Inner Mongolia Autonomous Region, a provincial-level government of the People's Republic of China. The divergence between these governments has widened in the past century, mostly due to a series of institutional changes that generated different socioeconomic and demographic trajectories. Due to its high latitude and altitude, the Plateau has been highly sensitive to the rapid changes in global and regional climates that have altered the spatial and temporal distributions of energy and water. Based on a recent workshop to synthesize findings on the sustainability of the Plateau amidst socioeconomic and environmental change, we identify five critical issues facing the social-ecological systems (SES): (1) divergent and uncertain changes in social and ecological characteristics; (2) declining prevalence of nomadism; (3) consequences of rapid urbanization in transitional economies; (4) the unsustainability of large-scale afforestation efforts in the semi-arid and arid areas of Inner Mongolia; and (5) the role of institutional changes in shaping the SES on the Plateau. We emphasize that lessons learned in Inner Mongolia are valuable, but may not always apply to Mongolia. National land management policies and regulations have long-term effects on the sustainability of SES; climate change adaptation policies and practices must be tuned to local conditions and should be central to decision-making on natural resource management and socioeconomic development pathways.*

Chen, J., Zhang, X. J., & Li, X. (2018). A weather generator-based statistical downscaling tool for site-specific assessment of climate change impacts. *Transactions of the ASABE, 61*(3), 977-993. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049782072&doi=10.13031%2ftrans.12601&partnerID=40&md5=57a698b5a664392c20b3daeeb9652b5a. doi:10.13031/trans.12601
Research Tags: Research
Abstract: *Statistical downscaling approaches are usually used to bridge the gap between climate model outputs and data requirements of impact models such as crop and soil erosion models. This study synthesizes, integrates, and standardizes a statistical downscaling method that was initially developed in 2005 and subsequently evaluated and improved during the last decade. A new downscaling software program, Generator for Point Climate Change (GPCC), has been developed to automate and visualize the method to assist end users with detailed technical and user documentation. GPCC readily generates daily time series of climate change scenarios for local and site-specific climate change impact studies using monthly projections from global climate models or regional climate models. The downscaled variables include precipitation and maximum and minimum temperatures. This software provides a simple but effective climate downscaling tool for assessing the impacts of climate change on crop production, soil hydrology, and soil erosion at a field scale. The tool can also provide an alternative downscaling method to facilitate the international collaborative efforts of the Agricultural Model Intercomparison and Improvement Project (AgMIP) for simulation of world food production and food security assessment. The detailed downscaling methods, their scientific bases, and the advantages of GPCC over other commonly used downscaling methods are presented. GPCC is written in the Matlab language, and a standalone version can be run on Windows XP or above without Matlab software. The tool has a graphical user interface that is simple and easy to generate downscaled climates as well as to visualize downscaled outputs. Each interface tab and key button and their functions are described to facilitate its widespread application.*

Chen, M., Griffis, T. J., Baker, J. M., Wood, J. D., Meyers, T., & Suyker, A. (2018). Comparing crop growth and carbon budgets simulated across AmeriFlux agricultural sites using the Community Land Model (CLM). *Agricultural*

and Forest Meteorology, 256-257, 315-333. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044952270&doi=10.1016%2fj.agrformet.2018.03.012&partnerID=40&md5=dd8504c9f21cbf3a92944bae049883d3. doi:10.1016/j.agrformet.2018.03.012
Research Tags: Research, Crops
Abstract: *Improvement of process-based crop models is needed to achieve high fidelity forecasts of regional energy, water, and carbon exchanges. However, most state-of-the-art Land Surface Models (LSMs) assessed in the fifth phase of the Coupled Model Inter-comparison project (CMIP5) simulated crops as unmanaged C3 or C4 grasses. This study evaluated the crop-enabled version of one of the most widely used LSMs, the Community Land Model (CLM4-Crop), for simulating corn and soybean agro-ecosystems at relatively long-time scales (up to 11 years) using 54 site-years of data. We found that CLM4-Crop had a biased phenology during the early growing season and that carbon emissions from corn and soybean were underestimated. The model adopts universal physiological parameters for all crop types neglecting the fact that different crops have different specific leaf area, leaf nitrogen content and vcmax25, etc. As a result, model performance varied considerably according to crop type. Overall, the energy and carbon exchange of corn systems were better simulated than soybean systems. Long-term simulations at multiple sites showed that gross primary production (GPP) was consistently over-estimated at soybean sites leading to very large short and long-term biases. A modified model, CLM4-CropM', with optimized phenology and calibrated crop physiological parameters yielded significantly better simulations of gross primary production (GPP), ecosystem respiration (ER) and leaf area index (LAI) at both short (hourly) and long-term (annual to decadal) timescales for both soybean and corn.*

Chen, R., Qin, Z., Han, J., Wang, M., Taheripour, F., Tyner, W., . . . Duffield, J. (2018). Life cycle energy and greenhouse gas emission effects of biodiesel in the United States with induced land use change impacts. *Bioresource Technology, 251*, 249-258. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039166786&doi=10.1016%2fj.biortech.2017.12.031&partnerID=40&md5=ad745148e7672bced6ba04ccfa005606. doi:10.1016/j.biortech.2017.12.031
Research Tags: Emissions, Energy
Abstract: *This study conducted the updated simulations to depict a life cycle analysis (LCA) of the biodiesel production from soybeans and other feedstocks in the U.S. It addressed in details the interaction between LCA and induced land use change (ILUC) for biodiesel. Relative to the conventional petroleum diesel, soy biodiesel could achieve 76% reduction in GHG emissions without considering ILUC, or 66–72% reduction in overall GHG emissions when various ILUC cases were considered. Soy biodiesel's fossil fuel consumption rate was also 80% lower than its petroleum counterpart. Furthermore, this study examined the cause and the implication of each key parameter affecting biodiesel LCA results using a sensitivity analysis, which identified the hot spots for fossil fuel consumption and GHG emissions of biodiesel so that future efforts can be made accordingly. Finally, biodiesel produced from other feedstocks (canola oil and tallow) were also investigated to contrast with soy biodiesel and petroleum diesel.*

Chen, X., Qi, Z., Gui, D., Gu, Z., Ma, L., Zeng, F., & Li, L. (2019). Simulating impacts of climate change on cotton yield and water requirement using RZWQM2. *Agricultural Water Management, 222*, 231-241. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067182352&doi=10.1016%2fj.agwat.2019.05.030&partnerID=40&md5=d0e152307e293d87201c84f80b3507d9. doi:10.1016/j.agwat.2019.05.030
Research Tags: Crops, Research
Abstract: *Assessing the potential impacts of climate change on cotton (Gossypium hirsutum L.) yield and water demand is crucial in allocating water resources. In this study, cotton yield and water requirement under future climate scenarios was evaluated in Qira oasis, China. Six general circulation models (GCMs), under moderate and high representative concentration pathway (RCP) scenarios (4.5 and 8.5) and elevated CO2 (eCO2) concentration (218–502ppm), were used to project climate for near (2041–2060) and far future (2061–2080) periods. With current management practices, the impacts of climate change on cotton yield and water requirement were simulated using the Root Zone Water Quality Model (RZWQM2), which was calibrated with experimental data (2007–2014) in a previous study. For the study region, the GCMs predicted an increase of 2.38°C and 3.24°C in temperature and 3.5% and 5.3% mm in precipitation during the growing seasons (April–October) for 2041–2060 and 2061–2080, respectively. For 2041–2060, seed cotton yield was projected to increase by 0.24Mg ha−1 (5.6%) under RCP4.5 and 0.19Mg ha−1 (4.5%) under RCP8.5 comparing to the*

baseline yield of 4.23Mg ha-1; however, for 2061–2080, the model predicted a 0.32Mg ha−1 (7.6%) yield increase under RCP4.5 but a 0.28Mg ha−1 (6.5%) decrease under RCP8.5. The increased cotton yield was mainly attributable to the fertilization effect of eCO2 dominating the detrimental effects of shorter growing seasons (8.0–9.5 days). Alleviated low temperature stress also slightly promoted cotton yield. Averaged across the RCP4.5 and RCP8.5 scenarios, simulated cropping season water requirement for the 2041–2060 and 2061–2080 were 728mm and 706mm, respectively, an decrease by 7.5% and 10.3% relative to the present day baseline (786mm), respectively. This decrease was attributed to shorter growing seasons and eCO2. These results suggest that the region's agricultural water crisis may be alleviated in the future.

Chen, Y., Marek, G. W., Marek, T. H., Moorhead, J. E., Heflin, K. R., Brauer, D. K., . . . Srinivasan, R. (2019). Simulating the impacts of climate change on hydrology and crop production in the Northern High Plains of Texas using an improved SWAT model. *Agricultural Water Management, 221*, 13-24. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064909717&doi=10.1016%2fj.agwat.2019.04.021&partnerID=40&md5=baac4d916d46113037fda1bf707c6503. doi:10.1016/j.agwat.2019.04.021

Research Tags: Crops, Water, Research

Abstract: *Modeling the effects of climate change on hydrology and crop yield provides opportunities for choosing appropriate crops for adapting to climate change. In this study, climate change impacts on irrigated corn and sorghum, dryland (rainfed) sorghum, and continuous fallow in the Northern High Plains of Texas were evaluated using an improved Soil and Water Assessment Tool (SWAT) model equipped with management allowed depletion (MAD) irrigation scheduling. Projected climate data (2020–2099) from the Coupled Model Intercomparison Project Phase 5 (CMIP 5) of 19 General Circulation Models (GCMs) were used. Climate data were divided into four 20-year periods of near future (2020–2039), middle (2040–2059), late (2060–2079), and end (2080–2099) of the 21st century under two Representative Concentration Pathway (RCP) emission scenarios (RCP 4.5 and RCP 8.5). For irrigated corn, median annual crop evapotranspiration (ET) and irrigation decreased by 8%–25% and 15%–42%, respectively, under the climate change scenarios compared to the historical period (2001–2010). The median yield was reduced by 3%–22% with exponentially decreases in the latter half of the 21st century. For sorghum, the reduction of median annual crop ET ranged from 6%–27%. However, the decline in the median annual irrigation was within 15%, except for the 2060–2079 and 2080–2099 periods under RCP 8.5 scenarios with 30% and 49% reductions in median annual irrigation. The median irrigated sorghum yield declined by 6%–42%. The median annual crop ET of dryland sorghum decreased by 10%–16%. The reduction in median yield was within 10% of the historical dryland sorghum yield. The decrease in median annual evaporation varied from 15%–23% under future continuous fallow conditions. The elevated CO2 level of future climate scenarios was the primary factor for the decrease in the ET and irrigation. The reduction in future crop yield was mainly attributed to the shortening of the maturity period caused by increased future temperature.*

Cheng, Q., Zhou, C., Jiang, W., Zhao, X., Via, B. K., & Wan, H. (2018). Mechanical and physical properties of oriented strand board exposed to high temperature and relative humidity and coupled with near-infrared reflectance modeling. *Forest Products Journal, 68*(1), 78-85. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055505895&doi=10.13073%2fFPJ-D-16-00069&partnerID=40&md5=ce46f544dc5870955b54a62f8ba558e6. doi:10.13073/FPJ-D-16-00069

Research Tags: Forestry

Abstract: *The mechanism underlying thermal degradation of oriented strand board was tested under a humid environment. Near-infrared reflectance (NIR) spectroscopy coupled with chemometric modeling was utilized to better understand the degradation of functional groups over time. The flexural properties, internal bond (IB), water absorption, and thickness swelling were tested after exposure to various times of 0, 3, 6, and 9 weeks in a climate-controlled laboratory to 76.7°C and 60 percent relative humidity. The largest reduction in all flexural and physical properties occurred during the first 3 weeks of exposure and then leveled off thereafter, while IB decreased significantly through the 9-week period (α = 0.05). Chemometric models built from NIR spectra revealed pertinent chemical changes in wood chemistry and resin components.*

Chhin, S., Zalesny, R. S., Parker, W. C., & Brissette, J. (2018). Dendroclimatic analysis of white pine (Pinus strobus L.) using long-term provenance test sites across eastern North America. *Forest Ecosystems, 5*(1). Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050395073&doi=10.1186%2fs40663-018-0136-0&partnerID=40&md5=e259301aef0e19a6e3731cbf0b58299f. doi:10.1186/s40663-018-0136-0

Research Tags: Forestry

Abstract: *Background*

The main objective of this study was to examine the climatic sensitivity of the radial growth response of 13 eastern white pine (Pinus strobus L.) provenances planted at seven test sites throughout the northern part of the species' native distribution in eastern North America.

Methods

The test sites (i.e., Wabeno, Wisconsin, USA; Manistique, Michigan, USA; Pine River, Michigan, USA; Newaygo, Michigan, USA; Turkey Point, Ontario, Canada; Ganaraska, Ontario, Canada; and Orono, Maine, USA) examined in this study were part of a range-wide white pine provenance trial established in the early 1960s in the eastern United States and Canada. Principal components analysis (PCA) was used to examine the main modes of variation [first (PC1) and second (PC2) principal component axes] in the standardized radial growth indices of the provenances at each test site. The year scores for PC1 and PC2 were examined in relation to an array of test site climate variables using multiple regression analysis to examine the commonality of growth response across all provenances to the climate of each test site. Provenance loadings on PC1 and PC2 were correlated with geographic parameters (i.e., latitude, longitude, elevation) and a suite of biophysical parameters associated with provenance origin location.

Results

The amount of variation in radial growth explained by PC1 and PC2 ranged from 43.4% to 89.6%. Dendroclimatic models revealed that white pine radial growth responses to climate were complex and differed among sites. The key dendroclimatic relationships observed included sensitivity to high temperature in winter and summer, cold temperature in the spring and fall (i.e., beginning and end of the growing season), summer moisture stress, potential sensitivity to storm-induced damage in spring and fall, and both positive and negative effects of higher winter snowfall. Separation of the loadings of provenances on principal component axes was mainly associated with temperature-related bioclimatic parameters of provenance origin at 5 of the 7 test sites close to the climate influence of the Great Lakes (i.e., Wabeno, Manistique, Pine River, Newaygo, and Turkey Point). In contrast, differences in radial growth response to climate at the Ganaraska test site, were driven more by precipitation-related bioclimatic parameters of the provenance origin location while radial growth at the easternmost Orono test site was independent of bioclimate at the provenance origin location.

Conclusions

Study results suggest that genetic adaptation to temperature and precipitation regime may significantly influence radial growth performance of white pine populations selected for use in assisted migration programs to better adapt white pine to a future climate.

Chi, J., Waldo, S., Pressley, S. N., Russell, E. S., O'Keeffe, P. T., Pan, W. L., . . . Lamb, B. K. (2017). Effects of Climatic Conditions and Management Practices on Agricultural Carbon and Water Budgets in the Inland Pacific Northwest USA. *Journal of Geophysical Research: Biogeosciences, 122*(12), 3142-3160. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037973656&doi=10.1002%2f2017JG004148&partnerID=40&md5=d3950aae655702ff537083bf7404f33a. doi:10.1002/2017JG004148

Research Tags: Emissions

Abstract: *Cropland is an important land cover influencing global carbon and water cycles. Variability of agricultural carbon and water fluxes depends on crop species, management practices, soil characteristics, and climatic conditions. In the context of climate change, it is critical to quantify the long-term effects of these environmental drivers and farming activities on carbon and water dynamics. Twenty site-years of carbon and water fluxes covering a large precipitation gradient and a variety of crop species and management practices were measured in the inland Pacific Northwest using the eddy covariance method. The rain-fed fields were net carbon sinks, while the irrigated site was close to carbon neutral during the winter wheat crop years. Sites growing spring crops were either carbon sinks, sources, or neutral, varying with crops, rainfall zones, and tillage practices. Fluxes were more sensitive to variability in precipitation than temperature: annual carbon and water fluxes increased with the increasing precipitation while only respiration increased with temperature in the high-rainfall area. Compared to a nearby rain-fed site, irrigation improved winter wheat production but resulted in large losses of carbon and water to the atmosphere. Compared to conventional tillage, no-till had*

significantly lower respiration but resulted in slightly lower yields and water use efficiency over 4 years. Under future climate change, it is expected that more carbon fixation by crops and evapotranspiration would occur in a warmer and wetter environment.

Chiodi, A. M., Larkin, N. S., & Varner, J. M. (2018). An analysis of Southeastern US prescribed burn weather windows: Seasonal variability and El Niño associations. *International Journal of Wildland Fire, 27*(3), 176-189. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045152332&doi=10.1071%2fWF17132&partnerID=40&md5=251bf596858950326b2d3d82a3047fbb. doi:10.1071/WF17132

Research Tags: Forestry, Weather

Abstract: *Fire plays an important role in wildland ecosystems, critical to sustaining biodiversity, wildlife habitat and ecosystem health. By area, 70% of US prescribed burns take place in the Southeast, where treatment objectives range widely and accomplishing them depends on finding specific weather conditions for the effective and controlled application of fire. The climatological variation of the preferred weather window is examined here using two weather model reanalyses, with focus on conditions critical to smoke dispersion and erratic fire behaviour. Large spatial gradients were evident in some months (e.g. 3× change across the Appalachian Mountains in winter). Over most of the Southeast, availability of preferred conditions in summer was several (up to 8) times less than in autumn or winter. We offer explanation for this variability in terms of the mean seasonal changes of key weather conditions (especially mixing height and transport wind). We also examine the interannual variability of the preferred weather window for linkage to the tropical Pacific (1979–2010). Associations with the subset of El Niño events identified by outgoing-longwave-radiation suggest skilful seasonal fire weather forecasts are feasible. Together, these findings offer a predictive tool to prioritise allocation of scarce prescribed fire resources and maximise annual area treated across this landscape.*

Chirici, G., Bottalico, F., Giannetti, F., Del Perugia, B., Travaglini, D., Nocentini, S., . . . Gozzini, B. (2018). Assessing forest windthrow damage using single-date, post-event airborne laser scanning data. *Forestry, 91*(1), 27-37. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041181051&doi=10.1093%2fforestry%2fcpx029&partnerID=40&md5=7ab43ca0633f1086b3a2fd7694e83741. doi:10.1093/forestry/cpx029

Research Tags: Weather, Forestry

Abstract: *One of many possible climate change effects in temperate areas is the increase of frequency and severity of windstorms; thus, fast and cost efficient new methods are needed to evaluate wind-induced damages in forests. We present a method for assessing windstorm damages in forest landscapes based on a two-stage sampling strategy using single-date, post-event airborne laser scanning (ALS) data. ALS data are used for delineating damaged forest stands and for an initial evaluation of the volume of fallen trees. The total volume of fallen trees is then estimated using a two-stage model-assisted approach, where variables from ALS are used as auxiliary information in the difference estimator. In the first stage, a sample of the delineated forest stands is selected, and in the second stage the within-stand damages are estimated by means of line intercept sampling (LIS). The proposed method produces maps of windthrown areas, estimates of forest damages in terms of the total volume of fallen trees, and the uncertainty of the estimates. A case study is presented for a large windstorm that struck the Tuscany Region of Italy the night of the 4th and the 5th of March 2015 and caused extensive damages to trees in both forest and urban areas. The pure field-based estimates from LIS and the ALS-based estimates of stand-level fallen wood were very similar. Our positive results demonstrate the utility of the single-date approach for a fast assessment of windthrow damages in forest stands which is especially useful when pre-event ALS data are not available.*

Chirinda, N., Arenas, L., Loaiza, S., Trujillo, C., Katto, M., Chaparro, P., . . . Barahona, R. (2017). Novel technological and management options for accelerating transformational changes in rice and livestock systems. *Sustainability (Switzerland), 9*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032335100&doi=10.3390%2fsu9111891&partnerID=40&md5=d1f437e212cd346942994e62a6013198. doi:10.3390/su9111891

Research Tags: Crops, Livestock

Abstract*: Agricultural producers grapple with low farm yields and declining ecosystem services within their* *landscapes. In several instances, agricultural production systems may be considered largely unsustainable in socioeconomic and ecological (resource conservation and use and impact on nature) terms. Novel technological and management options that can serve as vehicles to promote the provision of multiple benefits, including the improvement of smallholder livelihoods, are needed. We call for a paradigm shift to allow designing and implementing agricultural systems that are not only efficient (serving as a means to promote development based on the concept of creating more goods and services while using fewer resources and creating less waste) but can also be considered synergistic (symbiotic relationship between socio-ecological systems) by simultaneously contributing to major objectives of economic, ecological, and social (equity) improvement of agro-ecosystems. These transformations require strategic approaches that are supported by participatory system-level research, experimentation, and innovation. Using data from several studies, we here provide evidence for technological and management options that could be optimized, promoted, and adopted to enable agricultural systems to be efficient, effective, and, indeed, sustainable. Specifically, we present results from a study conducted in Colombia, which demonstrated that, in rice systems, improved water management practices such as Alternate Wetting and Drying (AWD) reduce methane emissions (~70%). We also show how women can play a key role in AWD adoption. For livestock systems, we present in vitro evidence showing that the use of alternative feed options such as cassava leaves contributes to livestock feed supplementation and could represent a cost-effective approach for reducing enteric methane emissions (22% to 55%). We argue that to design and benefit from sustainable agricultural systems, there is a need for better targeting of interventions that are co-designed, co-evaluated, and co-promoted, with farmers as allies of transformational change (as done in the climate-smart villages), not as recipients of external knowledge. Moreover, for inclusive sustainability that harnesses existing knowledge and influences decision-making processes across scales, there is a need for constant, efficient, effective, and real trans-disciplinary communication and collaboration.*

Chopra, R., Burow, G., Burke, J. J., Gladman, N., & Xin, Z. (2017). Genome-wide association analysis of seedling traits in diverse Sorghum germplasm under thermal stress. *BMC Plant Biology, 17*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009347613&doi=10.1186%2fs12870-016-0966-2&partnerID=40&md5=fb3eaf555b13be236d7b4ce3b0e8f14f. doi:10.1186/s12870-016-0966-2

Research Tags: Weather, Crops

Abstract: Climate variability due to fluctuation in temperature is a worldwide concern that imperils crop production. The need to understand how the germplasm variation in major crops can be utilized to aid in discovering and developing breeding lines that can withstand and adapt to temperature fluctuations is more necessary than ever. Here, we analyzed the genetic variation associated with responses to thermal stresses in a sorghum association panel (SAP) representing major races and working groups to identify single nucleotide polymorphisms (SNPs) that are associated with resilience to temperature stress in a major cereal crop.

Chouaib, W., Alila, Y., & Caldwell, P. V. (2018). Parameter transferability within homogeneous regions and comparisons with predictions from a priori parameters in the eastern United States. *Journal of Hydrology, 560*, 24-38. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045796076&doi=10.1016%2fj.jhydrol.2018.03.018&partnerID=40&md5=074a5c174f6f0c2c8848876a2ca8a871. doi:10.1016/j.jhydrol.2018.03.018

Research Tags: Research

Abstract: *The need for predictions of flow time-series persists at ungauged catchments, motivating the research goals of our study. By means of the Sacramento model, this paper explores the use of parameter transfer within homogeneous regions of similar climate and flow characteristics and makes comparisons with predictions from a priori parameters. We assessed the performance using the Nash-Sutcliffe (NS), bias, mean monthly hydrograph and flow duration curve (FDC). The study was conducted on a large dataset of 73 catchments within the eastern US. Two approaches to the parameter transferability were developed and evaluated; (i) the within homogeneous region parameter transfer using one donor catchment specific to each region, (ii) the parameter transfer disregarding the geographical limits of homogeneous regions, where one donor catchment was common to all regions. Comparisons between both parameter transfers enabled to assess the gain in performance from the parameter regionalization and its respective constraints and limitations. The parameter transfer within homogeneous regions outperformed the a priori parameters and led to a decrease in* *bias and increase in efficiency reaching a median NS of 0.77 and a NS of 0.85 at individual catchments. The use of FDC revealed the effect of bias on the inaccuracy of prediction from parameter transfer. In one specific region, of mountainous and forested catchments, the prediction accuracy of the parameter transfer was less satisfactory and equivalent to a priori parameters. In this region, the parameter transfer from the outsider catchment provided the best performance; less-biased with smaller uncertainty in medium flow percentiles (40%–60%). The large disparity of energy conditions explained the lack of performance from parameter transfer in this region. Besides, the subsurface stormflow is predominant and there is a likelihood of lateral preferential flow, which according to its specific properties further explained the reduced efficiency. Testing the parameter transferability using criteria of similar climate and flow characteristics at ungauged catchments and comparisons with predictions from a priori parameters are a novelty. The ultimate limitations of both approaches are recognized and recommendations are made for future research.*

Christenson, L., Clark, H., Livingston, L., Heffernan, E., Campbell, J., Driscoll, C., . . . Templer, P. H. (2017). Winter climate change influences on soil faunal distribution and abundance: Implications for decomposition in the Northern Forest. *Northeastern Naturalist, 24*, B209-B234. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037042404&doi=10.1656%2f045.024.s721&partnerID=40&md5=ae04101174cae3c4be416be7a612da4d. doi:10.1656/045.024.s721

Research Tags: Forestry

Abstract: *Winter is typically considered a dormant period in northern forests, but important ecological processes continue during this season in these ecosystems. At the Hubbard Brook Experimental Forest, located in the White Mountains of New Hampshire, we used an elevational climate gradient to investigate how changes in winter climate affect the litter and soil invertebrate community and related decomposition rates of Acer saccharum (Sugar Maple) litter over a 2-year period. The overall abundance and richness of litter invertebrates declined with increasing elevation, while the diversity and abundance of soil invertebrates was similar across the gradient. Snow depth and soil temperature were correlated to the abundance and distribution of the litter invertebrate community, whereas soil organic matter, soil moisture, and soil frost were correlated with the distribution and abundance of the soil invertebrate community. Decomposition rates were initially faster at lower-elevation sites following 1 year of decomposition, then stabilized at the end of 2 years with no difference between higher- and lower-elevation sites. This pattern may be explained by the distribution and abundance of the litter and soil invertebrates. Higher abundances of litter invertebrates, especially Collembola, at lower-elevation sites contribute to faster initial breakdown of litter, while greater abundances of Acari in soils at higher elevation contribute to the later stages of decay. The interaction between decomposition and the associated invertebrate community responded to changes in climatic conditions, with both soil temperature and soil moisture being important determinants.*

Cisneros, R., Schweizer, D., Tarnay, L., Navarro, K., Veloz, D., & Procter, C. T. (2018) Climate Change, Forest Fires, and Health in California. In. *Springer Climate* (pp. 99-130).

Research Tags: Weather, Forestry

Abstract: *Wildland fire is an important component to ecological health in California forests. Wildland fire smoke is a risk factor to human health. Exposure to smoke from fire cannot be eliminated, but managed fire in a fire-prone ecosystem for forest health and resiliency allows exposure to be mitigated while promoting other ecosystem services that benefit people. The California Sierra Nevada is a paragon of land management policy in a fire-prone natural system. Past fire suppression has led to extreme fuel loading where extreme fire events are much more likely, particularly with climate change increasing the length of fire season and the probability of extreme weather. We use the California Sierra Nevada to showcase the clash of increased development and urbanization, past land management policy, future scenarios including climate change, and the intertwining of ecological health and human health. Fire suppression to avoid smoke impact has proven to be an unreliable way to decrease smoke-related health impacts. Instead ecological beneficial fires should be employed, and their management should be based on smoke impacts at monitors, making air monitoring the foundation of fire management actions giving greater flexibility for managing fires. Tolerance of smoke impacts from restoration fire that is best for forest health and resiliency, as well as for human health, is paramount and preferred over the political expediency of reducing smoke impacts today that ignores that we are mortgaging these impacts to future generations.*

Claassen, R., Langpap, C., & Wu, J. (2017). Impacts of federal crop insurance on land use and environmental quality. *American Journal of Agricultural Economics, 99*(3), 592-613. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019928375&doi=10.1093%2fajae%2faaw075&partnerID=40&md5=e66797bd166721d45e880d8589c6fe78. doi:10.1093/ajae/aaw075

Research Tags: Economics

Abstract: *This article integrates economic and biophysical models to assess how federal crop revenue insurance programs affect land use, cropping systems, and environmental quality in the U.S. Corn Belt region. The empirical framework includes econometric models that predict land conversion and crop choices at the parcel level based on expectation and variance of crop revenues, land quality, climate conditions, and physical characteristics at each site. The predictions are then combined with site-specific environmental production functions to determine the effect of revenue insurance on nitrate runoff and leaching, soil water and wind erosion, and carbon sequestration. Results suggest that federal crop insurance has, on average, a small effect on conversions of non-cropland to cropland, and somewhat more significant impacts on crop choice and crop rotation. These changes in cropping systems have, on average, small impacts on agricultural pollution.*

Clark, D. A., Asao, S., Fisher, R., Reed, S., Reich, P. B., Ryan, M. G., . . . Yang, X. (2017). Reviews and syntheses: Field data to benchmark the carbon cycle models for tropical forests. *Biogeosciences, 14*(20), 4663-4690. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032291986&doi=10.5194%2fbg-14-4663-2017&partnerID=40&md5=be5c92c9f7136156857333cb0316ce1c. doi:10.5194/bg-14-4663-2017

Research Tags: Forestry, Research

Abstract: *For more accurate projections of both the global carbon (C) cycle and the changing climate, a critical current need is to improve the representation of tropical forests in Earth system models. Tropical forests exchange more C, energy, and water with the atmosphere than any other class of land ecosystems. Further, tropical-forest C cycling is likely responding to the rapid global warming, intensifying water stress, and increasing atmospheric CO2 levels. Projections of the future C balance of the tropics vary widely among global models. A current effort of the modeling community, the ILAMB (International Land Model Benchmarking) project, is to compile robust observations that can be used to improve the accuracy and realism of the land models for all major biomes. Our goal with this paper is to identify field observations of tropical-forest ecosystem C stocks and fluxes, and of their long-term trends and climatic and CO2 sensitivities, that can serve this effort. We propose criteria for reference-level field data from this biome and present a set of documented examples from old-growth lowland tropical forests. We offer these as a starting point towards the goal of a regularly updated consensus set of benchmark field observations of C cycling in tropical forests.*

Clark, J. A., Loehman, R. A., & Keane, R. E. (2017). Climate changes and wildfire alter vegetation of Yellowstone National Park, but forest cover persists. *Ecosphere, 8*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015186203&doi=10.1002%2fecs2.1636&partnerID=40&md5=686cc04371f3ee9a9fdccf33481ae9bd. doi:10.1002/ecs2.1636

Research Tags:

Abstract: *We present landscape simulation results contrasting effects of changing climates on forest vegetation and fire regimes in Yellowstone National Park, USA, by mid-21st century. We simulated potential changes to fire dynamics and forest characteristics under three future climate projections representing a range of potential future conditions using the FireBGCv2 model. Under the future climate scenarios with moderate warming (>2°C) and moderate increases in precipitation (3–5%), model simulations resulted in 1.2–4.2 times more burned area, decreases in forest cover (10–44%), and reductions in basal area (14–60%). In these same scenarios, lodgepole pine (Pinus contorta) decreased in basal area (18–41%), while Douglas-fir (Pseudotsuga menziesii) basal area increased (21–58%). Conversely, mild warming (<2°C) coupled with greater increases in precipitation (12–13%) suggested an increase in forest cover and basal area by mid-century, with spruce and subalpine fir increasing in abundance. Overall, we found changes in forest tree species compositions were caused by the climate-mediated changes in fire regime (56–315% increase in annual area burned). Simulated changes in forest composition and fire regime under warming climates portray a landscape that shifts from lodgepole pine to Douglas-fir caused by the interaction between the magnitude and seasonality of future climate changes, by climate-induced changes in the frequency and intensity of wildfires, and by tree species*

response.

Clifton, C. F., Day, K. T., Luce, C. H., Grant, G. E., Safeeq, M., Halofsky, J. E., & Staab, B. P. (2018). Effects of climate change on hydrology and water resources in the Blue Mountains, Oregon, USA. *10*, 9-19. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044531774&doi=10.1016%2fj.cliser.2018.03.001&partnerID=40&md5=181326cc0f9ba17e3fdcade564754dcc. doi:10.1016/j.cliser.2018.03.001
Research Tags: Forestry, Weather, Research
Abstract: *We present landscape simulation results contrasting effects of changing climates on forest vegetation and fire regimes in Yellowstone National Park, USA, by mid-21st century. We simulated potential changes to fire dynamics and forest characteristics under three future climate projections representing a range of potential future conditions using the FireBGCv2 model. Under the future climate scenarios with moderate warming (>2°C) and moderate increases in precipitation (3–5%), model simulations resulted in 1.2–4.2 times more burned area, decreases in forest cover (10–44%), and reductions in basal area (14–60%). In these same scenarios, lodgepole pine (Pinus contorta) decreased in basal area (18–41%), while Douglas-fir (Pseudotsuga menziesii) basal area increased (21–58%). Conversely, mild warming (<2°C) coupled with greater increases in precipitation (12–13%) suggested an increase in forest cover and basal area by mid-century, with spruce and subalpine fir increasing in abundance. Overall, we found changes in forest tree species compositions were caused by the climate-mediated changes in fire regime (56–315% increase in annual area burned). Simulated changes in forest composition and fire regime under warming climates portray a landscape that shifts from lodgepole pine to Douglas-fir caused by the interaction between the magnitude and seasonality of future climate changes, by climate-induced changes in the frequency and intensity of wildfires, and by tree species response.*

Cline, S., & Dissanayake, S. T. M. (2018). Special Issue on Climate Change and Land Conservation and Restoration: Advances in Economics Methods and Policies for Adaptation and Mitigation. *Agricultural and Resource Economics Review, 47*(2), 195-200. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054863754&doi=10.1017%2fage.2018.16&partnerID=40&md5=0df6ef6e05a814d0c2ac947f55c927a7. doi:10.1017/age.2018.16
Research Tags: Emissions
Abstract: *Climate change will likely impact the ecosystem services and biodiversity generated from conserved land. Land conservation can also play a significant role in achieving cost-effective mitigation of greenhouse gas emissions. In this special issue we feature seven papers from the 2017 NAREA Workshop, "Climate Change and Land Conservation and Restoration: Advances in Economics Methods and Policies for Adaptation and Mitigation." The articles include papers furthering the methodological frontier; portfolio optimization, dynamic rangeland stocking, and global timber harvest models, and those highlighting innovative applications; climate smart agricultural practices in Nigeria and Vietnam, welfare impacts on birding, and carbon and albedo pricing.*

Clough, B. J., Curzon, M. T., Domke, G. M., Russell, M. B., & Woodall, C. W. (2017). Climate-driven trends in stem wood density of tree species in the eastern United States: Ecological impact and implications for national forest carbon assessments. *Global Ecology and Biogeography, 26*(10), 1153-1164. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029587364&doi=10.1111%2fgeb.12625&partnerID=40&md5=ebc24bd50b9ddeb19d8d074d4e8743fb. doi:10.1111/geb.12625
Research Tags: Forestry, Emissions
Abstract: *Aim*
For trees, wood density is linked to competing energetic demands and therefore reflects responses to the environment. Climatic trends in wood density are recognized, yet their contribution to regional biogeographical patterns or impact on forest biomass stocks is not understood. This study has the following two objectives: (O1) to characterize wood density–climate trends for coarse (i.e., angiosperm versus gymnosperm) and fine (i.e., within-species) taxonomic units and test a predictive model that incorporates these trends into a model that assumes range-wide wood density is constant; and (O2) to assess the impact of climate-driven intraspecific variation on forest biomass stocks for major tree species.
Location

We use an assemblage of eastern U.S. tree species for assessing climatic trends (O1), and then apply fitted models to forest inventory data spanning the eastern U.S.A. to assess impacts of forest carbon estimation procedures (O2).
Methods
We compared hierarchical models fitted to the full data to characterize wood density/climate gradients and to assess the impact of within-species variation (O1). Then, we compared predictions of biomass stocks from the climate-variable model with those of the static model using the Forest Inventory and Analysis (FIA) database (O2).
Results
We found among- and within-species trends related to temperature and moisture regimes, with differing responses between angiosperms and gymnosperms. Incorporating within-species variation in wood density increases the carbon stock of the study region by an estimated 242 Tg when compared with a species-only model.
Main conclusions
Intraspecific variation in wood density across species ranges suggests that climate influences investment in stem wood within tree species and contributes to biogeographical patterns in wood density in the eastern U.S.A. This variation impacts forest biomass stock assessments, and thus contributes refinements to the U.S. National Greenhouse Gas Inventory. In addition, our work highlights the potential for combining trait data and forest inventory to infer forest ecological processes at broad spatial scales.

Clyatt, K. A., Keyes, C. R., & Hood, S. M. (2017). Long-term effects of fuel treatments on aboveground biomass accumulation in ponderosa pine forests of the northern Rocky Mountains. *Forest Ecology and Management, 400*, 587-599. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021396928&doi=10.1016%2fj.foreco.2017.06.021&partnerID=40&md5=d3e4722bee8ba5a8f4d23115a605342e. doi:10.1016/j.foreco.2017.06.021
Research Tags: Forestry
Abstract: *Fuel treatments in ponderosa pine forests of the northern Rocky Mountains are commonly used to modify fire behavior, but it is unclear how different fuel treatments impact the subsequent production and distribution of aboveground biomass, especially in the long term. This research evaluated aboveground biomass responses 23 years after treatment in two silvicultural installations with different cutting and underburning prescriptions in western Montana. The thinning installation included control (no treatment), thin/no burn, thin/spring burn, and thin/fall burn treatments. The shelterwood installation included control, cut/no burn, cut/wet burn, and cut/dry burn treatments. Across all fuel treatments in both the thinning and shelterwood installations, tree biomass had recovered to pre-harvest levels by 2015, or 23 years post-treatment. In the thinning, total aboveground and live-tree biomass were greatest in the control, but did not differ among the three thinned fuel treatments. Forest floor biomass was lower in the two burned treatments relative to the two unburned treatments. Seedling, vegetation, stump, and snag biomass did not differ among the four treatments. In the shelterwood, total aboveground and live-tree biomass were both greater in the unburned treatments relative to the burned treatments. Forest floor and snag biomass also tended to be lower in the burned treatments. Seedling, vegetation, and stump biomass were similar across all treatments. This research shows that tree biomass in ponderosa pine stands subjected to common fuels treatments can recover to pre-harvest levels in less than 23 years, while still exhibiting reduced stand densities that promote forest restoration objectives. Burgeoning biomass at the seedling layer suggests that additional understory treatments are necessary in order to abate ladder fuel development and sustain resistance to high-severity wildfire.*

Cochran, V. L., Schlentner, S. F., & Mosier, A. R. (2018). CH <inf>4</inf> and N <inf>2</inf> O flux in subarctic agricultural soils. In *Soil Management and Greenhouse Effect* (pp. 179-186).
Research Tags: Soil, Emissions
Abstract Unavilable:

Coen, J. L., Stavros, E. N., & Fites-Kaufman, J. A. (2018). Deconstructing the King megafire. *Ecological Applications, 28*(6), 1565-1580. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052726099&doi=10.1002%2feap.1752&partnerID=

40&md5=d8fcc18defb7d5f4e989c1dfd0991973. doi:10.1002/eap.1752
Research Tags: Weather, Forestry
Abstract: *Hypotheses that megafires, very large, high-impact fires, are caused by either climate effects such as drought or fuel accumulation due to fire exclusion with accompanying changes to forest structure have long been alleged and guided policy, but their physical basis remains untested. Here, unique airborne observations and microscale simulations using a coupled weather–wildland-fire-behavior model allowed a recent megafire, the King Fire, to be deconstructed and the relative impacts of forest structure, fuel load, weather, and drought on fire size, behavior, and duration to be separated. Simulations reproduced observed details including the arrival at an inclined canyon, a 25-km run, and later slower growth and features. Analysis revealed that fire-induced winds that equaled or exceeded ambient winds and fine-scale airflow undetected by surface weather networks were primarily responsible for the fire's rapid growth and size. Sensitivity tests varied fuel moisture and amount across wide ranges and showed that both drought and fuel accumulation effects were secondary, limited to sloped terrain where they compounded each other, and, in this case, unable to significantly impact the final extent. Compared to standard data, fuel models derived solely from remote sensing of vegetation type and forest structure improved simulated fire progression, notably in disturbed areas, and the distribution of burn severity. These results point to self-reinforcing internal dynamics rather than external forces as a means of generating this and possibly other outlier fire events. Hence, extreme fires need not arise from extreme fire environment conditions. Kinematic models used in operations do not capture fire-induced winds and dynamic feedbacks so can underestimate megafire events. The outcomes provided a nuanced view of weather, forest structure, fuel accumulation, and drought impacts on landscape-scale fire behavior—roles that can be misconstrued using correlational analyses between area burned and macroscale climate data or other exogenous factors. A practical outcome is that fuel treatments should be focused on sloped terrain, where factors multiply, for highest impact.*

Coiner, H. A., Hayhoe, K., Ziska, L. H., Van Dorn, J., & Sage, R. F. (2018). Tolerance of subzero winter cold in kudzu (Pueraria montana var. lobata). *Oecologia, 187*(3), 839-849. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047164287&doi=10.1007%2fs00442-018-4157-8&partnerID=40&md5=9d0badef610920550f8ae0256cc194d0. doi:10.1007/s00442-018-4157-8
Research Tags: Weather
Abstract: *The use of species distribution as a climate proxy for ecological forecasting is thought to be acceptable for invasive species. Kudzu (Pueraria montana var. lobata) is an important invasive whose northern distribution appears to be limited by winter survival; however, kudzu's cold tolerance thresholds are uncertain. Here, we used biogeographic evidence to hypothesize that exposure to − 20 °C is lethal for kudzu and thus determines its northern distribution limit. We evaluated this hypothesis using survival tests and electrolyte leakage to determine relative conductivity, a measure of cell damage, on 14 populations from eastern North America. Relative conductivity above 36% was lethal. Temperatures causing this damage averaged − 19.6 °C for northern and − 14.4 °C for southern populations, indicating kudzu acclimates to winter cold. To assess this, we measured relative conductivity of above- and belowground stems, and roots collected throughout the winter at a kudzu population in southern Ontario, Canada. Consistent with acclimation, the cold tolerance threshold of aboveground stems at the coldest time of year was − 26 °C, while stems insulated from cold extremes survived to − 17 °C—colder than the survival limits indicated by kudzu's biogeographic distribution. While these results do not rule out alternative cold limitations, they indicate kudzu can survive winters north of its current distribution. For kudzu, biogeography is not a proxy for climatic tolerance and continued northward migration is possible. Efforts to limit its spread are therefore prudent. These results demonstrate that physiological constraints inform predictions of climate-related changes in species distribution and should be considered where possible.*

Coleman, D. C., Callaham, M. A., & Crossley, D. A. (2017). *Fundamentals of Soil Ecology: Third Edition*.
Research Tags: Soil
No Abstract (Book):

Coleman, K., Murdoch, J., Rayback, S., Seidl, A., & Wallin, K. (2017). Students' understanding of sustainability and climate change across linked service-learning courses. *Journal of Geoscience Education, 65*(2), 158-167.

Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020168558&doi=10.5408%2f16-168.1&partnerID=40&md5=6b4158d58f5ccf315e281d2d5eff2492. doi:10.5408/16-168.1
Research Tags: Research
Abstract: *College and university faculty are increasingly being called upon to teach about sustainability. Many of these faculty members are incorporating content related to climate change because climate change is arguably the biggest threat to global sustainability. However, the concept of sustainability is complex, interdisciplinary, and potentially difficult to teach. Further, students may feel paralyzed in the face of climate change. Thus, delivering a course that effectively covers the concept of sustainability while also empowering students to take action against climate change is difficult. The goal of this article is to describe a joint effort between four college courses in different disciplines that used service-learning projects focused on climate change as a tool to teach sustainability concepts. Although the four courses were rooted in different disciplines, they intentionally shared common components and assignments, including community service projects, shared readings and reflections, and a symposium that brought all students together. Eighty preproject and 77 postproject reflections were qualitatively analyzed for themes related to learning outcomes. The results demonstrate that students in these classes gained a more sophisticated understanding of climate change and how it affects their respective disciplines, as well as a newfound sense of personal responsibility and agency for addressing climate change. Service-learning is an increasingly popular pedagogy on college campuses. This article highlights how the pedagogy can be used as a tool for integrating climate change into courses from multiple disciplines to teach about sustainability and empower students.*

Collins, H. P., Fa, P. A., Kimura, E., Fransen, S., & Himes, A. (2017). Intercropping with switchgrass improves net greenhouse gas balance in hybrid poplar plantations on a sand soil. *Soil Science Society of America Journal, 81*(4), 781-795. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028705545&doi=10.2136%2fsssaj2016.09.0294&partnerID=40&md5=41ff45de45c8885d547e08d20c0ac7c9. doi:10.2136/sssaj2016.09.0294
Research Tags: Forestry, Emissions
Abstract: *In the Pacific Northwest, commercial hybrid poplar (Populus generosa Henry × Populus canadensis Moench.) is managed at low stocking densities under irrigation for high-value timber production. The objectives of this study were to measure greenhouse gas emissions (CH4, CO2, and N2O) during intercropping of switchgrass (Panicum virgatum L.) with hybrid poplar; estimate losses of fertilizer-N as N2O, and estimate global warming potentials (GWP) of the intercrop. Cumulative above-ground biomass-C of the poplar monoculture (PM) closely matched the four year growing season (GS) soil CO2–C emissions, where aboveground biomass of the switchgrass monoculture (SM) and intercrop (IC) exceeded GS CO2–C emissions by 14.1 Mg C ha-1. Soil CH4–C uptake was not significantly different between treatments, while GS N2O-N emissions for PM were ~80% lower than both IC and SM. N2O emissions factors averaged 0.7% of the applied N-fertilizer. Cumulative contributions of CO2 emissions to GWP were offset by biomass-C resulting in a near zero balance (−5.1 Mg CO2eq ha -1) for the PM, where, IC and SM sequestered significantly more CO2 resulting in a net GWP of −42.5 and –32.2 Mg CO2eq ha-1, respectively. Intercropping with switchgrass can improve the net greenhouse gas balance of hybrid poplar. Continued research is needed on the effects of irrigated bioenergy production on GHG emissions in intercropped systems as they will become increasingly important as agricultural water use, water availability and quality are challenged by climate change.*

Comas, X., Terry, N., Hribljan, J. A., Lilleskov, E. A., Suarez, E., Chimner, R. A., & Kolka, R. K. (2017). Estimating belowground carbon stocks in peatlands of the Ecuadorian páramo using ground-penetrating radar (GPR). *Journal of Geophysical Research: Biogeosciences, 122*(2), 370-386. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013471770&doi=10.1002%2f2016JG003550&partnerID=40&md5=ad8d2693b4e15aa347bbd709d2fd159c. doi:10.1002/2016JG003550
Research Tags: Soil
Abstract: *The páramo ecoregion of Ecuador contains extensive peatlands that are known to contain carbon (C) dense soils capable of long-term C storage. Although high-altitude mountain peatlands are typically small when compared to low-altitude peatlands, they are abundant across the Andean landscape and are likely a key component in regional C cycling. Since efforts to quantify peatland distribution and C stocks across the tropical*

Andes have been limited due to the difficulty in sampling remote areas with very deep peat, there is a large knowledge gap in our quantification of the current C pools in the Andean mountains, which limits our ability to predict and monitor change from high rates of land use and climate change. In this paper we tested if ground-penetrating radar (GPR), combined with manual coring and C analysis, could be used for estimating C stocks in peatlands of the Ecuadorian páramo. Our results indicated that GPR was successful in quantifying peat depths and carbon stocks. Detection of volcanic horizons like tephra layers allowed further refinement of variability of C stocks within the peat column, while providing information on the lateral extent of tephras at high (centimeter-scale) resolution that may prove very useful for the correlation of time-stratigraphic markers between sediments in alpine peatlands. In conclusion, this paper provides a methodological basis for quantifying C stocks in high-altitude peatlands and to infer changes in the physical properties of soils that could be used as proxies for C content or paleoclimate reconstructions.

Condés, S., & McRoberts, R. E. (2017). Updating national forest inventory estimates of growing stock volume using hybrid inference. *Forest Ecology and Management, 400*, 48-57. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020460721&doi=10.1016%2fj.foreco.2017.04.046&partnerID=40&md5=f91bc43c166af18bbcb050ac00cd2229. doi:10.1016/j.foreco.2017.04.046

Research Tags: Research, Forestry

Abstract: *International organizations increasingly require estimates of forest parameters to monitor the state of and changes in forest resources, the sustainability of forest practices and the role of forests in the carbon cycle. Most countries rely on data from their national forest inventories (NFI) to produce these estimates. However, because NFI survey years may not match the required reporting years, techniques for updating NFI-based estimates are necessary.*

The main aim was to develop an unbiased method to update NFI estimates of mean growing stock volume (m3/ha) using models to predict annual plot-level volume change, and to estimate the associated uncertainties. Because the final large area volume estimates were based on plot-level model predictions rather than field observations, hybrid inference was necessary to accommodate both model prediction uncertainty and sampling variation. Specific objectives were to compare modelling approaches, to assess the utility of Landsat data for increasing model prediction accuracy, to select the most accurate method, and to compare model-based and design-based uncertainty components. For four monospecific forest types, data from the 2nd and 3rd Spanish NFI surveys together with site variables and Landsat images were used to construct models to predict NFI information for the year of the 4th NFI survey. Data from the 3rd and 4th surveys were used to assess the accuracy of the model predictions at both plot-level and large area spatial scales.

The most accurate method used a set of three models: one to predict the probability of volume removals, one to predict the amount of removed volume, and one to predict gross annual volume. Incorporation of Landsat-based variables in the models increased prediction accuracy. Differences between large area estimates based on plot-level field observations for the 4th NFI survey and estimates based on the model predictions were minimal for all four forest types. Further, the standard errors of the estimates based on the model predictions were only slightly greater than standard errors based on the field observations. Thus, model predictions of plot-level growing stock volume based on field and satellite image data as auxiliary information can be used to update large area NFI estimates for reporting years for which spectral data are available but field observations are not. Finally, variances of means are under-estimated unless hybrid inferential methods are used to incorporate both model prediction uncertainty and sampling variation. For the two forest types for which the two sources of uncertainty were of the same order of magnitude, the under-estimation was non-negligible.

Conkling, T. J., Belant, J. L., DeVault, T. L., & Martin, J. A. (2017). Effects of crop type and harvest on nest survival and productivity of dickcissels in semi-natural grasslands. *Agriculture, Ecosystems and Environment, 240*, 224-232. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014409697&doi=10.1016%2fj.agee.2017.01.028&partnerID=40&md5=2066771d940f2e04bb0d5bfc66fe6e96. doi:10.1016/j.agee.2017.01.028

Research Tags: Grassland, Energy, Wildlife

Abstract: *Recent focus on climate change and global energy production has increased interest in developing biofuels including perennial native grasses (e.g. switchgrass [Panicum virgatum]) as viable energy commodities while simultaneously maintaining ecosystem function and biodiversity. However, there is limited research*

examining the effects of biofuel-focused grasslands on grassland bird reproductive success and conservation. In 2011–2013 we studied the effects of vegetation composition and harvest regimens of switchgrass monocultures and native warm-season grass (NWSG) mixtures on nest success, nest density, and productivity for dickcissels (Spiza americana) in Clay Co. MS, USA. There was no effect of vegetation metrics, harvest frequency, or biofuel treatment on nest survival. However, both vegetation composition and harvest frequencies influenced nest density and productivity. Native warm season grasses contained 54–64 times more nests relative to switchgrass treatments, and nest density and productivity were 10% greater in single harvest plots. Our results suggest semi-natural grasslands can balance biofuel production, ecosystem functionality, and conservation so that biofuels offer an opportunity for wildlife conservation rather than a continued threat to grassland birds.

Conkling, T. J., Belant, J. L., DeVault, T. L., & Martin, J. A. (2018). Impacts of biomass production at civil airports on grassland bird conservation and aviation strike risk. *Ecological Applications, 28*(5), 1168-1181. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049299038&doi=10.1002%2feap.1716&partnerID=40&md5=76a9f93a73c7280076af456d9386ba60. doi:10.1002/eap.1716

Research Tags: Grassland, Energy, Wildlife

Abstract: *Growing concerns about climate change, foreign oil dependency, and environmental quality have fostered interest in perennial native grasses (e.g., switchgrass [Panicum virgatum]) for bioenergy production while also maintaining biodiversity and ecosystem function. However, biomass cultivation in marginal landscapes such as airport grasslands may have detrimental effects on aviation safety as well as conservation efforts for grassland birds. In 2011–2013, we investigated effects of vegetation composition and harvest frequency on seasonal species richness and habitat use of grassland birds and modeled relative abundance, aviation risk, and conservation value of birds associated with biomass crops. Avian relative abundance was greater in switchgrass monoculture plots during the winter months, whereas Native Warm-Season Grass (NWSG) mixed species plantings were favored by species during the breeding season. Conversely, treatment differences in aviation risk and conservation value were not biologically significant. Only 2.6% of observations included avian species of high hazard to aircraft, providing support for semi-natural grasslands as a feasible landcover option at civil airports. Additionally, varied harvest frequencies across a mosaic of switchgrass monocultures and NWSG plots allows for biomass production with multiple vegetation structure options for grassland birds to increase seasonal avian biodiversity and habitat use.*

Conner, M. M., Stephenson, T. R., German, D. W., Monteith, K. L., Few, A. P., & Bair, E. H. (2018). Survival analysis: Informing recovery of Sierra Nevada bighorn sheep. *Journal of Wildlife Management, 82*(7), 1442-1458. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047471700&doi=10.1002%2fjwmg.21490&partnerID=40&md5=936842a334929ba1620d43d0e67e5933. doi:10.1002/jwmg.21490

Research Tags: Wildlife

Abstract: *Survival in small populations (e.g., Sierra Nevada bighorn sheep or Sierra bighorn [Ovis canadensis sierrae]) is often highly variable. External selective pressures vary in the degree to which they regulate survival by sex and age class. Understanding the important factors and risks for different demographic classes helps managers design strategies that enhance the recovery of endangered species, including Sierra bighorn. Our goal was to determine what population-level factors (e.g., climate, habitat, population size, predation) affect survival and whether there are interactions between these factors by age and sex, and then apply our findings to recovery strategies. To this end, we conducted a known-fate survival analysis for female and male Sierra bighorn with data collected over 12 years, and used model selection to evaluate models with spatial, environmental, and other population-level factors hypothesized to be related to survival. Survival of adult Sierra bighorn declined continuously with age for both sexes; survival was generally higher for females than males, and there were no interactions between age and any environmental or population-level factors. The top model for both sexes included the date of peak value of normalized difference vegetation index (NDVI) from the previous summer; NDVI had a similar positive relationship with survival for both sexes, which indicates that the later the growing season persists into the summer, the better survival the subsequent year. For females, survival also was negatively related to an index of abundance for mountain lions (Puma concolor), whereas the relationship was less apparent for males. Instead, top models for males indicated elevated survival during warm wet years, but years with late peaks in NDVI the previous year ameliorated the effect of a cold, dry winter.*

Finally, competitive models for males and females included a variable representing avalanche risk, indicating reduced survival in areas with increased avalanche risk. From a recovery management perspective, the lack of any interaction between age and other covariates suggests that although we may still select younger female Sierra bighorn for translocations (an essential recovery action) because they have higher reproductive value than old females, there were no additional negative synergies between age and other factors to consider. All variables are of value in guiding expectations for newly established populations and established source populations and some may help fine tune the selection of translocation areas. In addition, including predation, weather covariates, and catastrophic effects, such as avalanche risk, in projection models is important for realistic estimation of the time required to meet recovery goals and predicting population trajectories under likely climate change scenarios. Our approach is generalizable to other systems; we demonstrated how survival analyses can inform endangered species recovery management by indicating ideal areas for translocations and provided realistic estimates of time-to-recovery or other recovery metrics.

Cook, D., Gardner, D. R., Pfister, J. A., Lee, S. T., Welch, K. D., & Welsh, S. L. (2017). A Screen for Swainsonine in Select North American Astragalus Species. *Chemistry and Biodiversity, 14*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017100618&doi=10.1002%2fcbdv.201600364&partnerID=40&md5=d5aba82c82fec3d79fea7fb82f9102dd. doi:10.1002/cbdv.201600364

Research Tags: Livestock

Abstract: *Swainsonine is found in several plant species worldwide, and causes severe toxicosis in livestock grazing these plants, leading to a chronic condition characterized by weight loss, altered behavior, depression, decreased libido, infertility, and death. Swainsonine has been detected in 13 North American Astragalus species of which eight belong to taxa in four taxonomic sections, the Densifolii, Diphysi, Inflati, and Trichopodi. These sections belong to two larger groups representing several morphologically related species, the Pacific Piptolobi and the small-flowered Piptolobi. The objective of this study was to screen the other 31 species for swainsonine in sections Densifolii, Diphysi, Inflati, and Trichopodi previously not known to contain swainsonine. Furthermore, to broaden the scope further, 21 species within the 8 sections of the Pacific Piptolobi and the small flowered Piptolobi were screened for swainsonine. Swainsonine was detected for the first time in 36 Astragalus taxa representing 29 species using liquid and gas chromatography coupled with mass spectrometry. Several taxonomic sections were highly enriched in species that contain swainsonine while others were not. A systematic examination for swainsonine in these species will provide important information on the toxic risk of these species and may be a valuable reference for diagnosticians and land managers.*

Cook, D., Gardner, D. R., Pfister, J. A., Stonecipher, C. A., Robins, J. G., & Morgan, J. A. (2017). Effects of Elevated CO <inf>2</inf> on the Swainsonine Chemotypes of Astragalus lentiginosus and Astragalus mollissimus. *Journal of Chemical Ecology, 43*(3), 307-316. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012131927&doi=10.1007%2fs10886-017-0820-5&partnerID=40&md5=a250bec60472f5f8154c47ea39429443. doi:10.1007/s10886-017-0820-5

Research Tags: Livestock

Abstract: *Rapid changes in the Earth's atmosphere and climate associated with human activity can have significant impacts on agriculture including livestock production. CO2 concentration has risen from the industrial revolution to the current time, and is expected to continue to rise. Climatic changes alter physiological processes, growth, and development in numerous plant species, potentially changing concentrations of plant secondary compounds. These physiological changes may influence plant population density, growth, fitness, and toxin concentrations and thus influence the risk of toxic plants to grazing livestock. Locoweeds, swainsonine-containing Astragalus species, are one group of plants that may be influenced by climate change. We evaluated how two different swainsonine-containing Astragalus species responded to elevated CO2 concentrations. Measurements of biomass, crude protein, water soluble carbohydrates and swainsonine concentrations were measured in two chemotypes (positive and negative for swainsonine) of each species after growth at CO2 levels near present day and at projected future concentrations. Biomass and water soluble carbohydrate concentrations responded positively while crude protein concentrations responded negatively to elevated CO2 in the two species. Swainsonine concentrations were not strongly affected by elevated CO2 in the two species. In the different chemotypes, biomass responded negatively and crude protein concentrations responded positively in the swainsonine-positive plants compared to the swainsonine-negative*

plants. Ultimately, changes in CO2 and endophyte status will likely alter multiple physiological responses in toxic plants such as locoweed, but it is difficult to predict how these changes will impact plant herbivore interactions.

Cooper, J., Tran, A. N., & Wallander, S. (2017). Testing for specification bias with a flexible fourier transform model for crop yields. *American Journal of Agricultural Economics, 99*(3), 800-817. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019947765&doi=10.1093%2fajae%2faaw084&partnerID=40&md5=b07984cef19611d858282e79404b146d. doi:10.1093/ajae/aaw084

Research Tags: Crops, Weather

Abstract: *The literature on climate risk and crop yields is currently focused on the potential for highly non-linear marginal effects, essentially modeling the threshold effects with a yield function that maps weather inputs into crop yields. Implicit in this line of research is the assertion that the traditional quadratic model of crop yield suffers from specification bias. This article examines this assumption by using the Flexible Fourier Transforms (FFT) to allow for global flexibility in the weather effects while also maintaining the traditional quadratic model as a nested model specification. In order to speak to the global flexibility of FFT, as well as to provide both robustness to outliers and information on the scale effects of weather variables, this article compares FFT with restricted cubic spline (RCS) and quadratic models in a quantile regression framework. Using U.S. county-level data on corn, soybeans, and winter wheat from 1975 to 2013, we find that while the threshold effects are largely captured by the traditional quadratic model, we statistically reject the hypothesis that the quadratic model is sufficiently flexible. We find that, under the more flexible FFT functional forms, at lower temperatures there is a greater positive impact of marginal increases in temperature on yield than with the quadratic model, which suggests a different yield-temperature relationship than found in much of the literature on threshold effects of temperature on crop yields, and is more consistent with the positive effects of minor temperature increases found in some of the Ricardian climate effect literature.*

Cooper, L. A., Ballantyne, A. P., Holden, Z. A., & Landguth, E. L. (2017). Disturbance impacts on land surface temperature and gross primary productivity in the western United States. *Journal of Geophysical Research: Biogeosciences, 122*(4), 930-946. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018252369&doi=10.1002%2f2016JG003622&partnerID=40&md5=ff9f3a15e93f2368c4704a8d0ad83ece. doi:10.1002/2016JG003622

Research Tags: Forestry, Weather

Abstract: *Forest disturbances influence forest structure, composition, and function and may impact climate through changes in net radiation or through shifts in carbon exchange. Climate impacts vary depending on environmental variables and disturbance characteristics, yet few studies have investigated disturbance impacts over large, environmentally heterogeneous, regions. We used satellite data to objectively determine the impacts of fire, bark beetles, defoliators, and "unidentified disturbances" (UDs) on land surface temperature (LST) and gross primary productivity (GPP) across the western United States (U.S.). We investigated immediate disturbance impacts, the drivers of those impacts, and long-term postdisturbance LST and GPP recovery patterns. All disturbance types caused LST increases (°C; fire: 3.45 ± 3.02, bark beetles: 0.76 ± 3.04, defoliators: 0.49 ± 3.12, and UD: 0.76 ± 3.03). Fire and insects resulted in GPP declines (%; fire: −25.05 ± 21.67, bark beetles: −2.84 ± 21.06, defoliators: −0.23 ± 15.40), while UDs resulted in slightly enhanced GPP (1.89 ± 24.20%). Disturbance responses also varied between ecoregions. Severity and interannual changes in air temperature were the primary drivers of short-term disturbance responses, and severity also had a strong impact on long-term recovery patterns. These results suggest a potential climate feedback due to disturbance-induced biophysical changes that may strengthen as disturbance regimes shift due to climate change.*

Cordeiro, M. R. C., Rotz, A., Kroebel, R., Beauchemin, K. A., Hunt, D., Bittman, S., . . . McKenzie, D. B. (2019). Prospects of forage production in northern regions under climate and land-use changes: A case-study of a dairy farm in Newfoundland, Canada. *Agronomy, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059944474&doi=10.3390%2fagronomy9010031&partnerID=40&md5=2169b335abcd2331e1ffe7ff5cbc2826. doi:10.3390/agronomy9010031

Research Tags: Grassland, Livestock, Crops

Abstract: *Forage production in northern latitudes is challenging and uncertain in the future. In this case-study, the integrated farm system model (IFSM) was used to assess the impact of climate change and cropland expansion scenarios on forage production in a dairy farm in Newfoundland, Canada. Climatic projections indicated increases in temperature in the recent past (1990–2016) and under any future climate (2020–2079), thus enhancing agronomic performance. Temperature increases ranged from 2.8 °C to 5.4 °C in winter and from 3.2 °C to 6.4 °C in spring. Small precipitation increases (<10%) create narrower time windows to perform farm operations in the already stringent condition of excess moisture in the region. Results of land use scenarios including expansions of 20, 30, and 40% in cropland area, out of which 5% was dedicated to corn silage and the remainder to grass-legume mixtures, indicated increased yield and total production. Improvements in grass-legume yield ranged from 8% to 52%. The full range of production increases ranged from 11% to 105%. Increments in corn silage yield ranged from 28% to 69%. Total farm corn silage production increases ranged from 29% to 77%. An attainable cropland expansion of 20% would enable the farm to become self-sufficient in forage production under any climate scenario.*

Corman, J. R., Bertolet, B. L., Casson, N. J., Sebestyen, S. D., Kolka, R. K., & Stanley, E. H. (2018). Nitrogen and Phosphorus Loads to Temperate Seepage Lakes Associated With Allochthonous Dissolved Organic Carbon Loads. *Geophysical Research Letters, 45*(11), 5481-5490. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048945494&doi=10.1029%2f2018GL077219&partnerID=40&md5=b9dcaccb3cd4ef06191c3ad7ca9a5cc5. doi:10.1029/2018GL077219
Research Tags: Water
Abstract: *Terrestrial loads of dissolved organic matter (DOM) have increased in recent years in many north temperate lakes. While much of the focus on the "browning" phenomena has been on its consequences for carbon cycling, much less is known about how it influences nutrient loading to lakes. We characterize potential loads of nitrogen and phosphorus to seepage lakes in northern Wisconsin, USA, based on a laboratory soil leaching experiment and a model that includes landscape cover and watershed area. In these seepage lakes, nutrient concentrations are positively correlated with dissolved organic carbon concentrations (nitrogen: r = 0.68, phosphorus: r = 0.54). Using long-term records of browning, we found that dissolved organic matter-associated nutrient loadings may have resulted in substantial increases in nitrogen and phosphorus in seepage lakes and could account for currently observed nutrient concentrations in the lake. "Silent" nutrient loadings to brown-water lakes may lead to future water-quality concerns.*

Costanza, J. K., Coulston, J. W., & Wear, D. N. (2017). An empirical, hierarchical typology of tree species assemblages for assessing forest dynamics under global change scenarios. *PLoS ONE, 12*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028984877&doi=10.1371%2fjournal.pone.0184062&partnerID=40&md5=11201cc1e6c39820d16a343513d25450. doi:10.1371/journal.pone.0184062
Research Tags: Forestry
Abstract: *The composition of tree species occurring in a forest is important and can be affected by global change drivers such as climate change. To inform assessment and projection of global change impacts at broad extents, we used hierarchical cluster analysis and over 120,000 recent forest inventory plots to empirically define forest tree assemblages across the U.S., and identified the indicator and dominant species associated with each. Cluster typologies in two levels of a hierarchy of forest assemblages, with 29 and 147 groups respectively, were supported by diagnostic criteria. Groups in these two levels of the hierarchy were labeled based on the top indicator species in each, and ranged widely in size. For example, in the 29-cluster typology, the sugar maple-red maple assemblage contained the largest number of plots (30,068), while the butternut-sweet birch and sourwood-scarlet oak assemblages were both smallest (6 plots each). We provide a case-study demonstration of the utility of the typology for informing forest climate change impact assessment. For five assemblages in the 29-cluster typology, we used existing projections of changes in importance value (IV) for the dominant species under one low and one high climate change scenario to assess impacts to the assemblages. Results ranged widely for each scenario by the end of the century, with each showing an average decrease in IV for dominant species in some assemblages, including the balsam fir-quaking aspen assemblage, and an average increase for others, like the green ash-American elm assemblage. Future work should assess adaptive capacity of these forest assemblages and investigate local population- and community-level dynamics in places where dominant species may be impacted. This typology will be ideal for monitoring, assessing, and*

projecting changes to forest communities within the emerging framework of macrosystems ecology, which emphasizes hierarchies and broad extents.

Costanza, J. K., Faber-Langendoen, D., Coulston, J. W., & Wear, D. N. (2018). Classifying forest inventory data into species-based forest community types at broad extents: exploring tradeoffs among supervised and unsupervised approaches. *Forest Ecosystems, 5*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050377311&doi=10.1186%2fs40663-017-0123-x&partnerID=40&md5=0f46e426500a2e6d95bf06ad4f94158d. doi:10.1186/s40663-017-0123-x

Research Tags: Forestry

Abstract: *Background*

Knowledge of the different kinds of tree communities that currently exist can provide a baseline for assessing the ecological attributes of forests and monitoring future changes. Forest inventory data can facilitate the development of this baseline knowledge across broad extents, but they first must be classified into forest community types. Here, we compared three alternative classifications across the United States using data from over 117,000 U.S. Department of Agriculture Forest Service Forest Inventory and Analysis (FIA) plots.

Methods

Each plot had three forest community type labels: (1) "FIA" types were assigned by the FIA program using a supervised method; (2) "USNVC" types were assigned via a key based on the U.S. National Vegetation Classification; (3) "empirical" types resulted from unsupervised clustering of tree species information. We assessed the degree to which analog classes occurred among classifications, compared indicator species values, and used random forest models to determine how well the classifications could be predicted using environmental variables.

Results

The classifications generated groups of classes that had broadly similar distributions, but often there was no one-to-one analog across the classifications. The longleaf pine forest community type stood out as the exception: it was the only class with strong analogs across all classifications. Analogs were most lacking for forest community types with species that occurred across a range of geographic and environmental conditions, such as loblolly pine types. Indicator species metrics were generally high for the USNVC, suggesting that USNVC classes are floristically well-defined. The empirical classification was best predicted by environmental variables. The most important predictors differed slightly but were broadly similar across all classifications, and included slope, amount of forest in the surrounding landscape, average minimum temperature, and other climate variables.

Conclusions

The classifications have similarities and differences that reflect their differing approaches and objectives. They are most consistent for forest community types that occur in a relatively narrow range of environmental conditions, and differ most for types with wide-ranging tree species. Environmental variables at a variety of scales were important for predicting all classifications, though strongest for the empirical and FIA, suggesting that each is useful for studying how forest communities respond to of multi-scale environmental processes, including global change drivers.

Coyle, D. R., Nagendra, U. J., Taylor, M. K., Campbell, J. H., Cunard, C. E., Joslin, A. H., . . . Callaham, M. A. (2017). Soil fauna responses to natural disturbances, invasive species, and global climate change: Current state of the science and a call to action. *Soil Biology and Biochemistry, 110*, 116-133. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016148807&doi=10.1016%2fj.soilbio.2017.03.008&partnerID=40&md5=1e969b2a3ca902efd2b0ff66e008ce37. doi:10.1016/j.soilbio.2017.03.008

Research Tags: Soil, Weather

Abstract: *Environmental disturbances seem to be increasing in frequency and impact, yet we have little understanding of the belowground impacts of these events. Soil fauna, while widely acknowledged to be important drivers of biogeochemical function, soil structure and sustainability, and trophic interactions, are understudied compared to other belowground organisms such as archaea, bacteria, and fungi. In this review we summarize the current state of knowledge of soil fauna as it relates to and is influenced by various disturbances. We focus our review on three main natural and anthropogenic disturbance types: 1) natural disturbances, including damage from wind and flooding; 2) invasive species, including above and belowground* *flora and fauna; and 3) climate change impacts on the atmosphere and temperature. We do not address the impacts of wildfires, forestry, agricultural practices, mining, or human-caused pollution, as these topics have all been covered in other works. We highlight knowledge gaps and suggest future avenues of research, with hope that the importance of soil fauna and their influences on ecosystems will be given greater emphasis in future research.*

Cragin, J., Serpe, M., Keller, M., & Shellie, K. (2017). Dormancy and cold hardiness transitions in winegrape cultivars chardonnay and cabernet sauvignon. *American Journal of Enology and Viticulture, 68*(2), 195-202. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016759906&doi=10.5344%2fajev.2016.16078&partnerID=40&md5=7a9ff551d036fe5b1852981589749dc1. doi:10.5344/ajev.2016.16078

Research Tags: Crops, Weather

Abstract: *Cold injury is a major cause of economic loss in winegrapes (Vitis vinifera L.) grown at high latitudes. The objective of this study was to investigate the relationship between dormancy and cold hardiness transitions in two cultivars with differing freeze tolerance (Chardonnay and Cabernet Sauvignon). Cold hardiness was measured by differential thermal analysis, and a bud forcing bioassay was used to measure the stage and depth of dormancy. Canes were sampled from field-grown grapevines in Parma, ID at periodic intervals during two consecutive winters. Both cultivars transitioned into endodormancy each year in September when day length was ~12.5 hr. Cold acclimation in both cultivars occurred each year in October during endodormancy and steadily increased during ecodormancy to a max hardiness in December. Effective temperatures for release from endodormancy were lower for Chardonnay (−3°C) than for Cabernet Sauvignon (3°C), and, each year, Chardonnay transitioned to ecodormancy earlier than Cabernet Sauvignon. From October to December, Chardonnay buds were more cold hardy than Cabernet Sauvignon buds. The number of days to budbreak under forcing conditions increased steadily during endodormancy and decreased during ecodormancy. Resistance to deacclimation during ecodormancy was inversely related to the level of bud cold hardiness and the duration of time in ecodormancy, suggesting that the mechanisms that impart hardiness may interact with those involved in resumption of growth. Results from this study show that the influence of autumn weather events on dormancy and cold hardiness transitions can affect vulnerability to subsequent cold injury and have important implications under global climate change. Differences between cultivars in dormancy and cold hardiness transitions can be used to improve cultivar and site selection.*

Crain, B. J., & Tremblay, R. L. (2017). Hot and bothered: Changes in microclimate alter chlorophyll fluorescence measures and increase stress levels in tropical epiphytic orchids. *International Journal of Plant Sciences, 178*(7), 503-511. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029498074&doi=10.1086%2f692767&partnerID=40&md5=f515324e263d53d36d64ff2145b2c1a6. doi:10.1086/692767

Research Tags: Weather

Abstract: *Premise of research. Tropical epiphytes are susceptible to climatic changes, as evidenced by documented population declines, range contractions, and range shifts; however, physiological changes in individual plants may also be indicative of deteriorating climate conditions. Consequently, physiological analyses of tropical epiphytes whose natural habitats are constrained by climatic conditions are warranted to evaluate their responses to potential changes in these conditions, to assess their vulnerability, and to guide conservation actions.*
Methodology. Here we investigate photosynthetic processes in Puerto Rican Lepanthes species, a group of Neotropical epiphytic orchids, as a model system to determine whether altered microclimate conditions elicit adverse physiological responses. We tested for differences in chlorophyll fluorescence, measured as Fv/Fm, as an indication of plant stress under modified temperature, humidity, and air vapor pressure deficit.
Pivotal results. Mean Fv/Fm was positively correlated with mean relative humidity and negatively correlated with mean temperature and air vapor pressure deficit. Collectively, plants exposed to altered microclimate conditions had significantly lower mean Fv/Fm than plants in unaltered conditions. Plants in altered microclimate conditions were also more likely to exhibit declines in Fv/Fm over time, and they exhibited greater reductions in Fv/Fm over the course of the study.
Conclusions. Epiphytic plant species such as Lepanthes could exhibit declines in Fv/Fm and experience greater

stress in their natural habitats if current warming and drying trends continue as anticipated in Puerto Rico and elsewhere. Declining Fv/Fm is a robust indicator of plant stress, and several studies show that increased stress can promote leaf loss, limit reproduction, and lower survival rates. Thus, analyses of Fv/Fm can be advantageous for monitoring epiphytic orchids and other vulnerable plant species by offering a valuable means for detecting adverse responses to climate change.

Crane-Droesch, A. (2018). Machine learning methods for crop yield prediction and climate change impact assessment in agriculture. *Environmental Research Letters, 13*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056865972&doi=10.1088%2f1748-9326%2faae159&partnerID=40&md5=48a4be477e1ad82bfd4537a60ac69397. doi:10.1088/1748-9326/aae159

Research Tags: Crops, Research, Weather

Abstract: *Crop yields are critically dependent on weather. A growing empirical literature models this relationship in order to project climate change impacts on the sector. We describe an approach to yield modeling that uses a semiparametric variant of a deep neural network, which can simultaneously account for complex nonlinear relationships in high-dimensional datasets, as well as known parametric structure and unobserved cross-sectional heterogeneity. Using data on corn yield from the US Midwest, we show that this approach outperforms both classical statistical methods and fully-nonparametric neural networks in predicting yields of years withheld during model training. Using scenarios from a suite of climate models, we show large negative impacts of climate change on corn yield, but less severe than impacts projected using classical statistical methods. In particular, our approach is less pessimistic in the warmest regions and the warmest scenarios.*

Cristóbal, J., Prakash, A., Anderson, M. C., Kustas, W. P., Euskirchen, E. S., & Kane, D. L. (2017). Estimation of surface energy fluxes in the Arctic tundra using the remote sensing thermal-based Two-Source Energy Balance model. *Hydrology and Earth System Sciences, 21*(3), 1339-1358. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014918264&doi=10.5194%2fhess-21-1339-2017&partnerID=40&md5=9c55aa59d3f5b1efb50a8e96ce977a0d. doi:10.5194/hess-21-1339-2017

Research Tags: Weather

Abstract: *The Arctic has become generally a warmer place over the past decades leading to earlier snow melt, permafrost degradation and changing plant communities. Increases in precipitation and local evaporation in the Arctic, known as the acceleration components of the hydrologic cycle, coupled with land cover changes, have resulted in significant changes in the regional surface energy budget. Quantifying spatiotemporal trends in surface energy flux partitioning is key to forecasting ecological responses to changing climate conditions in the Arctic. An extensive local evaluation of the Two-Source Energy Balance model (TSEB) – a remote-sensing-based model using thermal infrared retrievals of land surface temperature – was performed using tower measurements collected over different tundra types in Alaska in all sky conditions over the full growing season from 2008 to 2012. Based on comparisons with flux tower observations, refinements in the original TSEB net radiation, soil heat flux and canopy transpiration parameterizations were identified for Arctic tundra. In particular, a revised method for estimating soil heat flux based on relationships with soil temperature was developed, resulting in significantly improved performance. These refinements result in mean turbulent flux errors generally less than 50Wm−2 at half-hourly time steps, similar to errors typically reported in surface energy balance modeling studies conducted in more temperate climatic regimes. The MODIS leaf area index (LAI) remote sensing product proved to be useful for estimating energy fluxes in Arctic tundra in the absence of field data on the local biomass amount. Model refinements found in this work at the local scale build toward a regional implementation of the TSEB model over Arctic tundra ecosystems, using thermal satellite remote sensing to assess response of surface fluxes to changing vegetation and climate conditions.*

Cruz, J. L., LeCain, D. R., Alves, A. A. C., Coelho Filho, M. A., & Coelho, E. F. (2018). Elevated CO<inf>2</inf> reduces whole transpiration and substantially improves root production of cassava grown under water deficit. *Archives of Agronomy and Soil Science, 64*(12), 1623-1634. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042914572&doi=10.1080%2f03650340.2018.1446523&partnerID=40&md5=dc5e866eee2c46057b7fa34547203f5a. doi:10.1080/03650340.2018.1446523

Research Tags: Weather, Crops

Abstract: *We evaluated the possibility of elevated CO_2 concentration ([CO_2]) to reduce the negative effect of drought on growth and physiological parameters of cassava (Manihot esculenta Crantz). Plants were grown with 390 ppm or 750 ppm of CO_2, under well-watered or under water deficit conditions. The study was conducted in a climate-controlled greenhouse using 14 L pots, for 100 days. For any value of fraction of transpirable soil water (FTSW) the carbon assimilation was always higher for plants grown under elevated [CO_2]. Still, elevated [CO_2] reduced the negative effect of drought on transpiration, water use efficiency, all growth measures and harvest index. Elevated [CO_2] increased the dry matter of tuber roots (DMTR) of well-watered plants by 17.4%. The DMTR of plants grown under water deficit were 124.4 g and 58.9 g, respectively, for plants under elevated and ambient CO_2, an increase of 112%. Thus, the CO_2 effect was relatively stronger to the production of tuberous roots when cassava were subjected to water-deficit. Our results suggest that cassava tuber production might be resilient to changes in precipitation that will accompany higher atmospheric CO_2 and reinforce cassava as a specie that can significantly contribute to mitigate hunger in a changing climate environment.*

Cui, H., Kaufman, A. J., Peng, Y., Liu, X. M., Plummer, R. E., & Lee, E. I. (2018). The Neoproterozoic Hüttenberg δ13C anomaly: Genesis and global implications. *Precambrian Research, 313*, 242-262. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047638622&doi=10.1016%2fj.precamres.2018.05.024&partnerID=40&md5=1d966f37bec99b58e3f94d0e6d6f1469. doi:10.1016/j.precamres.2018.05.024

Research Tags: Water

Abstract: *The Neoproterozoic Hüttenberg Formation in northeastern Namibia records a remarkable δ13Ccarb positive excursion with a sustained plateau of values up to +12‰ (i.e., the Hüttenberg anomaly). High-resolution chemostratigraphic analyses of drill core samples spanning the upper Elandshoek and Hüttenberg formations reveal multiple new observations: (1) overall high but oscillatory δ13Ccarb values; (2) δ18Ocarb values ranging from −8‰ to −2‰; (3) significant enrichment of 13C in organic carbon and a broad co-variation between δ13Ccarb and δ13Corg; (4) a profound negative excursion in δ34Spyrite from +30‰ to −10‰; (5) an overall inverse δ13C–δ34S relationship; and (6) 87Sr/86Sr values down to 0.7074 in limestone samples. The new data suggest that the Hüttenberg anomaly records dynamic fluctuations in marine redox conditions, which may include an oxygenation event during the height of the δ13Ccarb positive excursion and a deoxygenation event at its termination. The δ34Spyrite negative excursion suggests the buildup of the marine sulfate reservoir, likely due to enhanced pyrite oxidation during the oxygenation event. The δ34Spyrite increase at the end of the Hüttenberg anomaly may result from a seawater sulfate concentration drawdown towards pre-anomaly conditions. On one hand, the Hüttenberg anomaly may reflect restricted basin signals that are deviated from the Ediacaran open ocean; on the other hand, the Ediacaran Hüttenberg anomaly, together with the Cryogenian δ13Ccarb positive excursions, suggests a stepwise pattern of the Neoproterozoic Oxygenation Event. Both local and global environmental factors may have contributed to the Hüttenberg anomaly. The Hüttenberg anomaly therefore represents a local enhancement of global oxygenation signals. Our data support the emerging view that the Neoproterozoic Oxygenation Event may have facilitated the evolution of early life at that time.*

Cuperlovic-Culf, M., Vaughan, M. M., Vermillion, K., Surendra, A., Teresi, J., & McCormick, S. P. (2019). Effects of Atmospheric CO<inf>2</inf> Level on the Metabolic Response of Resistant and Susceptible Wheat to Fusarium graminearum Infection. *Molecular Plant-Microbe Interactions, 32*(4), 379-391. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064722049&doi=10.1094%2fMPMI-06-18-0161-R&partnerID=40&md5=19a8d2795e47f6ef191f937f37ccdd3d. doi:10.1094/MPMI-06-18-0161-R

Research Tags: Crops

Abstract: *Rising atmospheric CO2 concentrations and associated climate changes are thought to have contributed to the steady increase of Fusarium head blight (FHB) on wheat. However, our understanding of precisely how elevated CO2 influences the defense response of wheat against Fusarium graminearum remains limited. In this study, we evaluated the metabolic profiles of susceptible (Norm) and moderately resistant (Alsen) spring wheat in response to whole-head inoculation with two deoxynivalenol (DON)-producing F. graminearum isolates (DON+), isolates 9F1 and Gz3639, and a DON-deficient (DON−) isolate (Gzt40) at ambient (400 ppm) and elevated (800 ppm) CO2 concentrations. The effects of elevated CO2 were dependent on both the Fusarium strain and the wheat variety, but metabolic differences in the host can explain the*

observed changes in F. graminearum biomass and DON accumulation. The complexity of abiotic and biotic stress interactions makes it difficult to determine if the observed metabolic changes in wheat are a result of CO2-induced changes in the host, the pathogen, or a combination of both. However, the effects of elevated CO2 were not dependent on DON production. Finally, we identified several metabolic biomarkers for wheat that can reliably predict FHB resistance or susceptibility, even as atmospheric CO2 levels rise.

Curzon, M. T., D'Amato, A. W., Fraver, S., Huff, E. S., & Palik, B. J. (2017). Succession, climate and neighbourhood dynamics influence tree growth over time: an 87-year record of change in a Pinus resinosa-dominated forest, Minnesota, USA. *Journal of Vegetation Science, 28*(1), 82-92. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84996560111&doi=10.1111%2fjvs.12471&partnerID=40&md5=bebca747efd9c27f42d7802b4cec02b8. doi:10.1111/jvs.12471
Research Tags: Forestry
Abstract: *Question*
Resource availability and its influence on tree-to-tree interactions are expected to change over the course of forest stand development, but the rarity of long-term data sets has limited examinations of neighbourhood crowding over extended time periods. How do a history of neighbourhood interactions and population-level dynamics, including demographic transition, impact long-term tree growth?
Location
Natural mature Pinus resinosa-dominated forest in northern Minnesota, USA.
Methods
Using a spatially explicit data set of repeated diameter measurements recorded over an 87-yr period, we modelled the influence of tree-to-tree interactions on growth as it varied over time. We also applied maximum likelihood estimation and simulated annealing to examine how inter- and intraspecific competition and the relative importance of neighbour size and distance varied over time and with different climatic conditions.
Results
Crowding had a consistent negative influence on growth, but crowding intensity and importance were dynamic over time and differed between trees that survived the entire study period compared to those that ultimately died. The scaling of neighbour diameter, neighbour distance, and neighbour species (inter- vs intraspecific competition) also varied as demographic transition occurred and longer-lived species assumed greater dominance.
Conclusions
Given observed relationships with moisture stress (based on precipitation: potential evapotranspiration) and maximum temperature, crowding intensity and importance may increase if temperatures rise in the future and water become more limiting. Long-term data sets, such as the record examined in this study, have immense value for testing assumptions about stand dynamics, particularly as forests respond to projected shifts in climate and disturbance regimes.

Dai, Z., Trettin, C. C., Frolking, S., & Birdsey, R. A. (2018). Mangrove carbon assessment tool: Model development and sensitivity analysis. *Estuarine, Coastal and Shelf Science, 208*, 23-35. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046618839&doi=10.1016%2fj.ecss.2018.04.035&partnerID=40&md5=15befca4ba14ffffdc41f4bc26eed7a0. doi:10.1016/j.ecss.2018.04.035
Research Tags: Water, Forestry, Research
Abstract: *It is important to have the capability to assess carbon (C) dynamics in mangrove forests and estimate their role in mitigating climate change because of their high carbon density, the threats to their integrity from land-use change and sea-level rise, and functional linkages of the many goods and services. A process-based model for mangroves was developed by integrating new features with existing biogeochemical processes in Forest-DNDC for simulating C sequestration and turnover in mangrove ecosystems. The new model is used to assess (1) the dynamics of C, nitrogen and phosphorous in mangrove ecosystems, including above-and below-ground C in saline wetlands, (2) the impacts of ecological drivers, including climate, soil nitrogen and phosphorous deficit and salt stress, on mangrove production, (3) the production of methane, and aerobic and anaerobic oxidation of methane with sulfate, nitrate and nitrite reductions, (4) the contributions of dissolved inorganic C (DIC), dissolved organic C (DOC), particulate organic C (POC) and burial C (BC) to blue C, and (5) impacts of natural and anthropogenic disturbances on C sequestration in mangrove ecosystems. Model*

sensitivity analysis showed that C sequestration in mangrove ecosystems was highly sensitive to multiple ecological factors, including climate, soil phosphorus, salinity and sulfate, as well as latitude. The responses of different C components to these factors were distinct. The responses of gross and net primary productivity and aboveground biomass to alterations of mean daily temperature (MDT) were quadratic, or increasing or decreasing non-linearly with an increment or decrement in MDT, but leaf production was linear. Similarly, other mangrove C components, such as BC, DIC, DOC and POC, respond substantially to variations of the ecological drivers. The combined effects of the driving factors are complex due to their intricate interactions. For example, while mangrove productivity is sensitive to available phosphorous, phosphorous cannot mitigate the stress imposed by high salinity. These results highlight the value of a tool to assess C dynamics in mangroves, especially for regional or large mangrove forests.

Dai, Z., Trettin, C. C., Frolking, S., & Birdsey, R. A. (2018). Mangrove carbon assessment tool: Model validation and assessment of mangroves in southern USA and Mexico. *Estuarine, Coastal and Shelf Science, 208*, 107-117. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046744061&doi=10.1016%2fj.ecss.2018.04.036&partnerID=40&md5=c427443a693c85a94861c5e2de7083d5. doi:10.1016/j.ecss.2018.04.036

Research Tags: Water, Forestry, Research

Abstract: *While mangroves are widely recognized as a significant carbon (C) reservoir and the valued ecosystem services are inextricably linked to the C stocks and fluxes. Modeling tools haven't been available to simulate C dynamics in mangroves to inform assessments, Monitoring, Reporting and Verification for REDD+, or management and restoration prescriptions. The process-based model MCAT-DNDC (Mangrove-Carbon-Assessment-Tool-DeNitrification-DeComposition) was validated using measurements from sites in Quintana Roo, Mexico and Florida, USA. The validated model was then applied to model C sequestration in mangroves sites in Texas, Louisiana and Florida that had measured data for comparison. The model validation against aboveground biomass (AGB) showed that the simulation provided good agreement with observations with a proper slope (1.06) and small intercept (1.32 Mg ha−1, about 1.4% of observed mean); the model performance efficiency for assessing AGB was high (R2 = 0.99). Among ten C pools and fluxes validated using data from the Everglades National Park, eight components were in good agreement with the observations, and two were within the range of observation; demonstrating effective model performance (R2 > 0.95). The metrics from the model validation showed that MCAT-DNDC can be used to estimate C sequestration in mangroves within the coastal areas along Gulf of Mexico and Mexican Caribbean with good model performance. Simulated C dynamics for plots in Texas, Louisiana and Florida showed that the relationship between above-ground biomass and stand age was non-linear, and that gross and net primary productivity increased logarithmically with stand age. The differences in C components among the sites exhibited the effects of ecological drivers on C sequestration in mangroves. Simulations also demonstrated that the model may be useful in considering the effect of forest management on C sequestration. The model appears to be stable and sufficiently robust to warrant further testing with additional data and across a variety of sites.*

Dalin, C., Taniguchi, M., & Green, T. R. (2019). Unsustainable groundwater use for global food production and related international trade. *Global Sustainability, 2*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069789201&doi=10.1017%2fsus.2019.7&partnerID=40&md5=360f7f16c7d0197d9805e06fc45f18b1. doi:10.1017/sus.2019.7

Research Tags: Water, Crops

Abstract: *Most of the water humans consume is for agriculture. Rapidly increasing water demand has led to overexploitation of water resources in many important food-producing regions. In particular, growing groundwater-based irrigation causes potentially damaging depletion. Food systems are increasingly globalized, leading to large export-oriented production. Much research has focused on quantifying the amount of water resources embedded in traded products, but less attention has been given to the role of groundwater use and the related sustainability of agriculture globally. We assess current knowledge of virtual water trade in light of groundwater use and sustainability and highlight remaining challenges in this field.*

Danner, A. G., Safeeq, M., Grant, G. E., Wickham, C., Tullos, D., & Santelmann, M. V. (2017). Scenario-Based and Scenario-Neutral Assessment of Climate Change Impacts on Operational Performance of a Multipurpose

Reservoir. *Journal of the American Water Resources Association, 53*(6), 1467-1482. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035750528&doi=10.1111%2f1752-1688.12589&partnerID=40&md5=bf5eef51dac948ff0f3ae4973c2ada73. doi:10.1111/1752-1688.12589

Research Tags: Water

Abstract: *Scenario-based and scenario-neutral impacts assessment approaches provide complementary information about how climate change-driven effects on streamflow may change the operational performance of multipurpose dams. Examining a case study of Cougar Dam in Oregon, United States, we simulated current reservoir operations under scenarios of plausible future hydrology. Streamflow projections from the CGCM3.1 general circulation model for the A1B emission scenario were used to generate stochastic reservoir inflows that were then further perturbed to simulate a potentially drier future. These were then used to drive a simple reservoir model. In the scenario-based analysis, we found reservoir operations are vulnerable to climate change. Increases in fall and winter inflow could lead to more frequent flood storage, reducing flexibility to store incoming flood flows. Uncertainty in spring inflow volume complicates projection of future filling performance. The reservoir may fill more or less often, depending on whether springs are wetter or drier. In the summer, drawdown may occur earlier to meet conservation objectives. From the scenario-neutral analysis, we identified thresholds of streamflow magnitude that can predict climate change impacts for a wide range of scenarios. Our results highlight projected operational challenges for Cougar Dam and provide an example of how scenario-based and scenario-neutral approaches may be applied concurrently to assess climate change impacts.*

Dante-Wood, S. K., Peterson, D. L., & Halofsky, J. E. (2018) Assessing Climate Change Effects in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 1-15).

Research Tags: Forestry

Abstract: *The Northern Adaptation Partnership (NRAP) identified climate change issues relevant to resource management in the Northern Rockies (USA) region, and developed solutions that minimize negative effects of climate change and facilitate transition of diverse ecosystems to a warmer climate. The NRAP region covers 74 million hectares, spanning northern Idaho, Montana, northwest Wyoming, North Dakota, and northern South Dakota, and includes 15 national forests and 3 national parks across the U.S. Forest Service Northern Region and adjacent Greater Yellowstone Area. U.S. Forest Service scientists, resource managers, and stakeholders worked together over a two-year period to conduct a state-of-science climate change vulnerability assessment and develop adaptation options for national forests and national parks in the Northern Rockies region. The vulnerability assessment emphasized key resource areas—water, fisheries, wildlife, forest and rangeland vegetation and disturbance, recreation, cultural heritage, and ecosystem services—regarded as the most important for local ecosystems and communities. Resource managers used the assessment to develop a detailed list of ways to address climate change vulnerabilities through management actions. The large number of adaptation strategies and tactics, many of which are a component of current management practice, provide a pathway for slowing the rate of deleterious change in resource conditions.*

D'Avello, T. P., Waltman, W. J., Waltman, S. W., Thompson, J. A., & Brennan, J. (2019). Revisiting the Pedocal/Pedalfer boundary and Soil Moisture Regimes using the javaNewhall simulation model and PRISM data. *Geoderma, 353*, 125-132. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068393889&doi=10.1016%2fj.geoderma.2019.06.042&partnerID=40&md5=428e64ecf16049b8738db28bc663e110. doi:10.1016/j.geoderma.2019.06.042

Research Tags: Water, Soil

Abstract: *We examine the climatic record of the conterminous United States from 1895 to 2014 as expressed through the PRISM dataset and the jNewhall model. Specifically, the zero line of the Annual Water Balance (AWB) and the respective oscillation zone through its longitudinal extent is examined. The zero line corresponds to the Pedocal/Pedalfer line defined by C.F. Marbut, considered outdated in current pedological circles, but conceptually powerful in denoting regional negative vs. positive AWB. Soil Moisture Regimes are reviewed and a means of expressing Soil Moisture Regime variability is introduced. Results indicate a difference in the width of the AWB oscillation zone from South to North with a demarcation approximating 40 degrees North Latitude. PRISM data is verified from a select set of National Weather Service station data to assess the utility of using readily accessible PRISM data for performing similar work by others. The effect of climate variables on organic* *carbon (OC) stock and depth of maximum Calcium Carbonate concentration is examined for a suite of soils along a climo-sequence from North Dakota to Central Iowa and found to account for a mild amount of the variability of both variables.*

David, A. S., Jones, I. M., & Lake, E. C. (2019). Wind speed predicts population dynamics of the eriophyid mite Floracarus perrepae on invasive Old World climbing fern (Lygodium microphyllum) in a shade house colony. *Experimental and Applied Acarology, 78*(2), 263-272. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067233643&doi=10.1007%2fs10493-019-00391-3&partnerID=40&md5=e52e19470c92bc407230433d9e9fe06b. doi:10.1007/s10493-019-00391-3
Research Tags: Forestry
Abstract: *Lygodium microphyllum is one of the most noxious invasive plants in Florida, USA, smothering native vegetation in cypress swamps, pine flatwoods, and Everglades tree islands and altering fire regimes. The eriophyid mite Floracarus perrepae was introduced from Australia to help control L. microphyllum infestations. While F. perrepae exhibits high population growth rates in its native range, its population dynamics in Florida are unknown, particularly the dynamics that occur within the leaf roll galls the mite induces on the margins of leaves. Here, we monitored a shade house colony of F. perrepae in south Florida for 2 years to identify seasonal patterns and potential climate drivers of within-gall mite density. Gall dissections of mite-infested colony plants were performed monthly. Mite density within galls exhibited two cycles per year: a strong cycle that boomed in spring and busted in summer, and a weak cycle that moderately increased mite density in fall and declined in winter. Climate variables, particularly those related to wind speed, were positively associated with higher mite density. Our study sheds light on the within-gall dynamics of F. perrepae and suggests that the highest within-gall mite densities occur in the spring and fall.*

Davis, C. M. (2018) Effects of Climate Change on Cultural Resources in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 209-219).
Research Tags: Forestry
Abstract: *People have inhabited the Northern Rocky Mountains of the United States since the close of the last Pleistocene glacial period, some 14,000 years B.P. (Fagan 1990; Meltzer 2009). Evidence of this ancient and more recent human occupation is found throughout the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and the Greater Yellowstone Area, hereafter called the Northern Rockies region. Each of the five subregions, and the public and private lands they now encompass, contains thousands of years of human history.*

Davis, K. T., Dobrowski, S. Z., Higuera, P. E., Holden, Z. A., Veblen, T. T., Rother, M. T., . . . Maneta, M. P. (2019). Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration. *Proceedings of the National Academy of Sciences of the United States of America, 116*(13), 6193-6198. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063940155&doi=10.1073%2fpnas.1815107116&partnerID=40&md5=0f720ebd9ffe52820b34839f5451e5a8. doi:10.1073/pnas.1815107116
Research Tags: Forestry, Weather
Abstract: *Climate change is increasing fire activity in the western United States, which has the potential to accelerate climate-induced shifts in vegetation communities. Wildfire can catalyze vegetation change by killing adult trees that could otherwise persist in climate conditions no longer suitable for seedling establishment and survival. Recently documented declines in postfire conifer recruitment in the western United States may be an example of this phenomenon. However, the role of annual climate variation and its interaction with long-term climate trends in driving these changes is poorly resolved. Here we examine the relationship between annual climate and postfire tree regeneration of two dominant, low-elevation conifers (ponderosa pine and Douglas-fir) using annually resolved establishment dates from 2,935 destructively sampled trees from 33 wildfires across four regions in the western United States. We show that regeneration had a nonlinear response to annual climate conditions, with distinct thresholds for recruitment based on vapor pressure deficit, soil moisture, and maximum surface temperature. At dry sites across our study region, seasonal to annual climate conditions over the past 20 years have crossed these thresholds, such that conditions have become increasingly unsuitable for regeneration. High fire severity and low seed availability further reduced the probability of*

postfire regeneration. Together, our results demonstrate that climate change combined with high severity fire is leading to increasingly fewer opportunities for seedlings to establish after wildfires and may lead to ecosystem transitions in low-elevation ponderosa pine and Douglas-fir forests across the western United States.

Davis, K. T., Dobrowski, S. Z., Holden, Z. A., Higuera, P. E., & Abatzoglou, J. T. (2019). Microclimatic buffering in forests of the future: the role of local water balance. *Ecography, 42*(1), 1-11. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052524379&doi=10.1111%2fecog.03836&partnerID=40&md5=b72f0b0681772ef95758ddde09ae6416. doi:10.1111/ecog.03836

Research Tags: Forestry, Water, Weather

Abstract: *Forest canopies buffer climate extremes and promote microclimates that may function as refugia for understory species under changing climate. However, the biophysical conditions that promote and maintain microclimatic buffering and its stability through time are largely unresolved. We posited that forest microclimatic buffering is sensitive to local water balance and canopy cover, and we measured this effect during the growing season across a climate gradient in forests of the northwestern United States (US). We found that forest canopies buffer extremes of maximum temperature and vapor pressure deficit (VPD), with biologically meaningful effect sizes. For example, during the growing season, maximum temperature and VPD under at least 50% forest canopy were 5.3°C and 1.1 kPa lower on average, respectively, compared to areas without canopy cover. Canopy buffering of temperature and vapor pressure deficit was greater at higher levels of canopy cover, and varied with water balance, implying that buffering effects are subject to changes in local hydrology. We project changes in the water balance for the mid-21st century and predict how such changes may impact the ability of western US forests to buffer climate extremes. Our results suggest that some forests will lose their capacity to buffer climate extremes as sites become increasingly water limited. Changes in water balance combined with accelerating canopy losses due to increases in the frequency and severity of disturbance will create potentially non-linear changes in the microclimate conditions of western US forests.*

Davis, M. P., Martin, E. A., Moorman, T. B., Isenhart, T. M., & Soupir, M. L. (2019). Nitrous oxide and methane production from denitrifying woodchip bioreactors at three hydraulic residence times. *Journal of Environmental Management, 242*, 290-297. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065475905&doi=10.1016%2fj.jenvman.2019.04.055&partnerID=40&md5=a974242f68d4a82b74011c28760888ae. doi:10.1016/j.jenvman.2019.04.055

Research Tags: Emissions, Water

Abstract: *Denitrifying bioreactors remove nitrate (NO_3^-) from agricultural drainage and are slated to be an integral part of nitrogen reduction strategies in the Mississippi River Basin. However, incomplete denitrification can result in nitrous oxide (N_2O) production and anaerobic conditions within bioreactors may be conducive to methane (CH_4) production via methanogenesis. Greenhouse gas production has the potential to trade excess NO_3^- in surface water with excess greenhouses gases in the atmosphere. Our study examined N_2O and CH_4 production from pilot scale (6.38 m^3) bioreactors across three hydraulic residence times (HRTs), 2, 8, and 16 h. Production was measured from both the surface of the bioreactors and dissolved in the bioreactor effluent. Nitrous oxide and CH_4 was produced across all HRTs, with the majority dissolved in the effluent. Nitrous oxide production was significantly greater ($P < 0.05$) from 2 h HRTs (478.43 mg N_2O m^{-3} day^{-1}) than from 8 (29.95 mg N_2O m^{-3} day^{-1}) and 16 (36.61 mg N_2O m^{-3} day^{-1}) hour HRTs. Methane production was significantly less ($P < 0.05$) from 2 h HRTs (0.51 g C m^3 day^{-1}) compared to 8 (1.50 g C m^3 day^{-1}) and 16 (1.69 g C m^3 day^{-1}) hour HRTs. The 2 h HRTs had significantly greater ($P = 0.05$) impacts to climate change compared to 8 and 16 h HRTs. Results from this study suggest managing HRTs between 6 and 8 h in field bioreactors could minimize total greenhouse gas production and maximize NO_3^- removal.*

Davis, R., Yang, Z., Yost, A., Belongie, C., & Cohen, W. (2017). The normal fire environment—Modeling environmental suitability for large forest wildfires using past, present, and future climate normals. *Forest Ecology and Management, 390*, 173-186. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011994913&doi=10.1016%2fj.foreco.2017.01.027&partnerID=40&md5=a386733c9598e82979fb41abcf133631. doi:10.1016/j.foreco.2017.01.027

Research Tags: Forestry, Weather

Abstract: *We modeled the normal fire environment for occurrence of large forest wildfires (>40 ha) for the*

Pacific Northwest Region of the United States. Large forest wildfire occurrence data from the recent climate normal period (1971–2000) was used as the response variable and fire season precipitation, maximum temperature, slope, and elevation were used as predictor variables. A projection of our model onto the 2001–2030 climate normal period showed strong agreement between model predictions and the area of forest burned by large wildfires from 2001 to 2015 (independent fire data). We then used downscaled climate projections for two greenhouse gas concentration scenarios and over 30 climate models to project changes in environmental suitability for large forest fires over the 21st century. Results indicated an increasing proportion of forested area with fire environments more suitable for the occurrence of large wildfires over the next century for all ecoregions but less pronounced for the Coast Range and Puget Lowlands. The largest increases occurred on federal lands, while private and state lands showed less. We calculated fire rotation periods for the recent historical and current climate and examined the relative differences between them and our modeled large wildfire suitability classes. By the end of the century, the models predicted shorter fire rotation periods, with cooler/moister forests experiencing larger magnitudes of change than warmer/drier forests. Modeling products, including a set of time series maps, can provide forest resource managers, fire protection agencies, and policy-makers empirical estimates of how much and where climate change might affect the geographic distribution of large wildfires and effect fire rotations.

Davis, R. J., Gray, A. N., Kim, J. B., & Cohen, W. B. (2017). Patterns of change across the forested landscape. In *People, Forests, and Change: Lessons from the Pacific Northwest* (pp. 91-101).
Research Tags: Forestry
Abstract: *The scope and extent of past natural disturbances and human-derived changes to the forest landscape often provide the historical context for management but are often insufficiently accounted for in forest planning. In particular, static components of many management plans are not easily adapted to unforeseen system dynamics. For example, when the Northwest Forest Plan was designed in 1993, the inherently dynamic nature of the forest ecosystem and landscape was acknowledged, but there was a general lack of scientific information about the ecological processes that would shape forests of the future. The expectation was that both management and natural disturbances would influence change in the forested landscape, but how management would then adapt to these altered conditions was not clear. At the time, climate change was not well understood and was just beginning to be discussed in relation to forests.*

Davis, T. W., Prentice, I. C., Stocker, B. D., Thomas, R. T., Whitley, R. J., Wang, H., . . . Cramer, W. (2017). Simple process-led algorithms for simulating habitats (SPLASH v.1.0): Robust indices of radiation, evapotranspiration and plant-available moisture. *Geoscientific Model Development, 10*(2), 689-708. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012939412&doi=10.5194%2fgmd-10-689-2017&partnerID=40&md5=27b9c3c8853d1a14bb3ad217fe16ac92. doi:10.5194/gmd-10-689-2017
Research Tags: Research
Abstract: *Bioclimatic indices for use in studies of ecosystem function, species distribution, and vegetation dynamics under changing climate scenarios depend on estimates of surface fluxes and other quantities, such as radiation, evapotranspiration and soil moisture, for which direct observations are sparse. These quantities can be derived indirectly from meteorological variables, such as near-surface air temperature, precipitation and cloudiness. Here we present a consolidated set of simple process-led algorithms for simulating habitats (SPLASH) allowing robust approximations of key quantities at ecologically relevant timescales. We specify equations, derivations, simplifications, and assumptions for the estimation of daily and monthly quantities of top-of-the-atmosphere solar radiation, net surface radiation, photosynthetic photon flux density, evapotranspiration (potential, equilibrium, and actual), condensation, soil moisture, and runoff, based on analysis of their relationship to fundamental climatic drivers. The climatic drivers include a minimum of three meteorological inputs: precipitation, air temperature, and fraction of bright sunshine hours. Indices, such as the moisture index, the climatic water deficit, and the Priestley–Taylor coefficient, are also defined. The SPLASH code is transcribed in C++, FORTRAN, Python, and R. A total of 1 year of results are presented at the local and global scales to exemplify the spatiotemporal patterns of daily and monthly model outputs along with comparisons to other model results.*

De Jesús Sánchez González, J., Corral, J. A. R., García, G. M., Ojeda, G. R., De La Cruz Larios, L., Holland, J. B., . . .

Romero, G. E. G. (2018). Ecogeography of teosinte. *PLoS ONE, 13*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042214920&doi=10.1371%2fjournal.pone.0192676&partnerID=40&md5=5df30145bd6657b2cbbe57cfef2fc59a. doi:10.1371/journal.pone.0192676

Research Tags: Crops, Weather

Abstract: *Adaptation of crops to climate change has motivated an increasing interest in the potential value of novel traits from wild species; maize wild relatives, the teosintes, harbor traits that may be useful to maize breeding. To study the ecogeographic distribution of teosinte we constructed a robust database of 2363 teosinte occurrences from published sources for the period 1842–2016. A geographical information system integrating 216 environmental variables was created for Mexico and Central America and was used to characterize the environment of each teosinte occurrence site. The natural geographic distribution of teosinte extends from the Western Sierra Madre of the State of Chihuahua, Mexico to the Pacific coast of Nicaragua and Costa Rica, including practically the entire western part of Mesoamerica. The Mexican annuals Zea mays ssp. parviglumis and Zea mays ssp. mexicana show a wide distribution in Mexico, while Zea diploperennis, Zea luxurians, Zea perennis, Zea mays ssp. huehuetenangensis, Zea vespertilio and Zea nicaraguensis had more restricted and distinct ranges, representing less than 20% of the total occurrences. Only 11.2% of teosinte populations are found in Protected Natural Areas in Mexico and Central America. Ecogeographical analysis showed that teosinte can cope with extreme levels of precipitation and temperatures during growing season. Modelling teosinte geographic distribution demonstrated congruence between actual and potential distributions; however, some areas with no occurrences appear to be within the range of adaptation of teosintes. Field surveys should be prioritized to such regions to accelerate the discovery of unknown populations. Potential areas for teosintes Zea mays ssp. mexicana races Chalco, Nobogame, and Durango, Zea mays ssp. huehuetenangensis, Zea luxurians, Zea diploperennis and Zea nicaraguensis are geographically separated; however, partial overlapping occurs between Zea mays ssp. parviglumis and Zea perennis, between Zea mays ssp. parviglumis and Zea diploperennis, and between Zea mays ssp. mexicana race Chalco and Zea mays ssp. mexicana race Central Plateau. Assessing priority of collecting for conservation showed that permanent monitoring programs and in-situ conservation projects with participation of local farmer communities are critically needed; Zea mays ssp. mexicana (races Durango and Nobogame), Zea luxurians, Zea diploperennis, Zea perennis and Zea vespertilio should be considered as the highest priority taxa.*

De Kauwe, M. G., Medlyn, B. E., Walker, A. P., Zaehle, S., Asao, S., Guenet, B., . . . Norby, R. J. (2017). Challenging terrestrial biosphere models with data from the long-term multifactor Prairie Heating and CO<inf>2</inf> Enrichment experiment. *Global Change Biology, 23*(9), 3623-3645. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014453179&doi=10.1111%2fgcb.13643&partnerID=40&md5=392de578a191f8c5454f363b45402773. doi:10.1111/gcb.13643

Research Tags: Grassland, Research

Abstract: *Multifactor experiments are often advocated as important for advancing terrestrial biosphere models (TBMs), yet to date, such models have only been tested against single-factor experiments. We applied 10 TBMs to the multifactor Prairie Heating and CO_2 Enrichment (PHACE) experiment in Wyoming, USA. Our goals were to investigate how multifactor experiments can be used to constrain models and to identify a road map for model improvement. We found models performed poorly in ambient conditions; there was a wide spread in simulated above-ground net primary productivity (range: 31–390 g C m^{-2} yr^{-1}). Comparison with data highlighted model failures particularly with respect to carbon allocation, phenology, and the impact of water stress on phenology. Performance against the observations from single-factors treatments was also relatively poor. In addition, similar responses were predicted for different reasons across models: there were large differences among models in sensitivity to water stress and, among the N cycle models, N availability during the experiment. Models were also unable to capture observed treatment effects on phenology: they overestimated the effect of warming on leaf onset and did not allow CO_2-induced water savings to extend the growing season length. Observed interactive (CO_2 × warming) treatment effects were subtle and contingent on water stress, phenology, and species composition. As the models did not correctly represent these processes under ambient and single-factor conditions, little extra information was gained by comparing model predictions against interactive responses. We outline a series of key areas in which this and future experiments could be used to improve model predictions of grassland responses to global change.*

De La Mata, R., Hood, S., & Sala, A. (2017). Insect outbreak shifts the direction of selection from fast to slow growth rates in the long-lived conifer Pinus ponderosa. *Proceedings of the National Academy of Sciences of the United States of America, 114*(28), 7392-7396. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023184233&doi=10.1073%2fpnas.1700032114&partnerID=40&md5=ced4246fa680eaa11c6ce59165fe89c6. doi:10.1073/pnas.1700032114

Research Tags: Forestry, Wildlife

Abstract: *Long generation times limit species' rapid evolution to changing environments. Trees provide critical global ecosystem services, but are under increasing risk of mortality because of climate change-mediated disturbances, such as insect outbreaks. The extent to which disturbance changes the dynamics and strength of selection is unknown, but has important implications on the evolutionary potential of tree populations. Using a 40-y-old Pinus ponderosa genetic experiment, we provide rare evidence of context-dependent fluctuating selection on growth rates over time in a long-lived species. Fast growth was selected at juvenile stages, whereas slow growth was selected at mature stages under strong herbivory caused by a mountain pine beetle (Dendroctonus ponderosae) outbreak. Such opposing forces led to no net evolutionary response over time, thus providing a mechanism for the maintenance of genetic diversity on growth rates. Greater survival to mountain pine beetle attack in slow-growing families reflected, in part, a host-based life-history trade-off. Contrary to expectations, genetic effects on tree survival were greatest at the peak of the outbreak and pointed to complex defense responses. Our results suggest that selection forces in tree populations may be more relevant than previously thought, and have implications for tree population responses to future environments and for tree breeding programs.*

Deal, R. L., Hennon, P. E., D'amore, D. V., Davis, R. J., Smith, J. E., & Lowell, E. C. (2017). Ecosystem services with diverse forest landowners. In *People, Forests, and Change: Lessons from the Pacific Northwest* (pp. 79-90).

Research Tags: Forestry

Abstract: *Pacific Northwest moist coniferous forests provide a wide array of globally important goods and services, including water, carbon sequestration, wood products, fish and wildlife habitat, cultural values, and world-class recreation. These forests are owned and managed by a mix of public, private, and tribal landowners (plates 6, 7), however, who often have different forest-management objectives. Overall, this diverse landownership provides a highly variable forest landscape with forest-management objectives ranging from intensive management on industrial forestlands, to longer rotations on state and tribal lands, to an emphasis on preservation and restoration of late-successional forests to support endangered species and water quality on federal lands. In this chapter, we synthesize some of the objectives of different landowners in the region and the potential opportunities and challenges of integrating goods and services (ecosystem services) into forest management. We show how broad assessment of ecosystem services can be used to plan management activities and to evaluate trade-offs of managing public and private lands to provide a suite of goods and services.*

Dell, C. J., Gollany, H. T., Adler, P. R., Skinner, R. H., & Polumsky, R. W. (2018). Implications of observed and simulated soil carbon sequestration for management options in corn-based rotations. *Journal of Environmental Quality, 47*(4), 617-624. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049422423&doi=10.2134%2fjeq2017.07.0298&partnerID=40&md5=ec1d67fc3667ecf56c8c894d2056e811. doi:10.2134/jeq2017.07.0298

Research Tags: Soil, Crops

Abstract: *Managing cropping systems to sequester soil organic C (SOC) improves soil health and resilience to changing climate. Perennial crops, no-till planting, manure, and cover crops can add SOC; however, their impacts have not been well documented in the northeastern United States. Our objectives were (i) to monitor SOC from a bioenergy cropping study in Pennsylvania that included a corn (Zea mays L.)–soybean [Glycine max (L.) Merr.]–alfalfa (Medicago sativa L.) rotation, switchgrass (Panicum virgatum L.), and reed canarygrass (Phalaris arundinacea L.); (ii) to use the CQESTR model to predict SOC sequestration in the bioenergy crops (with and without projected climate change); and (iii) to use CQESTR to simulate influence of tillage, manure, cover cropping, and corn stover removal in typical dairy forage (silage corn–alfalfa) or grain corn–soybean rotations. Over 8 yr, measured SOC increased 0.4, 1.1, and 0.8 Mg C ha^{-1} yr^{-1} in the bioenergy rotation, reed canarygrass, and switchgrass, respectively. Simulated and measured data were significantly correlated (p <*

0.001) at all depths. Predicted sequestration (8–14 Mg C ha−1 over 40 yr) in dairy forage rotations was much larger than with corn–soybean rotations (−4.0–0.6 Mg C ha−1 over 40 yr), due to multiple years of perennial alfalfa. No-till increased sequestration in the simulated dairy forage rotation and prevented a net loss of C in corn–soybean rotations. Simulations indicated limited impact of cover crops and manure on long-term SOC sequestration. The low solids content of liquid dairy manure is the likely reason for the less-than-expected impact of manure. Overall, simulations suggest that inclusion of alfalfa provides the greatest potential for SOC sequestration with a typical Pennsylvania crop rotation.

DeLuca, W. V., & King, D. I. (2017). Montane birds shift downslope despite recent warming in the northern Appalachian Mountains. *Journal of Ornithology, 158*(2), 493-505. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015744329&doi=10.1007%2fs10336-016-1414-7&partnerID=40&md5=ab786d9c3ccc7d65bc46f9a891ff4d66. doi:10.1007/s10336-016-1414-7
Research Tags: Wildlife
Abstract: *Montane regions support distinct animal and plant communities that are widely viewed as communities of high conservation concern due to their significant contribution to regional biodiversity. These communities are also thought to be particularly vulnerable to anthropogenically caused stressors such as climate change, which is generally expected to cause upward shifts and potential range restrictions in montane plant and animal distributions. In the northern Appalachian Mountains of North America, not only is it becoming warmer at mid-elevations but the ecotone between the northern hardwood and the montane coniferous forests is also shifting. Therefore, species that are limited by climate or habitat along the elevational gradient of mountains may also be experiencing distributional shifts. We studied birds along replicate elevational gradients in the White Mountains of New Hampshire, USA, from 1993 to 2009 and used mixed effects models to estimate the rate of elevational change to test the hypothesis that northern hardwood forest- and montane forest-dependent birds are shifting upslope, consistent with climate change predictions. As predicted, the upper elevational boundary of 9 out of 16 low-elevation species showed evidence of shifting upslope an average of 99 m over the course of the study period. Contrary to our expectations, 9 out of 11 high-elevation species had lower elevational boundaries that shifted downslope an average of 19 m. The opposing elevational shifts of two distinct and adjacent bird communities is, to our knowledge, unprecedented and highlights the need for caution when applying conventional expectations to species' responses to climate change.*

Demaria, E. M. C., Hazenberg, P., Scott, R. L., Meles, M. B., Nichols, M., & Goodrich, D. (2019). Intensification of the North American Monsoon Rainfall as Observed From a Long-Term High-Density Gauge Network. *Geophysical Research Letters, 46*(12), 6839-6847. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067895858&doi=10.1029%2f2019GL082461&partnerID=40&md5=4dc116733724293013724847af490de0. doi:10.1029/2019GL082461
Research Tags: Weather
Abstract: *As the atmosphere gets warmer, rainfall intensification is expected across the planet with anticipated impacts on ecological and human systems. In the southwestern United States and northwestern Mexico, the highly variable and localized nature of rainfall during the North American Monsoon makes it difficult to detect temporal changes in rainfall intensities in response to climatic change. This study addresses this challenge by using the dense, subdaily, and daily observations from 59 rain gauges located in southeastern Arizona. We find an intensification of monsoon subdaily rainfall intensities starting in the mid-1970s that has not been observed in previous studies or simulated with high-resolution climate models. Our results highlight the need for long-term, high spatiotemporal observations to detect environmental responses to a changing climate in highly variable environments and show that analyses based on limited observations or gridded data sets fail to capture temporal changes potentially leading to erroneous conclusions.*

Denton, E. M., Dietrich, J. D., Smith, M. D., & Knapp, A. K. (2017). Drought timing differentially affects above- and belowground productivity in a mesic grassland. *Plant Ecology, 218*(3), 317-328. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007227816&doi=10.1007%2fs11258-016-0690-x&partnerID=40&md5=bd761e393ec2424c0f4423d225a64c39. doi:10.1007/s11258-016-0690-x
Research Tags: Grassland, Weather, Soil

Abstract: *Climate models forecast an intensification of the global hydrological cycle with droughts becoming more frequent and severe, and shifting to times when they have been historically uncommon. Droughts, or prolonged periods of precipitation deficiency, are characteristic of most temperate grasslands, yet few experiments have explored how variation in the seasonal timing of drought may impact ecosystem function. We investigated the response of above- and belowground net primary production (ANPP & BNPP) to altered drought timing in a mesic grassland in NE Kansas. Moderate drought treatments (25% reduction from the mean growing season precipitation [GSP]) were imposed by erecting rainout shelters in late spring (LSP), early summer (ESM), and mid-summer (MSM, n = 10 plots/treatment). These treatments were compared to two controls (long-term average GSP [LTA] and ambient GSP [AMB]) and a wet treatment (+30% of the long-term average GSP [WET]). We found that LSP drought did not significantly reduce ANPP relative to control plots while the ESM and MSM drought did despite equivalent reductions in soil moisture. In contrast, the WET treatment did not affect ANPP. Neither the WET nor the drought treatments altered BNPP as compared to the controls. Our results suggest that forecasts of ecosystem responses to climate change will be improved if both the seasonal timing of alterations in precipitation as well as differential responses of above- and belowground productivity to drought are incorporated into models.*

Derner, J., Briske, D., Reeves, M., Brown-Brandl, T., Meehan, M., Blumenthal, D., . . . Peck, D. (2018). Vulnerability of grazing and confined livestock in the Northern Great Plains to projected mid- and late-twenty-first century climate. *Climatic Change, 146*(1-2), 19-32. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85025646887&doi=10.1007%2fs10584-017-2029-6&partnerID=40&md5=c5b99fde478c9fc10c7830c20182a95a. doi:10.1007/s10584-017-2029-6

Research Tags: Livestock, Grassland

Abstract: *The Northern Great Plains (NGP) region of the USA—which comprises Montana, Wyoming, Colorado, North Dakota, South Dakota, and Nebraska—is a largely rural area that provides numerous ecosystem services, including livestock products, cultural services, and conservation of biological diversity. The region contains 25% of the Nation's beef cattle and approximately one-third of the confined beef cattle, as well as the largest remaining native prairie in the US—the Northern Mixedgrass Prairie. With rising atmospheric CO2, the NGP is projected to experience warmer and longer growing seasons, greater climatic variability, and more extreme events (e.g., increased occurrence of large precipitation events). These climatic changes may affect livestock production both directly via physiological impacts on animals and indirectly via modifications to forage, invasion of undesirable plants, and increased exposure to parasites. This raises concerns about the vulnerability of grazing livestock operations and confined livestock operations to projected changes in mid- (2050) and late- (2085) twenty-first century climate. Our objectives are to (1) describe the NGP's exposure to temperature and precipitation trends, inter-annual variability, and extreme events; (2) evaluate the sensitivity of beef cattle production to direct and indirect effects imposed by these projected climatic changes; and (3) provide a typology of adaptation strategies to minimize adverse consequences of projected changes and maximize beneficial consequences. Agricultural managers have developed considerable adaptive capacity to contend with environmental and economic variability. However, projected climatic changes, especially the increased frequency and magnitude of weather extremes, will require even greater adaptive capacity to maintain viable production systems. Consequently, regional vulnerability to projected climatic changes will be determined not only by ecological responses but also by the adaptive capacity of individual managers. Adaptive capacity in the NGP will differ from other regions, in part because projections suggest some opportunities for increased livestock production. Adaptations in both grazing and confined beef cattle systems will require enhanced decision-making skills capable of integrating biophysical, social, and economic considerations. Social learning networks that support integration of experimental and experiential knowledge—such as lessons learned from early adopters and involvement with science-based organizations—can help enhance decision-making and climate adaptation planning. Many adaptations have already been implemented by a subset of producers in this region, providing opportunities for assessment, further development, and greater adoption. Context-specific decision-making can also be enhanced through science-management partnerships, which aim to build adaptive capacity that recognizes multiple production and conservation/environmental goals.*

Derner, J. D., Augustine, D. J., & Frank, D. A. (2018). Does Grazing Matter for Soil Organic Carbon Sequestration in the

Western North American Great Plains? *Ecosystems*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058380011&doi=10.1007%2fs10021-018-0324-3&partnerID=40&md5=7072316eef00da48ba24dabc0e1acacf. doi:10.1007/s10021-018-0324-3

Research Tags: Soil, Livestock, Grassland

Abstract: *Considerable uncertainty remains regarding grazing-induced influences on soil organic carbon (SOC) sequestration in semiarid grassland ecosystems due to three important complications associated with studying such effects: (1) Ecologically meaningful shifts in SOC pools attributable to grazing are difficult to detect relative to inherently large grassland SOC pools, (2) a lack of baseline (pre-treatment) data, and (3) frequent lack of or limited replication of long-term grazing manipulations. SOC sequestration rates were determined in 74-year-old grazing exclosures and paired moderately grazed sites, established across a soil texture gradient, in the western North American shortgrass steppe in northeastern Colorado. We sampled soils (0–20 cm) from 12 exclosures and paired grazed sites to measure SOC concentration and soil radiocarbon Δ14C (‰); the latter allowed us to determine turnover of the SOC pool over a 7-decade period in the presence versus the absence of grazing. Removal of grazing for more than 7 decades substantially altered plant community composition but did not affect total soil C, SOC, soil Δ14C, SOC turnover rate, or total soil N. Grazing effect also did not interact with soil texture to influence any of those soil properties. Soil texture (silt + clay content) did influence total soil C and SOC, and total soil N, but not Δ14C or SOC turnover. Results provide evidence that long-term removal of grazing from semiarid grassland ecosystems in the western North American Great Plains does not enhance long-term SOC sequestration, despite changes in the relative dominance of C3 versus C4 grasses.*

Dey, D. C., Knapp, B. O., Battaglia, M. A., Deal, R. L., Hart, J. L., O'Hara, K. L., . . . Schuler, T. M. (2019). Barriers to natural regeneration in temperate forests across the USA. *New Forests, 50*(1), 11-40. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059065396&doi=10.1007%2fs11056-018-09694-6&partnerID=40&md5=78066abd1d10c067185557d885f13730. doi:10.1007/s11056-018-09694-6

Research Tags: Forestry, Weather

Abstract: *For millennia, natural disturbance regimes, including anthropogenic fire and hunting practices, have led to forest regeneration patterns that created a diversity of forest lands across the USA. But dramatic changes in climates, invasive species, and human population, and land use have created novel disturbance regimes that are causing challenges to securing desired natural regeneration. Climate is an ever-present background disturbance and determinant of species distribution. Changes in certain other factors such as large herbivore populations, wildfire, and pests modify forest composition and structure, and are common barriers to natural regeneration of desired species. Changes in long-standing disturbance regimes have led to the homogenization of forest landscape composition and structure. Today, forests have low regeneration potential and are low in resilience. They have reduced productivity and are prone to widespread health issues including severe forest mortality. In addition to epidemics of native invasive species due to climate change and availability of habitat at landscape scales, the continued introduction and spread of non-native pests and diseases are causing large-scale forest mortality. These ecological changes have cascading ecological consequences such as increases in severe wildfire, which pose new barriers to natural regeneration. Equally challenging are the barriers to natural regeneration that arise from social, political and economic factors. To address many of these issues requires active management that links all critical stages in the regeneration niche necessary for achieving desired regeneration to sustain forest development and production in a socially acceptable manner and economically viable market system.*

Dhungel, R., Aiken, R., Colaizzi, P. D., Lin, X., O'Brien, D., Baumhardt, R. L., . . . Marek, G. W. (2019). Evaluation of uncalibrated energy balance model (BAITSSS) for estimating evapotranspiration in a semiarid, advective climate. *Hydrological Processes, 33*(15), 2110-2130. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067075071&doi=10.1002%2fhyp.13458&partnerID=40&md5=96060d098605025fab00c67e829a153f. doi:10.1002/hyp.13458

Research Tags: Research, Weather

Abstract: *The backward-averaged iterative two-source surface temperature and energy balance solution (BAITSSS) model was developed to calculate evapotranspiration (ET) at point to regional scales. The BAITSSS model is driven by micrometeorological data and vegetation indices and simulates the water and energy balance of the soil and canopy sources separately, using the Jarvis model to calculate canopy resistance. The*

BAITSSS model has undergone limited testing in Idaho, United States. We conducted a blind test of the BAITSSS model without prior calibration for ET against weighing lysimeter measurements, net radiation, and surface temperature of drought-tolerant corn (Zea mays L. cv. PIO 1151) in a semiarid, advective climate (Bushland, Texas, United States) in 2016. Later in the season (20 days), BAITSSS consistently overestimated ET by up to 3 mm d^{-1}. For the entire growing season (127 days), simulated versus measured ET resulted in a 7% error in cumulative ET, RMSE = 0.13 mm h^{-1}, and 1.70 mm d^{-1}; r^2 = 0.66 (daily) and r^2 = 0.84 (hourly); MAE = 0.08 mm h^{-1} and 1.24 mm d^{-1}; and MBE = 0.02 mm h^{-1} and 0.58 mm d^{-1}. The results were comparable with thermally driven instantaneous ET models that required some calibration. Next, the initial soil water boundary condition was reduced, and model revisions were made to resistance terms related to incomplete cover and assumption of canopy senescence. The revisions reduced discrepancies between measured and modelled ET resulting in <1% error in cumulative ET, RMSE = 0.1 mm h^{-1}, and 1.09 mm d^{-1}; r^2 = 0.86 (daily) and r^2 = 0.90 (hourly); MAE = 0.06 mm h^{-1} and 0.79 mm d^{-1}; and MBE = 0.0 mm h^{-1} and 0.17 mm d^{-1} and generally mitigated the previous overestimation. The advancement in ET modelling with BAITSSS assists to minimize uncertainties in crop ET modelling in a time series.

Dijak, W. D., Hanberry, B. B., Fraser, J. S., He, H. S., Wang, W. J., & Thompson, F. R. (2017). Revision and application of the LINKAGES model to simulate forest growth in central hardwood landscapes in response to climate change. *Landscape Ecology, 32*(7), 1365-1384. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007190231&doi=10.1007%2fs10980-016-0473-8&partnerID=40&md5=6f48396604eacd499aa2dcf99dd68a47. doi:10.1007/s10980-016-0473-8

Research Tags: Forestry, Research, Soil

Abstract: *Context*

Global climate change impacts forest growth and methods of modeling those impacts at the landscape scale are needed to forecast future forest species composition change and abundance. Changes in forest landscapes will affect ecosystem processes and services such as succession and disturbance, wildlife habitat, and production of forest products at regional, landscape and global scales.

Objectives

LINKAGES 2.2 was revised to create LINKAGES 3.0 and used it to evaluate tree species growth potential and total biomass production under alternative climate scenarios. This information is needed to understand species potential under future climate and to parameterize forest landscape models (FLMs) used to evaluate forest succession under climate change.

Methods

We simulated total tree biomass and responses of individual tree species in each of the 74 ecological subsections across the central hardwood region of the United States under current climate and projected climate at the end of the century from two general circulation models and two representative greenhouse gas concentration pathways.

Results

Forest composition and abundance varied by ecological subsection with more dramatic changes occurring with greater changes in temperature and precipitation and on soils with lower water holding capacity. Biomass production across the region followed patterns of soil quality.

Conclusions

Linkages 3.0 predicted realistic responses to soil and climate gradients and its application was a useful approach for considering growth potential and maximum growing space under future climates. We suggest Linkages 3.0 can also can used to inform parameter estimates in FLMs such as species establishment and maximum growing space.

Dijkstra, F. A., Carrillo, Y., Blumenthal, D. M., Mueller, K. E., LeCain, D. R., Morgan, J. A., . . . Pendall, E. (2018). Elevated CO<inf>2</inf> and water addition enhance nitrogen turnover in grassland plants with implications for temporal stability. *Ecology Letters, 21*(5), 674-682. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043316184&doi=10.1111%2fele.12935&partnerID=40&md5=bd3d939f2abacbd2d6e102905d2e135d. doi:10.1111/ele.12935

Research Tags: Grassland

Abstract: *Temporal variation in soil nitrogen (N) availability affects growth of grassland communities that*

differ in their use and reuse of N. In a 7-year-long climate change experiment in a semi-arid grassland, the temporal stability of plant biomass production varied with plant N turnover (reliance on externally acquired N relative to internally recycled N). Species with high N turnover were less stable in time compared to species with low N turnover. In contrast, N turnover at the community level was positively associated with asynchrony in biomass production, which in turn increased community temporal stability. Elevated CO2 and summer irrigation, but not warming, enhanced community N turnover and stability, possibly because treatments promoted greater abundance of species with high N turnover. Our study highlights the importance of plant N turnover for determining the temporal stability of individual species and plant communities affected by climate change.

Djonko-Moore, C. M., Leonard, J., Holifield, Q., Bailey, E. B., & Almughyirah, S. M. (2018). Using culturally relevant experiential education to enhance urban children's knowledge and engagement in science. *Journal of Experiential Education, 41*(2), 137-153. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046039608&doi=10.1177%2f1053825917742164&partnerID=40&md5=6b23fb29a096dd82c75133651a2633d8. doi:10.1177/1053825917742164

Research Tags: Research

Abstract: *Background: Children living in urban areas often have limited opportunities to experience informal science environments. As a result, some do not have a deep understanding of the environment, natural resources, ecosystems, and the ways human activities affect nature. Purpose: This article examines how experiential science education supported urban children's science knowledge and engagement through cultural relevance and eco-justice during a 1-week summer camp. Methodology/Approach: Third- through sixth-grade children from African American and Latinx urban communities in Colorado participated in a weeklong program using experiential learning opportunities including environmental and climate change lessons, activities at a local community-based site, and field trips to nature- and science-themed sites. Pre- and posttests, focus group interviews, journals, and student work samples were analyzed. Findings/Conclusions: Children's science content knowledge as well as their engagement in science lessons and field trips were positively influenced during the study. Implications: This study provides a template for establishing culturally relevant experiential learning opportunities to engage underrepresented children in science.*

Djukic, I., Kepfer-Rojas, S., Schmidt, I. K., Larsen, K. S., Beier, C., Berg, B., . . . Tóth, Z. (2018). Early stage litter decomposition across biomes. *Science of the Total Environment, 628-629*, 1369-1394. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042424360&doi=10.1016%2fj.scitotenv.2018.01.012&partnerID=40&md5=598ece9ffdd870b96aa382dbc4b6ee0e. doi:10.1016/j.scitotenv.2018.01.012

Research Tags: Emissions, Soil, Forestry

Abstract: *Through litter decomposition enormous amounts of carbon is emitted to the atmosphere. Numerous large-scale decomposition experiments have been conducted focusing on this fundamental soil process in order to understand the controls on the terrestrial carbon transfer to the atmosphere. However, previous studies were mostly based on site-specific litter and methodologies, adding major uncertainty to syntheses, comparisons and meta-analyses across different experiments and sites. In the TeaComposition initiative, the potential litter decomposition is investigated by using standardized substrates (Rooibos and Green tea) for comparison of litter mass loss at 336 sites (ranging from −9 to +26 °C MAT and from 60 to 3113 mm MAP) across different ecosystems. In this study we tested the effect of climate (temperature and moisture), litter type and land-use on early stage decomposition (3 months) across nine biomes. We show that litter quality was the predominant controlling factor in early stage litter decomposition, which explained about 65% of the variability in litter decomposition at a global scale. The effect of climate, on the other hand, was not litter specific and explained <0.5% of the variation for Green tea and 5% for Rooibos tea, and was of significance only under unfavorable decomposition conditions (i.e. xeric versus mesic environments). When the data were aggregated at the biome scale, climate played a significant role on decomposition of both litter types (explaining 64% of the variation for Green tea and 72% for Rooibos tea). No significant effect of land-use on early stage litter decomposition was noted within the temperate biome. Our results indicate that multiple drivers are affecting early stage litter mass loss with litter quality being dominant. In order to be able to quantify the relative importance of the different drivers over time, long-term studies combined with experimental trials are needed.*

Dold, C., Büyükcangaz, H., Rondinelli, W., Prueger, J. H., Sauer, T. J., & Hatfield, J. L. (2017). Long-term carbon uptake of agro-ecosystems in the Midwest. *Agricultural and Forest Meteorology, 232*, 128-140. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84983087209&doi=10.1016%2fj.agrformet.2016.07.012&partnerID=40&md5=c0da0e68e029489cbc1c2a48c0dad377. doi:10.1016/j.agrformet.2016.07.012

Research Tags: Crops, Grassland, Soil

Abstract: *The Midwest is one of the most important production areas for corn and soybean worldwide, but also comprises remnants of natural tallgrass prairie vegetation. Future predictions suggest that corn (Zea mays L.) and soybean (Glycine max (L.) Merr.) production in the Midwest may be limited by precipitation and temperature due to climate change. Cross-biome long-term studies in situ are needed to understand carbon assimilation and impact of climate change on the entire region. In this study, we investigated the differences of gross primary production (GPP) and net ecosystem production (NEP) among typical (agro-) ecosystems of corn, soybean and tallgrass prairie from eddy flux stations from 2006 to 2015 under contrasting weather conditions. Corn had the highest annual GPP and NEP with 1305 and 327 g C m^{-2} yr^{-1}, while soybean had significantly lower GPP and NEP with 630 and −34 g C m^{-2} yr^{-1}, excluding additional carbon loss by yield. Corn and soybean NEP was linear related ($p < 0.05$) to leaf area index (LAI), height or phenological stage, confirming the strong link between plant growth and ecosystem carbon balance. Tallgrass prairie had average values of GPP and NEP of 916 and 61 g C m^{-2} yr^{-1}, excluding loss of carbon by annual burning. Thus, prairie GPP and NEP were significantly lower than corn, but significantly higher than soybean. Probably the long fallow period on cropland, which enhanced heterotrophic respiration, and the low carbon assimilation of soybean reduced its overall carbon balance. In total, the corn-soybean agroecosystem acted as a carbon source due to carbon loss by yield removal. Values for GPP and NEP were reflected in inherent water use efficiency (IWUE) and light use efficiency (LUE) among the agroecosystems. In addition, IWUE , LUE or GPP of crops and tallgrass prairie were linearly related ($p < 0.05$) to precipitation, volumetric soil water content (VWC) and maximum air temperature. Air temperature increased IWUE in both, cropland and prairie vegetation. However, rainfall and VWC affected crops and prairie vegetation differently: while excessive rainfall and VWC reduced GPP or IWUE in cropland, prairie vegetation GPP and LUE were adversely affected by reduced VWC or precipitation. Future measures of climate change adaption should consider the contrasting effects of precipitation and VWC among the different agro-ecosystems in the Midwestern USA.*

Dold, C., Thomas, A. L., Ashworth, A. J., Philipp, D., Brauer, D. K., & Sauer, T. J. (2019). Carbon sequestration and nitrogen uptake in a temperate silvopasture system. *Nutrient Cycling in Agroecosystems, 114*(1), 85-98. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064541316&doi=10.1007%2fs10705-019-09987-y&partnerID=40&md5=f37bdb1fd60ebd1d51d6608336a0d624. doi:10.1007/s10705-019-09987-y

Research Tags: Livestock, Forestry

Abstract: *Agroforestry systems (AFS) have the potential to foster long-term carbon sequestration and nutrient uptake. Yet, information on sequestration rates is still scarce, especially for AFS in temperate regions and for maturing AFS. This study aims to determine the rate and amount of carbon and nitrogen uptake in a 17-year-old northern red oak (Quercus rubra)–pecan (Carya illinoinensis) silvopastoral planting in Fayetteville, AR, USA. Seven oak and pecan trees were felled to develop AFS-specific allometric equations for above-ground biomass, carbon, and nitrogen. Tree-stand woody biomass (DWw), carbon (Cw) and nitrogen (Nw) and leaf biomass (DWL), carbon (CL), and nitrogen (NL) were calculated with these equations. Diameter at 1.37 m above ground (DBH) was measured annually, and a non-linear mixed-effect model was used to estimate absolute (AGR) and relative growth rates. DWw and Cw was 7.1 and 3.4 Mg ha^{-1} for pecan and 26.6 and 12.7 Mg ha^{-1} for oak, which corresponds to a carbon sequestration rate of 0.75 and 0.20 Mg C ha^{-1} yr^{-1}, respectively. Total N uptake was approximately 66 and 71 g N $tree^{-1}$ yr^{-1} for oak and pecan. The mixed-effect model with individual-tree-level random effects for all parameters provided the best representation of DBH growth of oak and pecan, likely due to the high heterogeneity of site characteristics. The AGR explained the non-linear plant growth and reached its maximum of 0.017 and 0.0179 m yr^{-1} for oak and pecan, respectively, 11 years after planting. This suggests that carbon and nitrogen uptake also declined after 11 years.*

Domke, G. M., Perry, C. H., Walters, B. F., Nave, L. E., Woodall, C. W., & Swanston, C. W. (2017). Toward inventory-based estimates of soil organic carbon in forests of the United States. *Ecological Applications, 27*(4), 1223-1235.

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https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020162497&doi=10.1002%2feap.1516&partnerID=40&md5=11a2e680994b06c6e6a3fac063c0a01f. doi:10.1002/eap.1516
Research Tags: Soil
Abstract: *Soil organic carbon (SOC) is the largest terrestrial carbon (C) sink on Earth; this pool plays a critical role in ecosystem processes and climate change. Given the cost and time required to measure SOC, and particularly changes in SOC, many signatory nations to the United Nations Framework Convention on Climate Change report estimates of SOC stocks and stock changes using default values from the Intergovernmental Panel on Climate Change or country-specific models. In the United States, SOC in forests is monitored by the national forest inventory (NFI) conducted by the Forest Inventory and Analysis (FIA) program within the U.S. Department of Agriculture, Forest Service. The FIA program has been consistently measuring soil attributes as part of the NFI since 2001 and has amassed an extensive inventory of SOC in forest land in the conterminous United States and southeast and southcentral coastal Alaska. That said, the FIA program has been using country-specific predictions of SOC based, in part, upon a model using SOC estimates from the State Soil Geographic (STATSGO) database compiled by the Natural Resources Conservation Service. Estimates obtained from the STATSGO database are averages over large map units and are not expected to provide accurate estimates for specific locations, e.g., NFI plots. To improve the accuracy of SOC estimates in U.S. forests, NFI SOC observations were used for the first time to predict SOC density to a depth of 100 cm for all forested NFI plots. Incorporating soil-forming factors along with observations of SOC into a new estimation framework resulted in a 75% (48 ± 0.78 Mg/ha) increase in SOC densities nationally. This substantially increases the contribution of the SOC pool, from approximately 44% (17 Pg) of the total forest ecosystem C stocks to 56% (28 Pg), in the forest C budget of the United States.*

Dong, J., & Crow, W. T. (2017). An Improved Triple Collocation Analysis Algorithm for Decomposing Autocorrelated and White Soil Moisture Retrieval Errors. *Journal of Geophysical Research: Atmospheres, 122*(24), 13,081-"013,094". Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038238425&doi=10.1002%2f2017JD027387&partnerID=40&md5=4ec08b1b96067a6c41cf5d72116beaf2. doi:10.1002/2017JD027387
Research Tags: Research, Soil
Abstract: *If not properly account for, autocorrelated retrieval errors can lead to inaccurate results in soil moisture data analysis and reanalysis. Here we propose a more generalized form of the triple collocation analysis algorithm (GTC) capable of decomposing the total error variance of remotely sensed surface soil moisture retrievals into their autocorrelated and the serially white components. Synthetic tests demonstrate the robustness and accuracy of GTC—even in the presence of significant temporal data gaps. However, the accuracy of GTC error autoregressive parameter estimates is relatively more sensitive to temporal data availability. In addition, land surface model soil moisture predictions collected from phase 2 of the North American Land Data Assimilation System and remotely sensed surface soil moisture retrievals obtained from the European Space Agency Climate Change Initiative (ESA CCI) are applied for a real data demonstration. Despite expectations to the contrary, significant error autocorrelation is found in the remotely sensed-based ESA CCI soil moisture data sets. In particular, ESA CCI-Act (i.e., the subset of ESA CCI soil moisture retrievals based on active scattomotter data) demonstrates the largest autoregressive parameters over low biomass areas. Conversely, ESA CCI-Pas retrievals (based on passive radiometer data) have larger error autoregressive parameters over high biomass areas. As such, results clarify circumstances in which errors in remotely sensed surface soil moisture retrievals cannot be considered serially white.*

Dong, J., & Crow, W. T. (2018). The Added Value of Assimilating Remotely Sensed Soil Moisture for Estimating Summertime Soil Moisture-Air Temperature Coupling Strength. *Water Resources Research, 54*(9), 6072-6084. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052962050&doi=10.1029%2f2018WR022619&partnerID=40&md5=5ab9565efeebe29b6c45e362a7f88e10. doi:10.1029/2018WR022619
Research Tags: Soil
Abstract: *To date, the direct use of remote-sensing soil moisture data sets for examining surface/atmosphere coupling strengths has been hampered by the presence of significant random errors and data gaps in these*

products. This study investigates the potential for obtaining an improved observation-based lower bound of summertime soil moisture-air temperature coupling strength via the assimilation of long-term, remote-sensing soil moisture data sets into a simple, prognostic model driven by observed rainfall. In particular, we utilize simultaneous scatterometer- and radiometer-based soil moisture products obtained from the European Space Agency Climate Change Initiative soil moisture product and a triple collocation analysis approach to estimate the variance of modeling and observation errors (required as input by a data assimilation system). Results show that assimilating remotely sensed soil moisture leads to larger coupling strength estimates as measured by the absolute anomaly correlation with independent temperature observation data than those obtained from modeled or remotely sensed soil moisture alone. According to an analyses of soil moisture error impacts on coupling strength estimates, this increase in coupling strength is likely attributable to an improvement in the precision of the soil moisture product used to estimate it. Based on this, we conclude that data assimilation provides an improved lower bound on the magnitude of true coupling strength between soil moisture and screen-level air temperature.

Dong, J., & Crow, W. T. (2018). Use of Satellite Soil Moisture to Diagnose Climate Model Representations of European Soil Moisture-Air Temperature Coupling Strength. *Geophysical Research Letters, 45*(23), 12,884-"812,891". Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058038005&doi=10.1029%2f2018GL080547&partnerID=40&md5=5a8aac98f4509f8cf81c909c56de72e6. doi:10.1029/2018GL080547

Research Tags: Soil, Weather

Abstract: *Using newly available soil moisture data sets from Soil Moisture Passive/Active mission, we derive new observation-based estimates of soil moisture-air temperature coupling strengths over Europe, which demonstrate that General Circulation Model predictions of soil moisture and surface air temperature are generally undercoupled in areas of Europe. Since the variability of European summertime air temperatures has been linked to the strength of soil moisture-air temperature coupling, this result has significant implications for efforts to accurately project heat wave risks in Europe during coming the decades.*

Dong, Z., Driscoll, C. T., Johnson, S. L., Campbell, J. L., Pourmokhtarian, A., Stoner, A. M. K., & Hayhoe, K. (2019). Projections of water, carbon, and nitrogen dynamics under future climate change in an old-growth Douglas-fir forest in the western Cascade Range using a biogeochemical model. *Science of the Total Environment, 656*, 608-624. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057853532&doi=10.1016%2fj.scitotenv.2018.11.377&partnerID=40&md5=b2904dd2d6415fd4f15035bbf94ace5c. doi:10.1016/j.scitotenv.2018.11.377

Research Tags: Forestry, Soil

Abstract: *Statistically downscaled climate change scenarios from four General Circulation Models for two Representative Concentration Pathways (RCP) were applied as inputs to a biogeochemical model, PnET-BGC, to examine potential future dynamics of water, carbon, and nitrogen in an old-growth Douglas-fir forest in the western Cascade Range. Projections show 56% to 77% increases in stomatal conductance throughout the year from 1986–2010 to 2076–2100, and 65% to 104% increases in leaf carbon assimilation between October and June over the same period. However, future dynamics of water and carbon under the RCP scenarios are affected by a 49% to 86% reduction in foliar biomass resulting from severe air temperature and humidity stress to the forest in summer. Important implications of future decreases in foliar biomass include 1) 20% to 71% decreases in annual transpiration which increase soil moisture by 7% to 15% in summer and fall; 2) decreases in photosynthesis by 77% and soil organic matter by 62% under the high radiative forcing scenario; and 3) altered foliar and soil carbon to nitrogen stoichiometry. Potential carbon dioxide fertilization effects on vegetation are projected to 1) amplify decreases in transpiration by 4% to 9% and increases in soil moisture in summer and fall by 1% to 2%; and 2) alleviate decreases in photosynthesis by 4%; while 3) having negligible effects on the dynamics of nitrogen. Our projections suggest that future decrease in transpiration and moderate water holding capacity may mitigate soil moisture stress to the old-growth Douglas-fir forest. Future increases in nitrogen concentration in soil organic matter are projected to alleviate the decrease in net nitrogen mineralization despite a reduction in decomposition of soil organic matter by the end of the century.*

Donner, D. M., Brown, D. J., Ribic, C. A., Nelson, M., & Greco, T. (2018). Managing forest habitat for

conservation-reliant species in a changing climate: The case of the endangered Kirtland's Warbler. *Forest Ecology and Management, 430*, 265-279. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051653244&doi=10.1016%2fj.foreco.2018.08.026&partnerID=40&md5=8cfbbc6013f57f0537d01cba8f57c896. doi:10.1016/j.foreco.2018.08.026
Research Tags: Forestry, Wildlife
Abstract: *Conservation and recovery of species of concern necessitates evaluating forest habitat conditions under changing climate conditions, especially in the early stages of the delisting process. Managers must weigh implications of near-term habitat management activities within the context of changing environmental conditions and a species' biological traits that may influence their vulnerability to changing conditions. Here we applied established population-habitat relationships based on decades of monitoring and research-management collaborations for the Kirtland's Warbler (Setophaga kirtlandii) to project potential impacts of changing environmental conditions to breeding habitat distribution, quantity, and quality in the near future. Kirtland's warblers are habitat-specialists that nest exclusively within dense jack pine (Pinus banksiana) forests between ca. 5–20 years of age. Using Random Forests to predict changes in distribution and growth rate of jack pine under future scenarios, results indicate the projected distribution of jack pine will contract considerably (ca. 75%) throughout the Lake States region, U.S.A. in response to projected environmental conditions in 2099 under RCP 4.5 and 8.5 climate scenarios regardless of climate model. Reduced suitability for jack pine regeneration across the Lake States may constrain management options, especially for creating high stem-density plantations nesting habitat. However, conditions remain suitable for jack pine regeneration within their historical and current core breeding range in northern Lower Michigan and several satellite breeding areas. Projected changes in jack pine growth rates varied within the core breeding area, but altered growth rates did not greatly alter the duration that habitat remained suitable for nesting by the Kirtland's Warblers. These findings contribute to Kirtland's Warbler conservation by informing habitat spatial planning of plantation management to provide a constant supply of nesting habitat based on the spatial variability of potential loss or gain of lands environmentally suitable for regenerating jack pine in the long-term.*

dos Santos, E. A., de Almeida, A. A. F., da Silva Branco, M. C., dos Santos, I. C., Ahnert, D., Baligar, V. C., & Valle, R. R. (2018). Path analysis of phenotypic traits in young cacao plants under drought conditions. *PLoS ONE, 13*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041657922&doi=10.1371%2fjournal.pone.0191847&partnerID=40&md5=c683b545102d8ce4283f27c1a38ce233. doi:10.1371/journal.pone.0191847
Research Tags: Crops, Weather
Abstract: *Drought is worldwide considered one of the most limiting factors of Theobroma cacao production, which can be intensified by global climate changes. In this study, we aimed to investigate the phenotypic correlation among morphological characteristics of cacao progenies submitted to irrigation and drought conditions and their partitions into direct and indirect effects. Path analysis with phenotypic plasticity index was used as criteria for estimation of basic and explanatory variables. The experiment was conducted in a greenhouse at the Cacao Research Center (CEPEC), Ilhéus, Bahia, Brazil, in a randomized block 21 x 2 factorial arrangement [21 cacao progenies obtained from complete diallel crosses and two water regimes (control and drought)] and six replications. In general, drought conditions influenced biomass production in most progenies, causing significant reductions in total leaf area, leaf number, leaf biomass, fine-roots length (diameter <1 mm), root volume and root area for considered drought intolerant. All progenies showed alterations in growth due to drought. Phenotypic plasticity was most strongly pronounced in root volume. Stem and root diameters, as well as stem dry biomass were the growth variables with the greatest direct effects on root volume under drought conditions, these characters being indicated in screening of cacao progenies drought tolerant.*

Doughty, R., Xiao, X., Wu, X., Zhang, Y., Bajgain, R., Zhou, Y., . . . Steiner, J. (2018). Responses of gross primary production of grasslands and croplands under drought, pluvial, and irrigation conditions during 2010–2016, Oklahoma, USA. *Agricultural Water Management, 204*, 47-59. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044938286&doi=10.1016%2fj.agwat.2018.04.001&partnerID=40&md5=73b43c410577ccd824ff2029a7d29b47. doi:10.1016/j.agwat.2018.04.001
Research Tags: Grassland, Weather

Abstract: *To accurately estimate the terrestrial carbon cycle and food production, it is essential to understand how gross primary production (GPP) of irrigated and non-irrigated grasslands and croplands respond to drought and pluvial events. This study analyzed annual GPP of irrigation-permitted and non-permitted grasslands, winter wheat (Triticum aestivum L.), other C3 croplands, and C4 croplands in Caddo County of western Oklahoma from 2010 through 2016, a period which consisted of extreme drought (2011) and pluvial events (2015). First, we compared GPP from the Vegetation Photosynthesis Model (GPPVPM) and GPP data from the Moderate Resolution Imaging Spectroradiometer (GPPMOD17) with GPP estimates from three eddy covariance towers (GPPEC) in Oklahoma. GPPVPM more accurately estimated mean daily GPPEC at each of the three sites than GPPMOD17. Second, we analyzed the seasonal and interannual dynamics of GPPVPM for eight pixels, one each for the four irrigation-permitted and non-permitted land types. The interannual variation of GPPVPM was due to the complexity of decision making and practice for irrigation, cropping intensity, and crop types. Finally, at the county scale, annual GPPVPM from the 2011 drought and pluvial 2015 were compared with mean annual GPPVPM from the other 5 years of the study period. The results show that for the 2011 drought: 1) non-permitted C4 croplands had the largest percentage decrease in GPP, but permitted C4 croplands had the smallest decrease; 2) regardless of water rights, GPP was significantly lower than the 5-year reference mean for grasslands, winter wheat, and other C3 crops; and 3) non-permitted lands were more affected by drought than irrigation-permitted lands, except for grasslands, which had similar percentage reductions in GPP. Results for the pluvial year 2015 show that: 1) GPP was significantly higher for grasslands, winter wheat, and non-permitted C3 croplands than the 5-year reference mean, but there was no significant difference in GPP for irrigation-permitted C3 croplands or non-permitted C4 croplands; and 2) GPP for C4 irrigation-permitted croplands was lower than the 5-year reference mean. Crop-specific responses to drought and pluvial events largely depend on a landowner's ability to irrigate, and caution should be used when assessing or generalizing how crops respond to climate variability, drought, and pluvial conditions in the absence of irrigation-related data.*

Dowd, P. F., & Johnson, E. T. (2018). Insect damage influences heat and water stress resistance gene expression in field-grown popcorn: implications in developing crop varieties adapted to climate change. *Mitigation and Adaptation Strategies for Global Change, 23*(7), 1063-1081. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037123993&doi=10.1007%2fs11027-017-9772-x&partnerID=40&md5=4d68c4291c3f359ee984cac5b900e7be. doi:10.1007/s11027-017-9772-x
Research Tags: Crops, Weather, Wildlife
Abstract: *Warming climatic conditions can pose problems for crop production in many parts of the world, but detailed information on the expression of heat and drought stress resistance genes of potentially affected crop plants is lacking. This information is important to have in order to most efficiently guide the breeding of crops that are adapted to new climatic conditions. A maize (Zea mays) gene microarray, a method used worldwide to evaluate the expression of tens of thousands of genes at once, was used to investigate changes in expression of genes involved in resistance to heat and water stress in milk stage popcorn kernels from undamaged and insect-damaged ears. Popcorn is a form of maize that is more susceptible to heat and drought stress due to its smaller root system. In years of heat and drought stress, expression of many heat shock- and senescence-related proteins increased compared to the year when weather was closer to average conditions, but the expression of many genes related to drought stress resistance decreased in years of weather stress. A different complex of heat shock protein and water stress resistance protein genes had higher expression in kernels from undamaged compared to insect-damaged ears in years of heat and drought stress. These results indicate that the interaction of biotic components, such as insects, are important to consider in developing crop lines with adaptation to stress as this will help identify additional genes and their regulatory components involved in heat and drought stress resistance that might otherwise be overlooked, and will likely be an important strategy for the most effective development of climate stress-tolerant crops globally.*

Duan, J. J., Schmude, J. M., Wang, X. Y., Watt, T. J., & Bauer, L. S. (2018). Host utilization, reproductive biology, and development of the larval parasitoid Tetrastichus planipennisi as influenced by temperature: Implications for biological control of the emerald ash borer in North America. *Biological Control, 125*, 50-56. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049336260&doi=10.1016%2fj.biocontrol.2018.06.009&partnerID=40&md5=0519d790c4eea60dfd18d1ed288774ee. doi:10.1016/j.biocontrol.2018.06.009

Research Tags: Forestry, Wildlife, Weather
Abstract: *The success of classical biological control programs depends in part on understanding climate effects on introduced agents. Tetrastichus planipennisi Yang (Hymenoptera: Eulophidae), a larval endoparasitoid of emerald ash borer (EAB), Agrilus planipennis Fairmaire (Coleoptera: Buprestidae), is being introduced to EAB-invaded regions of the United States (USA) and Canada for biological control. To optimize regional release strategies and increase efficiency of the EAB-biocontrol program, we determined the effects of five constant temperatures from 15 °C to 35 °C on T. planipennisi parasitism rate, development, adult longevity, and fecundity in EAB. Results showed a decrease in parasitoid development time from 139.8 days at 15 °C to 26.3 days at 30 °C, while no parasitoid eggs hatched at 35 °C. Parasitism rates, provisioned with an excess of host larvae throughout their life, increased from 1.4% at 15 °C to 28% at 30 °C then declined to 0.5% at 35 °C. Adult parasitoid longevity declined from 24 weeks at 15 °C to <2 weeks at 35 °C. Fertility table analyses revealed T. planipennisi net reproductive rate was highest at 25 °C, and intrinsic and finite rates of increase were highest at 30 °C, suggesting 25–30 °C as optimal rearing temperatures for this parasitoid. Combining these results with temperature data from climate zones of 3–7 in the USA, we predicted T. planipennisi can complete more than one generation in all locations in these climatic zones, with more generations in warmer climates. Moreover, our findings also suggest that despite the availability of suitable EAB larval stages for parasitism, releases of T. planipennisi in early spring or late fall in cold climate zones may be suboptimal due to low temperatures, as may mid-summer releases in hot climate zones due to high temperatures.*

Duan, K., Caldwell, P. V., Sun, G., McNulty, S. G., Zhang, Y., Shuster, E., . . . Bolstad, P. V. (2019). Data on projections of surface water withdrawal, consumption, and availability in the conterminous United States through the 21st century. *Data in Brief, 23*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062708876&doi=10.1016%2fj.dib.2019.103786&partnerID=40&md5=d30c643769200496b969cbf710f46947. doi:10.1016/j.dib.2019.103786
Research Tags: Water
Abstract: *We report data on the projections of annual surface water demand and supply in the conterminous United States at a high spatial resolution from 2010s to the end of the 21st century, including: 1) water withdrawal and consumption in the water-use sectors of domestic, thermoelectric power generation, and irrigation; 2) availability of surface water generated from local watershed runoff, accumulated from upstream areas, and artificially transferred from other basins. These data were derived from the projected changes in climate, population, energy structure, technology and water uses. These data are related to the original article "Understanding the role of regional water connectivity in mitigating climate change impacts on surface water supply stress in the United States" (Duan et al., 2019) [1].*

Duan, K., Caldwell, P. V., Sun, G., McNulty, S. G., Zhang, Y., Shuster, E., . . . Bolstad, P. V. (2019). Understanding the role of regional water connectivity in mitigating climate change impacts on surface water supply stress in the United States. *Journal of Hydrology, 570*, 80-95. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060095901&doi=10.1016%2fj.jhydrol.2019.01.011&partnerID=40&md5=3afc00c2e2157ece898b29816495201e. doi:10.1016/j.jhydrol.2019.01.011
Research Tags: Water
Abstract: *Surface water supply for a watershed relies on local water generated from precipitation and water connections with other watersheds. These connections are confined by topography and infrastructure, and respond diversely to stressors such as climate change, population growth, increasing energy and water demands. This study presents an integrative simulation and evaluation framework that incorporates the natural and anthropogenic water connections (i.e., stream flows, inter-basin water transfers, water withdrawals and return flows) among the 2099 8-digit Hydrologic Unit Code (HUC-8) watersheds across the conterminous United States. The framework is then applied to investigate the potential impacts of changes in climate and water use on regional water availability and water stress (the ratio of demand to supply). Our projections suggest that highly water-stressed areas may expand from 14% to 18% and the stressed population would increase from 19% to 24% by 2070–2099. Climate-change mitigation practices (e.g., energy structure reform, technology innovation) could largely offset these trends by reducing demand and enhancing supply. At the watershed scale, the spatially inhomogeneous responses to future changes suggest that regional water connectivity could significantly buffer the potential stress escalations due to the redistribution of water*

resources and diverse changes in consumptive uses and water supplies in different source areas. However, the detrimental future changes (e.g., depleting river discharges, larger demands of water withdrawal) may aggravate conflicts over water rights among regions and challenge our current water infrastructure system. This study provides new insights into the critical role of regional water connectivity in water supply security, and highlights the increasing need for integrated monitoring and management of water resources at various spatial levels in a changing world.

Duan, K., Sun, G., Caldwell, P. V., McNulty, S. G., & Zhang, Y. (2018). Implications of Upstream Flow Availability for Watershed Surface Water Supply across the Conterminous United States. *Journal of the American Water Resources Association, 54*(3), 694-707. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044351211&doi=10.1111%2f1752-1688.12644&partnerID=40&md5=2f777c81a40da9f9b32324889a1b5c1d. doi:10.1111/1752-1688.12644
Research Tags: Water
Abstract: *Although it is well established that the availability of upstream flow (AUF) affects downstream water supply, its significance has not been rigorously categorized and quantified at fine resolutions. This study aims to fill this gap by providing a nationwide inventory of AUF and local water resource, and assessing their roles in securing water supply across the 2,099 8-digit hydrologic unit code watersheds in the conterminous United States (CONUS). We investigated the effects of river hydraulic connectivity, climate variability, and water withdrawal, and consumption on water availability and water stress (ratio of demand to supply) in the past three decades (i.e., 1981–2010). The results show that 12% of the CONUS land relied on AUF for adequate freshwater supply, while local water alone was sufficient to meet the demand in another 74% of the area. The remaining 14% highly stressed area was mostly found in headwater areas or watersheds that were isolated from other basins, where stress levels were more sensitive to climate variability. Although the constantly changing water demand was the primary cause of escalating/diminishing stress, AUF variation could be an important driver in the arid south and southwest. This research contributes to better understanding of the significance of upstream–downstream water nexus in regional water availability, and this becomes more crucial under a changing climate and with intensified human activities.*

Duan, K., Sun, G., McNulty, S. G., Caldwell, P. V., Cohen, E. C., Sun, S., . . . Zhang, Y. (2017). Future shift of the relative roles of precipitation and temperature in controlling annual runoff in the conterminous United States. *Hydrology and Earth System Sciences, 21*(11), 5517-5529. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034030752&doi=10.5194%2fhess-21-5517-2017&partnerID=40&md5=29c886e7cb32040589fbd28eed4d73a5. doi:10.5194/hess-21-5517-2017
Research Tags: Weather, Water
Abstract: *This study examines the relative roles of climatic variables in altering annual runoff in the conterminous United States (CONUS) in the 21st century, using a monthly ecohydrological model (the Water Supply Stress Index model, WaSSI) driven with historical records and future scenarios constructed from 20 Coupled Model Intercomparison Project Phase 5 (CMIP5) climate models. The results suggest that precipitation has been the primary control of runoff variation during the latest decades, but the role of temperature will outweigh that of precipitation in most regions if future climate change follows the projections of climate models instead of the historical tendencies. Besides these two key factors, increasing air humidity is projected to partially offset the additional evaporative demand caused by warming and consequently enhance runoff. Overall, the projections from 20 climate models suggest a high degree of consistency on the increasing trends in temperature, precipitation, and humidity, which will be the major climatic driving factors accounting for 43–50, 20–24, and 16–23% of the runoff change, respectively. Spatially, while temperature rise is recognized as the largest contributor that suppresses runoff in most areas, precipitation is expected to be the dominant factor driving runoff to increase across the Pacific coast and the southwest. The combined effects of increasing humidity and precipitation may also surpass the detrimental effects of warming and result in a hydrologically wetter future in the east. However, severe runoff depletion is more likely to occur in the central CONUS as temperature effect prevails.*

Duan, K., Sun, G., Zhang, Y., Yahya, K., Wang, K., Madden, J. M., . . . McNulty, S. G. (2017). Impact of air pollution induced climate change on water availability and ecosystem productivity in the conterminous United States.

Climatic Change, 140(2), 259-272. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84994447128&doi=10.1007%2fs10584-016-1850-7&partnerID=40&md5=7a2be2ec6a532e615dc7a981351b05df. doi:10.1007/s10584-016-1850-7
Research Tags: Water
Abstract: *Air pollution from greenhouse gases and atmospheric aerosols are the major driving force of climate change that directly alters the terrestrial hydrological cycle and ecosystem functions. However, most current Global Climate Models (GCMs) use prescribed chemical concentrations of limited species; they do not explicitly simulate the time-varying concentrations of trace gases and aerosols and their impacts on climate change. This study investigates the individual and combined impacts of climate change and air pollution on water availability and ecosystem productivity over the conterminous US (CONUS). An ecohydrological model is driven by multiple regional climate scenarios with and without taking into account the impacts of air pollutants on the climate system. The results indicate that regional chemistry-climate feedbacks may largely offset the future warming and wetting trends predicted by GCMs without considering air pollution at the CONUS scale. Consequently, the interactions of air pollution and climate change are expected to significantly reduce water availability by the middle of twenty-first century. On the other hand, the combined impact of climate change and air pollution on ecosystem productivity is less pronounced, but there may still be notable declines in eastern and central regions. The results suggest that air pollution could aggravate regional climate change impacts on water shortage. We conclude that air pollution plays an important role in affecting climate and thus ecohydrological processes. Overlooking the impact of air pollution may cause evident overestimation of future water availability and ecosystem productivity.*

Duarte, H. F., Raczka, B. M., Ricciuto, D. M., Lin, J. C., Koven, C. D., Thornton, P. E., . . . Ehleringer, J. R. (2017). Evaluating the Community Land Model (CLM4.5) at a coniferous forest site in northwestern United States using flux and carbon-isotope measurements. *Biogeosciences, 14*(18), 4315-4340. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030527867&doi=10.5194%2fbg-14-4315-2017&partnerID=40&md5=8289d5deee9c782e44a116109d0f853c. doi:10.5194/bg-14-4315-2017
Research Tags: Forestry, Weather
Abstract: *Droughts in the western United States are expected to intensify with climate change. Thus, an adequate representation of ecosystem response to water stress in land models is critical for predicting carbon dynamics. The goal of this study was to evaluate the performance of the Community Land Model (CLM) version 4.5 against observations at an old-growth coniferous forest site in the Pacific Northwest region of the United States (Wind River AmeriFlux site), characterized by a Mediterranean climate that subjects trees to water stress each summer. CLM was driven by site-observed meteorology and calibrated primarily using parameter values observed at the site or at similar stands in the region. Key model adjustments included parameters controlling specific leaf area and stomatal conductance. Default values of these parameters led to significant underestimation of gross primary production, overestimation of evapotranspiration, and consequently overestimation of photosynthetic 13C discrimination, reflected in reduced 13C : 12C ratios of carbon fluxes and pools. Adjustments in soil hydraulic parameters within CLM were also critical, preventing significant underestimation of soil water content and unrealistic soil moisture stress during summer. After calibration, CLM was able to simulate energy and carbon fluxes, leaf area index, biomass stocks, and carbon isotope ratios of carbon fluxes and pools in reasonable agreement with site observations. Overall, the calibrated CLM was able to simulate the observed response of canopy conductance to atmospheric vapor pressure deficit (VPD) and soil water content, reasonably capturing the impact of water stress on ecosystem functioning. Both simulations and observations indicate that stomatal response from water stress at Wind River was primarily driven by VPD and not soil moisture. The calibration of the Ball–Berry stomatal conductance slope (mbb) at Wind River aligned with findings from recent CLM experiments at sites characterized by the same plant functional type (needleleaf evergreen temperate forest), despite significant differences in stand composition and age and climatology, suggesting that CLM could benefit from a revised mbb value of 6, rather than the default value of 9, for this plant functional type. Conversely, Wind River required a unique calibration of the hydrology submodel to simulate soil moisture, suggesting that the default hydrology has a more limited applicability. This study demonstrates that carbon isotope data can be used to constrain stomatal conductance and intrinsic water use efficiency in CLM, as an alternative to eddy covariance flux measurements. It also demonstrates that carbon isotopes can expose structural weaknesses in the model and provide a key constraint that may guide future*

model development.

Ducey, M. J., Woodall, C. W., & Bravo-Oviedo, A. (2017). Climate and species functional traits influence maximum live tree stocking in the Lake States, USA. *Forest Ecology and Management, 386*, 51-61. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007071256&doi=10.1016%2fj.foreco.2016.12.007&partnerID=40&md5=7da266ff26970631488fd26ec39315b8. doi:10.1016/j.foreco.2016.12.007
Research Tags: Forestry
Abstract: *Quantifying the density of live trees in forest stands and partitioning it between species or other stand components is critical for predicting forest dynamics and responses to management, as well as understanding the impacts of stand composition and structure on productivity. As plant traits such as shade tolerance have been proven to refine understanding of plant community dynamics, we extended a previous model relating maximum stand density to wood specific gravity to incorporate shade tolerance as an additional functional trait. Additionally, we included climatic variables that might influence ecological dynamics and modulate species-specific traits, across a region and also potentially over time under climate change scenarios. We used data from the USDA Forest Service, Forest Inventory and Analysis program for three states in the northern United States (Minnesota, Wisconsin, and Michigan) that reflect strong gradients in climate and species composition, to fit a maximum density model by quantile regression. The resulting strictly additive density measure conforms well to both existing silvicultural guidance and to observed densities of monocultures that lack such guidance. Wood specific gravity appears to interact with precipitation, while shade tolerance interacts with temperature, in driving maximum density relationships. Our proposed maximum stand density model is not only parsimonious for field application in management situations, but also empowers the evaluation of the effects of future climate and tree range scenarios on forest management guidelines.*

Duff, T. J., Keane, R. E., Penman, T. D., & Tolhurst, K. G. (2017). Revisiting wildland fire fuel quantification methods: The challenge of understanding a dynamic, biotic entity. *Forests, 8*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029741564&doi=10.3390%2ff8090351&partnerID=40&md5=c88c17ff1ad99306485ec215c7081669. doi:10.3390/f8090351
Research Tags: Forestry, Weather
Abstract: *Wildland fires are a function of properties of the fuels that sustain them. These fuels are themselves a function of vegetation, and share the complexity and dynamics of natural systems. Worldwide, the requirement for solutions to the threat of fire to human values has resulted in the development of systems for predicting fire behaviour. To date, regional differences in vegetation and independent fire model development has resulted a variety of approaches being used to describe, measure and map fuels. As a result, widely different systems have been adopted, resulting in incompatibilities that pose challenges to applying research findings and fire models outside their development domains. As combustion is a fundamental process, the same relationships between fuel and fire behaviour occur universally. Consequently, there is potential for developing novel fuel assessment methods that are more broadly applicable and allow fire research to be leveraged worldwide. Such a movement would require broad cooperation between researchers and would most likely necessitate a focus on universal properties of fuel. However, to truly understand fuel dynamics, the complex biotic nature of fuel would also need to remain a consideration—particularly when looking to understand the effects of altered fire regimes or changing climate.*

Dugan, A. J., Birdsey, R., Healey, S. P., Pan, Y., Zhang, F., Mo, G., . . . Dante-Wood, K. (2017). Forest sector carbon analyses support land management planning and projects: assessing the influence of anthropogenic and natural factors. *Climatic Change, 144*(2), 207-220. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026918281&doi=10.1007%2fs10584-017-2038-5&partnerID=40&md5=0cffa0b63769af18b62e2d64694932d3. doi:10.1007/s10584-017-2038-5
Research Tags:
Abstract: *Management of forest carbon stocks on public lands is critical to maintaining or enhancing carbon dioxide removal from the atmosphere. Acknowledging this, an array of federal regulations and policies have emerged that requires US National Forests to report baseline carbon stocks and changes due to disturbance and management and assess how management activities and forest plans affect carbon stocks. To address these requirements with the best-available science, we compiled empirical and remotely sensed data covering*

the National Forests (one fifth of the area of US forest land) and analyzed this information using a carbon modeling framework. We demonstrate how integration of various data and models provides a comprehensive evaluation of key drivers of observed carbon trends, for individual National Forests. The models in this framework complement each other with different strengths: the Carbon Calculation Tool uses inventory data to report baseline carbon stocks; the Forest Carbon Management Framework integrates inventory data, disturbance histories, and growth and yield trajectories to report relative effects of disturbances on carbon stocks; and the Integrated Terrestrial Ecosystem Carbon Model incorporates disturbance, climate, and atmospheric data to determine their relative impacts on forest carbon accumulation and loss. We report results for several National Forests across the USA and compare their carbon dynamics. Results show that recent disturbances are causing some forests to transition from carbon sinks to sources, particularly in the West. Meanwhile, elevated atmospheric carbon dioxide and nitrogen deposition are consistently increasing carbon stocks, partially offsetting declines due to disturbances and aging. Climate variability introduces concomitant interannual variability in net carbon uptake or release. Targeting forest disturbance and post-disturbance regrowth is critical to management objectives that involve maintaining or enhancing future carbon sequestration.

Dugan, A. J., Birdsey, R., Mascorro, V. S., Magnan, M., Smyth, C. E., Olguin, M., & Kurz, W. A. (2018). A systems approach to assess climate change mitigation options in landscapes of the United States forest sector. *Carbon Balance and Management, 13*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053132876&doi=10.1186%2fs13021-018-0100-x&partnerID=40&md5=cae7c98797a6c04eecbdf9cdbfc5f1c2. doi:10.1186/s13021-018-0100-x

Research Tags: Forestry

Abstract: *Background*

United States forests can contribute to national strategies for greenhouse gas reductions. The objective of this work was to evaluate forest sector climate change mitigation scenarios from 2018 to 2050 by applying a systems-based approach that accounts for net emissions across four interdependent components: (1) forest ecosystem, (2) land-use change, (3) harvested wood products, and (4) substitution benefits from using wood products and bioenergy. We assessed a range of land management and harvested wood product scenarios for two case studies in the U.S: coastal South Carolina and Northern Wisconsin. We integrated forest inventory and remotely-sensed disturbance data within a modelling framework consisting of a growth-and-yield driven ecosystem carbon model; a harvested wood products model that estimates emissions from commodity production, use and post-consumer treatment; and displacement factors to estimate avoided fossil fuel emissions. We estimated biophysical mitigation potential by comparing net emissions from land management and harvested wood products scenarios with a baseline ('business as usual') scenario.

Results

Baseline scenario results showed that the strength of the ecosystem carbon sink has been decreasing in the two sites due to age-related productivity declines and deforestation. Mitigation activities have the potential to lessen or delay the further reduction in the carbon sink. Results of the mitigation analysis indicated that scenarios reducing net forest area loss were most effective in South Carolina, while extending harvest rotations and increasing longer-lived wood products were most effective in Wisconsin. Scenarios aimed at increasing bioenergy use either increased or reduced net emissions within the 32-year analysis timeframe.

Conclusions

It is critical to apply a systems approach to comprehensively assess net emissions from forest sector climate change mitigation scenarios. Although some scenarios produced a benefit by displacing emissions from fossil fuel energy or by substituting wood products for other materials, these benefits can be outweighed by increased carbon emissions in the forest or product systems. Maintaining forests as forests, extending rotations, and shifting commodities to longer-lived products had the strongest mitigation benefits over several decades. Carbon cycle impacts of bioenergy depend on timeframe, feedstocks, and alternative uses of biomass, and cannot be assumed carbon neutral.

Dumroese, R. K., Balloffet, N., Crockett, J. W., Stanturf, J. A., & Nave, L. E. (2019). A national approach to leverage the benefits of tree planting on public lands. *New Forests, 50*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060538148&doi=10.1007%2fs11056-019-09703-2

&partnerID=40&md5=cbc610fee88d4de0887c267cbb99829b. doi:10.1007/s11056-019-09703-2
Research Tags: Forestry
Abstract: *The number of global initiatives for forest restoration, and the scope of these initiatives, continues to increase. An important tool for meeting objectives of these global initiatives is reforestation, achieved by natural processes or by tree planting. Worldwide, organizations are challenged to most efficiently and effectively direct resources to the most critical reforestation needs. Currently in the United States, the reforestation efforts of the Department of Agriculture, Forest Service, are challenged by changes in policy, funding, climate change, and mega-fires, to name a few, and identifying strategies for timely successful reforestation at scale is needed. A 2016 conference brought together reforestation experts from across North America to discuss potential benefits of reforestation activities in the face of mounting challenges from invasive species, wildfires, diseases, and climate change. As a result of that effort, here we provide background on the challenges confronting successful reforestation on lands managed by the Forest Service, and describe the six manuscripts in this special issue and their foci: barriers to natural regeneration, when to actively plant trees or not to ensure a heterogeneous landscape, ecological and economic concerns when reforestation is delayed, employing traditional and novel silvicultural techniques in support of reforestation, leveraging reforestation to improve resilience of species affected by introduced pests, and the potential carbon sequestration benefits of a robust reforestation program.*

Duncanson, L., Huang, W., Johnson, K., Swatantran, A., McRoberts, R. E., & Dubayah, R. (2017). Implications of allometric model selection for county-level biomass mapping. *Carbon Balance and Management, 12*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031670035&doi=10.1186%2fs13021-017-0086-9&partnerID=40&md5=72327d8d12ff1c112a29452e6136607c. doi:10.1186/s13021-017-0086-9
Research Tags: Research
Abstract: *Background*
Carbon accounting in forests remains a large area of uncertainty in the global carbon cycle. Forest aboveground biomass is therefore an attribute of great interest for the forest management community, but the accuracy of aboveground biomass maps depends on the accuracy of the underlying field estimates used to calibrate models. These field estimates depend on the application of allometric models, which often have unknown and unreported uncertainties outside of the size class or environment in which they were developed.
Results
Here, we test three popular allometric approaches to field biomass estimation, and explore the implications of allometric model selection for county-level biomass mapping in Sonoma County, California. We test three allometric models: Jenkins et al. (For Sci 49(1): 12–35, 2003), Chojnacky et al. (Forestry 87(1): 129–151, 2014) and the US Forest Service's Component Ratio Method (CRM). We found that Jenkins and Chojnacky models perform comparably, but that at both a field plot level and a total county level there was a ~ 20% difference between these estimates and the CRM estimates. Further, we show that discrepancies are greater in high biomass areas with high canopy covers and relatively moderate heights (25–45 m). The CRM models, although on average ~ 20% lower than Jenkins and Chojnacky, produce higher estimates in the tallest forests samples (> 60 m), while Jenkins generally produces higher estimates of biomass in forests < 50 m tall. Discrepancies do not continually increase with increasing forest height, suggesting that inclusion of height in allometric models is not primarily driving discrepancies. Models developed using all three allometric models underestimate high biomass and overestimate low biomass, as expected with random forest biomass modeling. However, these deviations were generally larger using the Jenkins and Chojnacky allometries, suggesting that the CRM approach may be more appropriate for biomass mapping with lidar.
Conclusions
These results confirm that allometric model selection considerably impacts biomass maps and estimates, and that allometric model errors remain poorly understood. Our findings that allometric model discrepancies are not explained by lidar heights suggests that allometric model form does not drive these discrepancies. A better understanding of the sources of allometric model errors, particularly in high biomass systems, is essential for improved forest biomass mapping.

Dunn, C. J., Thompson, M. P., & Calkin, D. E. (2017). A framework for developing safe and effective large-fire response

in a new fire management paradigm. *Forest Ecology and Management, 404*, 184-196. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028701451&doi=10.1016%2fj.foreco.2017.08.039&partnerID=40&md5=27760faec4f6cbe56aad6e4ffefedbbe. doi:10.1016/j.foreco.2017.08.039
Research Tags: Forestry, Weather
Abstract: *The impacts of wildfires have increased in recent decades because of historical forest and fire management, a rapidly changing climate, and an increasingly populated wildland urban interface. This increasingly complex fire environment highlights the importance of developing robust tools to support risk-informed decision making. While tools have been developed to aid fire management, few have focused on large-fire management and those that have typically simplified the decision environment such that they are not operationally relevant. Additionally, fire managers need to be able to evaluate alternative response strategies that lead to tradeoff analyses balancing fire impacts, responder exposure, financial and resource investments, and probability of success. In this review, we describe limitations in existing operational research models from the perspective of large fire management decisions. We identify a broader set of objectives, decisions and constraints to be integrated into the next generation operational research models. Including these changes would support evaluation of a suite of response options and the efficient resource packages necessary to achieve response objectives, aiding decision maker's ability to minimize responder exposure while reducing the social, ecological and economic impacts of wildfires. We follow with a proposed framework for expanding current large fire decision support systems, and conclude by briefly highlighting critical research needs and organizational changes necessary to create and implement these tools and overcome the negative consequences of positive feedbacks derived from historical and current wildfire management policies and strategies.*

Durán, J., Morse, J. L., Rodríguez, A., Campbell, J. L., Christenson, L. M., Driscoll, C. T., . . . Groffman, P. M. (2017). Differential sensitivity to climate change of C and N cycling processes across soil horizons in a northern hardwood forest. *Soil Biology and Biochemistry, 107*, 77-84. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008395045&doi=10.1016%2fj.soilbio.2016.12.028&partnerID=40&md5=7b4d7b01740256b75ee0ccea8299d2f5. doi:10.1016/j.soilbio.2016.12.028
Research Tags: Forestry, Soil
Abstract: *Climate of the northern hardwood forests of North America will become significantly warmer in the coming decades. Associated increases in soil temperature, decreases in water availability and changes in winter snow pack and soil frost are likely to affect soil carbon (C) and nitrogen (N) cycling. Most studies of the effects of climate change on soil function have focused on the upper-organic part of the soil profile (e.g., forest floor), and little is known about effects on deeper mineral soil horizons. We exploited an elevation/orientation gradient at the Hubbard Brook Experimental Forest (New Hampshire, USA) to evaluate how variation in climate, similar to that projected to occur over the next 50–100 years, affects soil C and N pools and transformation rates in different soil horizons of northern hardwood forests. Lower elevation, south-facing plots with higher soil temperature, less soil moisture and snow, and increased frequency of soil freeze/thaw events had less soil inorganic N content and lower potential net N mineralization rates compared to higher elevation, north facing plots. These differences in N pools and fluxes were consistent for all soil horizons, but sensitivity to climate variation increased with soil depth, confirming that assessments of climate change effects that do not consider variation throughout the soil profile are likely to be incomplete and potentially inaccurate. Nitrogen cycling processes were more sensitive to climate variation than C cycling processes, suggesting a decoupling of C and N cycles in coming decades, with important implications for ecosystem function. Soil processes showed greater sensitivity to climate variation in summer than in spring, and in the warmer and less snowy year of sampling, suggesting that the effects of climate change might become more pronounced as temperatures increase and snow fall and water availability decrease in the coming decades.*

Duveneck, M. J., Thompson, J. R., Gustafson, E. J., Liang, Y., & de Bruijn, A. M. G. (2017). Recovery dynamics and climate change effects to future New England forests. *Landscape Ecology, 32*(7), 1385-1397. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84978087254&doi=10.1007%2fs10980-016-0415-5&partnerID=40&md5=a1dcc7ac0eb379a4cd76e8eb4c0c9c51. doi:10.1007/s10980-016-0415-5
Research Tags: Forestry
Abstract: *Context*

Forests throughout eastern North America continue to recover from broad-scale intensive land use that peaked in the nineteenth century. These forests provide essential goods and services at local to global scales. It is uncertain how recovery dynamics, the processes by which forests respond to past forest land use, will continue to influence future forest conditions. Climate change compounds this uncertainty.
Objectives
We explored how continued forest recovery dynamics affect forest biomass and species composition and how climate change may alter this trajectory.
Methods
Using a spatially explicit landscape simulation model incorporating an ecophysiological model, we simulated forest processes in New England from 2010 to 2110. We compared forest biomass and composition from simulations that used a continuation of the current climate to those from four separate global circulation models forced by a high emission scenario (RCP 8.5).
Results
Simulated forest change in New England was driven by continued recovery dynamics; without the influence of climate change forests accumulated 34 % more biomass and succeed to more shade tolerant species; Climate change resulted in 82 % more biomass but just nominal shifts in community composition. Most tree species increased AGB under climate change.
Conclusions
Continued recovery dynamics will have larger impacts than climate change on forest composition in New England. The large increases in biomass simulated under all climate scenarios suggest that climate regulation provided by the eastern forest carbon sink has potential to continue for at least a century.

Dwire, K. A., Mellmann-Brown, S., & Gurrieri, J. T. (2018). Potential effects of climate change on riparian areas, wetlands, and groundwater-dependent ecosystems in the Blue Mountains, Oregon, USA. *10*, 44-52. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033552347&doi=10.1016%2fj.cliser.2017.10.002&partnerID=40&md5=29e0b724eb185d361e2ce0e6e7968812. doi:10.1016/j.cliser.2017.10.002

Research Tags: Water

Abstract: *Riparian areas, wetlands, and groundwater-dependent ecosystems, which are found at all elevations throughout the Blue Mountains, comprise a small portion of the landscape but have high conservation value because they provide habitat for diverse flora and fauna. The effects of climate change on these special habitats may be especially profound, due to altered snowpack and hydrologic regimes predicted to occur in the near future. The functionality of many riparian areas is currently compromised by water diversions and livestock grazing, which reduces their resilience to additional stresses that a warmer climate may bring. Areas associated with springs and small streams will probably experience near-term changes, and some riparian areas and wetlands may decrease in size over time. A warmer climate and reduced soil moisture could lead to a transition from riparian hardwood species to more drought tolerant conifers and shrubs. Increased frequency and spatial extent of wildfire spreading from upland forests could also affect riparian species composition. The specific effects of climate change will vary, depending on local hydrology (especially groundwater), topography, streamside microclimates, and current conditions and land use.*

Dwyer, J. T., & Drewnowski, A. (2017). Overview: Food and nutrition security. In *Sustainable Nutrition in a Changing World* (pp. 3-24).

Research Tags: Economics

No Abstract (Book): *This book is the first of its kind to tackle in detail the nutritional requirements of the industrialized, so-called developed world. It discusses the link between socio-economic status and food security, focusing especially on the relationship between income and food security in different age groups. The authors calculate the actual levels of essential micronutrients delivered by current dietary patterns, identifying important shortfalls in the provision of key micronutrients, and elucidate the public health consequences of nutrition insecurity. Finally, the authors discuss future approaches for ensuring nutrition security on the basis of three pillars: access, availability and nutritional value. The approaches advocated in this ground-breaking publication will allow all people, irrespective of age and social status, to have access to a safe and nutritious diet. Key stakeholders such as legislators, government, academia and industry, as well as consumers* *themselves, all have important roles to play in making this a reality.*

Dymond, S. F., Bradford, J. B., Bolstad, P. V., Kolka, R. K., Sebestyen, S. D., & DeSutter, T. M. (2017). Topographic, edaphic, and vegetative controls on plant-available water. *Ecohydrology, 10*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037157730&doi=10.1002%2feco.1897&partnerID=40&md5=cc50889668fa8429d67ef5eac352432d. doi:10.1002/eco.1897
Research Tags: Soil, Forestry
Abstract: *Soil moisture varies within landscapes in response to vegetative, physiographic, and climatic drivers, which makes quantifying soil moisture over time and space difficult. Nevertheless, understanding soil moisture dynamics for different ecosystems is critical, as the amount of water in a soil determines a myriad ecosystem services and processes such as net primary productivity, runoff, microbial decomposition, and soil fertility. We investigated the patterns and variability in in situ soil moisture measurements converted to plant-available water across time and space under different vegetative cover types and topographic positions at the Marcell Experimental Forest (Minnesota, USA). From 0- to 228.6-cm soil depth, plant-available water was significantly higher under the hardwoods (12%), followed by the aspen (8%) and red pine (5%) cover types. Across the same soil depth, toeslopes were wetter (mean plant-available water = 10%) than ridges and backslopes (mean plant-available water was 8%), although these differences were not statistically significant (p < .05). Using a mixed model of fixed and random effects, we found that cover type, soil texture, and time were related to plant-available water and that topography was not significantly related to plant-available water within this low-relief landscape. Additionally, during the 3-year monitoring period, red pine and quaking aspen sites experienced plant-available water levels that may be considered limiting to plant growth and function. Given that increasing temperatures and more erratic precipitation patterns associated with climate change may result in decreased soil moisture in this region, these species may be sensitive and vulnerable to future shifts in climate.*

Earles, J. M., Stevens, J. T., Sperling, O., Orozco, J., North, M. P., & Zwieniecki, M. A. (2018). Extreme mid-winter drought weakens tree hydraulic–carbohydrate systems and slows growth. *New Phytologist, 219*(1), 89-97. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045727028&doi=10.1111%2fnph.15136&partnerID=40&md5=0a0a8d881f84b8b6d1d251f5652dcd43. doi:10.1111/nph.15136
Research Tags: Weather, Forestry
Abstract: *Rising temperatures and extended periods of drought compromise tree hydraulic and carbohydrate systems, threatening forest health globally. Despite winter's biological significance to many forests, the effects of warmer and dryer winters on tree hydraulic and carbohydrate status have largely been overlooked.*
Here we report a sharp and previously unknown decline in stem water content of three conifer species during California's anomalous 2015 mid-winter drought that was followed by dampened spring starch accumulation. Recent precipitation and seasonal vapor pressure deficit (VPD) anomaly, not absolute VPD, best predicted the hydraulic patterns observed.
By linking relative water content and hydraulic conductivity (Kh), we estimated that stand-level Kh declined by 52% during California's 2015 mid-winter drought, followed by a 50% reduction in spring starch accumulation. Further examination of tree increment records indicated a concurrent decline of growth with rising mid-winter, but not summer, VPD anomaly.
Thus, our findings suggest a seasonality to tree hydraulic and carbohydrate declines, with consequences for annual growth rates, raising novel physiological and ecological questions about how rising winter temperatures will affect forest vitality as climate changes.

Easton, Z. M., Kleinman, P. J. A., Buda, A. R., Goering, D., Emberston, N., Reed, S., . . . Sharpley, A. (2017). Short-term forecasting tools for agricultural nutrient management. *Journal of Environmental Quality, 46*(6), 1257-1269. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027570406&doi=10.2134%2fjeq2016.09.0377&partnerID=40&md5=b44ea85370aeb3e5191bd884f1f65080. doi:10.2134/jeq2016.09.0377
Research Tags: Crops
Abstract: *The advent of real-time, short-term farm management tools is motivated by the need to protect*

water quality above and beyond the general guidance offered by existing nutrient management plans. Advances in high-performance computing and hydrologic or climate modeling have enabled rapid dissemination of real-time information that can assist landowners and conservation personnel with short-term management planning. This paper reviews short-term decision support tools for agriculture that are under various stages of development and implementation in the United States: (i) Wisconsin's Runoff Risk Advisory Forecast (RRAF) System, (ii) New York's Hydrologically Sensitive Area Prediction Tool, (iii) Virginia's Saturated Area Forecast Model, (iv) Pennsylvania's Fertilizer Forecaster, (v) Washington's Application Risk Management (ARM) System, and (vi) Missouri's Design Storm Notification System. Although these decision support tools differ in their underlying model structure, the resolution at which they are applied, and the hydroclimates to which they are relevant, all provide forecasts (range 24–120 h) of runoff risk or soil moisture saturation derived from National Weather Service Forecast models. Although this review highlights the need for further development of robust and well-supported short-term nutrient management tools, their potential for adoption and ultimate utility requires an understanding of the appropriate context of application, the strategic and operational needs of managers, access to weather forecasts, scales of application (e.g., regional vs. field level), data requirements, and outreach communication structure.

Ebi, K. L., & Ziska, L. H. (2018). Increases in atmospheric carbon dioxide: Anticipated negative effects on food quality. *PLoS Medicine, 15*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051105011&doi=10.1371%2fjournal.pmed.1002600&partnerID=40&md5=849a8c067cf6a9124eb51eeef59f8dc4. doi:10.1371/journal.pmed.1002600
Research Tags: Crops, Nutrition
Abstract: *Higher atmospheric concentrations of carbon dioxide (CO2) increase the growth of cereal crops. At the same time, CO2 decreases the nutritional value of key staple crops, particularly rice and wheat, by lowering concentrations of protein, micronutrients, and B vitamins.*
From 2015–2050, elevated CO2 could result in an additional 125.8 million disability-adjusted life-years (95% credible interval [CrI] 113.6–138.9) globally, attributable to a greater burden of infectious diseases, diarrhea, and anemia.
Impacts are projected to be greater in countries in the Southeast Asia and African regions.
Implementing strategies to reduce greenhouse gas emissions could avert as much as 48.2% (95% CrI 47.8–48.5) of the health burden, compared with traditional public health interventions that could avert about 26.6% (95% CrI 23.8–29.6).

Edwards, B. L., Allen, S. T., Braud, D. H., & Keim, R. F. (2019). Stand density and carbon storage in cypress-tupelo wetland forests of the Mississippi River delta. *Forest Ecology and Management, 441*, 106-114. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063295341&doi=10.1016%2fj.foreco.2019.03.046&partnerID=40&md5=83c0b22582dd6d7cb47ccb4b783dc4d6. doi:10.1016/j.foreco.2019.03.046
Research Tags: Forestry, Water
Abstract: *Forested wetlands play a vital role in the coastal zone, but their vulnerability to coastal change—and the impact to high-value ecosystem services—is not as well established as that of more seaward systems such as saltmarsh and mangroves. To address this need, we develop field-based stand density classes, then classify baldcypress-water tupelo (Taxodium distichum (L.) Rich var. distichum; Nyssa aquatica L.) stand density on the Mississippi River delta using a multitemporal ordination of reflectance from Landsat Thematic Mapper imagery. Approximately 29, 50, and 21% of forest was classified as full canopy, intermediate, and open canopy, respectively. We estimate stand-level live-stem carbon stocks and annual accumulation rates of 96, 67, and 39 t-C ha−1 and 1.9, 1.4 and 0.8 t-C ha−1 yr−1 for full-canopy, intermediate, and open-canopy forest, respectively. Regional live-stem carbon stocks are ∼69 t-C ha-1, and total carbon and annual increment for all forest analyzed are ∼17 Mt-C and ∼0.34 Mt-C yr-1. Much of the cypress-tupelo forest on the delta stores carbon at rates significantly below the potential of fully stocked stands, yet overall rates of accumulation are comparable to other forest types and coastal systems. Delta-wide, there is a well-defined coastward gradient of stand density, which has important implications for the future of deltaic forests and their ecosystem services. The similarities between forest density gradients and well-documented marsh loss patterns in the region suggest that the same processes driving coastal marsh loss—relative sea level rise exacerbated by human activity—are likely responsible for a second, more gradual interface of land loss at the marsh-forest boundary.*

Results highlight the potential response of coastal forests to continued environmental change—and associated impacts to the carbon cycle—and provide a baseline for detecting future change to forests on the Mississippi River delta.

Edwards, B. L., Webb, N. P., Brown, D. P., Elias, E., Peck, D. E., Pierson, F. B., . . . Herrick, J. E. (2019). Climate change impacts on wind and water erosion on US rangelands. *Journal of Soil and Water Conservation, 74*(4), 405-418. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068734862&doi=10.2489%2fjswc.74.4.405&partnerID=40&md5=45f12b5737bf06a16fd00fc0f15cdcc8. doi:10.2489/jswc.74.4.405

Research Tags: Grassland, Soil

Abstract: *Soil erosion by water and wind in US rangelands has serious implications for rangeland health and food security and poses significant hazards to human health and communities. Accordingly, understanding how future climate change may impact soil erosion is critical for developing appropriate management strategies that mitigate negative impacts to the extent practical and potentially build resilience. Here, we review potential impacts of climate change on controls of erosion in US rangelands and discuss potential erosion responses. Projected climate changes are expected to have regionally variable effects on important controls of erosion, especially vegetation cover; community composition; frequency, magnitude, and geographical range of fire disturbance; and high intensity, erosive weather events, all of which have the potential to increase rangeland vulnerability to erosion. We identify knowledge gaps relevant to these controls and discuss management considerations to address climate change impacts to soil erosion concerns for US rangelands. In order to improve resilience and the efficacy of climate change adaptation, we recommend that existing monitoring data be used to create assessments of vulnerability, that soil erosion should be explicitly included in management benchmarks and decision support tools, and that no-regrets management options be implemented in anticipation of future impacts.*

Ehrhardt, F., Soussana, J. F., Bellocchi, G., Grace, P., McAuliffe, R., Recous, S., . . . Zhang, Q. (2018). Assessing uncertainties in crop and pasture ensemble model simulations of productivity and N<inf>2</inf>O emissions. *Global Change Biology, 24*(2), e603-e616. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041341242&doi=10.1111%2fgcb.13965&partnerID=40&md5=347b22604cb55b1a27ce8b2eca770967. doi:10.1111/gcb.13965

Research Tags: Crop, Livestock, Research

Abstract: *Simulation models are extensively used to predict agricultural productivity and greenhouse gas emissions. However, the uncertainties of (reduced) model ensemble simulations have not been assessed systematically for variables affecting food security and climate change mitigation, within multi-species agricultural contexts. We report an international model comparison and benchmarking exercise, showing the potential of multi-model ensembles to predict productivity and nitrous oxide (N2O) emissions for wheat, maize, rice and temperate grasslands. Using a multi-stage modelling protocol, from blind simulations (stage 1) to partial (stages 2–4) and full calibration (stage 5), 24 process-based biogeochemical models were assessed individually or as an ensemble against long-term experimental data from four temperate grassland and five arable crop rotation sites spanning four continents. Comparisons were performed by reference to the experimental uncertainties of observed yields and N2O emissions. Results showed that across sites and crop/grassland types, 23%–40% of the uncalibrated individual models were within two standard deviations (SD) of observed yields, while 42 (rice) to 96% (grasslands) of the models were within 1 SD of observed N2O emissions. At stage 1, ensembles formed by the three lowest prediction model errors predicted both yields and N2O emissions within experimental uncertainties for 44% and 33% of the crop and grassland growth cycles, respectively. Partial model calibration (stages 2–4) markedly reduced prediction errors of the full model ensemble E-median for crop grain yields (from 36% at stage 1 down to 4% on average) and grassland productivity (from 44% to 27%) and to a lesser and more variable extent for N2O emissions. Yield-scaled N2O emissions (N2O emissions divided by crop yields) were ranked accurately by three-model ensembles across crop species and field sites. The potential of using process-based model ensembles to predict jointly productivity and N2O emissions at field scale is discussed.*

Eidson, E. L., Mock, K. E., & Bentz, B. J. (2018). Low offspring survival in mountain pine beetle infesting the resistant

Great Basin bristlecone pine supports the preference-performance hypothesis. *PLoS ONE, 13*(5). Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046364462&doi=10.1371%2fjournal.pone.0196732&partnerID=40&md5=a3bd2fd125a95f0ab073f5ec0f2af68c. doi:10.1371/journal.pone.0196732
Research Tags: Forestry, Wildlife
Abstract: *The preference-performance hypothesis states that ovipositing phytophagous insects will select host plants that are well-suited for their offspring and avoid host plants that do not support offspring performance (survival, development and fitness). The mountain pine beetle (Dendroctonus ponderosae), a native insect herbivore in western North America, can successfully attack and reproduce in most species of Pinus throughout its native range. However, mountain pine beetles avoid attacking Great Basin bristlecone pine (Pinus longaeva), despite recent climate-driven increases in mountain pine beetle populations at the high elevations where Great Basin bristlecone pine grows. Low preference for a potential host plant species may not persist if the plant supports favorable insect offspring performance, and Great Basin bristlecone pine suitability for mountain pine beetle offspring performance is unclear. We infested cut bolts of Great Basin bristlecone pine and two susceptible host tree species, limber (P. flexilis) and lodgepole (P. contorta) pines with adult mountain pine beetles and compared offspring performance. To investigate the potential for variation in offspring performance among mountain pine beetles from different areas, we tested beetles from geographically-separated populations within and outside the current range of Great Basin bristlecone pine. Although mountain pine beetles constructed galleries and laid viable eggs in all three tree species, extremely few offspring emerged from Great Basin bristlecone pine, regardless of the beetle population. Our observed low offspring performance in Great Basin bristlecone pine corresponds with previously documented low mountain pine beetle attack preference. A low preference-low performance relationship suggests that Great Basin bristlecone pine resistance to mountain pine beetle is likely to be retained through climate-driven high-elevation mountain pine beetle outbreaks.*

Eigenbrode, S. D., Patrick Binns, W., & Huggins, D. R. (2018). Confronting climate change challenges to dryland cereal production: A call for collaborative, transdisciplinary research, and producer engagement. *Frontiers in Ecology and Evolution, 5*(JAN). Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040521591&doi=10.3389%2ffevo.2017.00164&partnerID=40&md5=20d363dbd37465858bf8f6ab22b55f46. doi:10.3389/fevo.2017.00164
Research Tags: Crops
Abstract: *Semi-arid cereal systems face challenges worldwide that are driven by ongoing and projected climate change. These challenges include ensuring cropping system resilience and productivity under changing water and temperature regimes while reversing soil degradation, reducing crop susceptibility to pests, pathogens and weed competition, and exploiting genetic resources to develop cultivars with resilience to climate stresses and improved compatibility with cropping system innovations. Meeting these interdependent challenges requires transdisciplinary efforts that integrate knowledge across many scientific domains. The USDA-NIFA-funded coordinated agricultural project, "Regional Approaches to Climate Change for Pacific Northwest Agriculture" (REACCH), employed this transdisciplinary approach to address climate change and sustainability challenges for rain-fed cereal-based systems in the semi-arid intermountain Pacific Northwest. To engage with and contribute to similar efforts globally, REACCH sponsored a workshop "Transitioning Cereal Systems to Adapt to Climate Change" (TCSACC) in November 2015. Participants from 17 countries and five continents with expertise in agronomy, crop physiology, crop modeling, crop protection, breeding and genetics, sociology and economics shared their perspectives, successes, and challenges to achieving transdisciplinary research integration for semi-arid cereal systems under changing climates. Conference goals were to: (1) strengthen the global network of researchers addressing climate change effects on semi-arid cereal-based systems, (2) share the approaches to achieving transdisciplinary collaboration to advance climate change resilience in cereal systems, and (3) identify the elements of a collaborative research agenda that are needed to advance global food security in the twenty-first century. This paper distills the conference themes and summarizes the calls to action that were discussed: Establish coordinated, large scale, transdisciplinary efforts; Consider Genetic × Environment × Management × Social system (G × E × M × S) interactions; Integrate social, economic, and biophysical science, and engineering; Improve integration among knowledge communities; Consider global context of production systems; Develop more inclusive cropping system models; Enable*

comprehensive data management and data sharing; Include landscape and ecosystem services perspectives; Establish and support existing global collaboration networks.

Elhakeem, M., Papanicolaou, A. N. T., Wilson, C. G., Chang, Y. J., Burras, L., Abban, B., . . . Wills, S. (2018). Understanding saturated hydraulic conductivity under seasonal changes in climate and land use. *Geoderma, 315*, 75-87. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037539432&doi=10.1016%2fj.geoderma.2017.11.011&partnerID=40&md5=eef72bede52dff5e3b8bff26cb83be89. doi:10.1016/j.geoderma.2017.11.011
Research Tags: Soil, Weather
Abstract: *The goal of this study was to understand better the co-play of intrinsic soil properties and extrinsic factors of climate and management in the estimation of saturated hydraulic conductivity (Ksat) in intensively managed landscapes. For this purpose, a physically-based, modeling framework was developed using hydro-pedotransfer functions (PTFs) and watershed models integrated with Geographic Information System (GIS) modules. The integrated models were then used to develop Ksat maps for the Clear Creek, Iowa watershed and the state of Iowa. Four types of saturated hydraulic conductivity were considered, namely the baseline (Kb), the bare (Kbr), the effective with no-rain (Ke-nr) and the effective (Ke) in order to evaluate how management and seasonality affect Ksat spatiotemporal variability. Kb is dictated by soil texture and bulk density, whereas Kbr, Ke-nr, and Ke are driven by extrinsic factors, which vary on an event to seasonal time scale, such as vegetation cover, land use, management practices, and precipitation. Two seasons were selected to demonstrate Ksat dynamics in the Clear Creek watershed, IA and the state of Iowa; specifically, the months of October and April that corresponded to the before harvesting and before planting conditions, respectively. Statistical analysis of the Clear Creek data showed that intrinsic soil properties incorporated in Kb do not reflect the degree of soil surface disturbance due to tillage and raindrop impact. Additionally, vegetation cover affected the infiltration rate. It was found that the use of Kb instead of Ke in water balance studies can lead to an overestimation of the amount of water infiltrated in agricultural watersheds by a factor of two. Therefore, we suggest herein that Ke is both the most dynamic and representative saturated hydraulic conductivity for intensively managed landscapes because it accounts for the contributions of land cover and management, local hydropedology and climate condition, which all affect the soil porosity and structure and hence, Ksat.*

Elias, E., Reyes, J., Steele, C., & Rango, A. (2018). Diverse landscapes, diverse risks: synthesis of the special issue on climate change and adaptive capacity in a hotter, drier Southwestern United States. *Climatic Change, 148*(3), 339-353. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047663533&doi=10.1007%2fs10584-018-2219-x&partnerID=40&md5=e443498d1e8ff140590e203ea9328860. doi:10.1007/s10584-018-2219-x
Research Tags: Grassland
Abstract: *Assessing regional-scale vulnerability of agricultural systems to climate change and variability is vital in securing food and fiber systems, as well as sustaining rural livelihoods. Farmers, ranchers, and forest landowners rely on science-based, decision-relevant, and localized information to maintain production, ecological viability, and economic returns. This paper synthesizes the collection of research on the future of agricultural production in the Southwestern United States. A variety of assessment methods indicate the diverse impacts and risks across the Southwest, often related to water availability, which drives adaptive measures in this region. Sector- or species-specific adaptive measures have long been practiced in this region and will continue to be necessary to support agricultural production as a regional enterprise. Diversification of crop selection and income source imparts climate resilience. Building upon biophysical vulnerability through incorporating social and economic factors is critical to future adaptation planning efforts. The persistence and adaptive capacity of agriculture in the water-limited Southwest serves as an instructive example for producers outside the region expecting drier and warmer conditions and may offer solutions to reduce future climate impacts.*

Elias, E., Schrader, T. S., Abatzoglou, J. T., James, D., Crimmins, M., Weiss, J., & Rango, A. (2018). County-level climate change information to support decision-making on working lands. *Climatic Change, 148*(3), 355-369. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028543516&doi=10.1007%2fs10584-017-2040-y&

partnerID=40&md5=da0fd74f0f470adafe4955c182ce5acb. doi:10.1007/s10584-017-2040-y
Research Tags: Research
Abstract: *Farmers, ranchers, and forest landowners across the USA make weather- and climate-related management decisions at varying temporal and spatial scales, often with input from local experts like crop consultants and cooperative extension (CE) personnel. In order to provide additional guidance to such longer-term planning efforts, we developed a tool that shows statistically downscaled climate projections of temperature and precipitation consolidated to the county level for the contiguous US. Using the county as a fundamental mapping unit encourages the use of this information within existing institutional structures like CE and other U.S. Department of Agriculture (USDA) programs. A "quick-look" metric based on the spatial variability of climate within each county aids in the interpretation of county-level information. For instance, relatively higher spatial variability within a county indicates that more localized information should be used to support stakeholder planning. Changes in annual precipitation show a latitudinal dipole where increases are projected for much of the northern US while declines are projected for counties across the southern US. Seasonal shifts in county-level precipitation are projected nationwide with declines most evident in summer months in most regions. Changes in the spatial variability of annual precipitation for most counties were less than 10 mm, indicating fairly spatially homogenous midcentury precipitation changes at the county level. Annual and seasonal midcentury temperatures are projected to increase across the USA, with relatively low change in the spatial variability (<0.3 °C) of temperature across most counties. The utility of these data is shown for forage and almond applications, both indicating a potential decline in production in some future years, to illustrate use of county-level seasonal projections in adaptation planning and decision-making.*

Elliott, J., Glotter, M., Ruane, A. C., Boote, K. J., Hatfield, J. L., Jones, J. W., . . . Foster, I. (2018). Characterizing agricultural impacts of recent large-scale US droughts and changing technology and management. *Agricultural Systems, 159*, 275-281. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85025440335&doi=10.1016%2fj.agsy.2017.07.012&partnerID=40&md5=131db816c577df2ad84c0c5e5fa24028. doi:10.1016/j.agsy.2017.07.012
Research Tags: Weather
Abstract: *Process-based agricultural models, applied in novel ways, can reproduce historical crop yield anomalies in the US, with median absolute deviation from observations of 6.7% at national-level and 11% at state-level. In seasons for which drought is the overriding factor, performance is further improved. Historical counterfactual scenarios for the 1988 and 2012 droughts show that changes in agricultural technologies and management have reduced system-level drought sensitivity in US maize production by about 25% in the intervening years. Finally, we estimate the economic costs of the two droughts in terms of insured and uninsured crop losses in each US county (for a total, adjusted for inflation, of $9 billion in 1988 and $21.6 billion in 2012). We compare these with cost estimates from the counterfactual scenarios and with crop indemnity data where available. Model-based measures are capable of accurately reproducing the direct agro-economic losses associated with extreme drought and can be used to characterize and compare events that occurred under very different conditions. This work suggests new approaches to modeling, monitoring, forecasting, and evaluating drought impacts on agriculture, as well as evaluating technological changes to inform adaptation strategies for future climate change and extreme events.*

Elsen, P. R., Monahan, W. B., & Merenlender, A. M. (2018). Global patterns of protection of elevational gradients in mountain ranges. *Proceedings of the National Academy of Sciences of the United States of America, 115*(23), 6004-6009. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047977804&doi=10.1073%2fpnas.1720141115&partnerID=40&md5=66214bf010a745acc78043c79610296a. doi:10.1073/pnas.1720141115
Research Tags: Wildlife
Abstract: *Protected areas (PAs) that span elevational gradients enhance protection for taxonomic and phylogenetic diversity and facilitate species range shifts under climate change. We quantified the global protection of elevational gradients by analyzing the elevational distributions of 44,155 PAs in 1,010 mountain ranges using the highest resolution digital elevation models available. We show that, on average, mountain ranges in Africa and Asia have the lowest elevational protection, ranges in Europe and South America have intermediate elevational protection, and ranges in North America and Oceania have the highest elevational*

protection. We use the Convention on Biological Diversity's Aichi Target 11 to assess the proportion of elevational gradients meeting the 17% suggested minimum target and examine how different protection categories contribute to elevational protection. When considering only strict PAs [International Union for Conservation of Nature (IUCN) categories I–IV, n = 24,706], nearly 40% of ranges do not contain any PAs, roughly half fail to meet the 17% target at any elevation, and ~75% fail to meet the target throughout ≥50% of the elevational gradient. Observed elevational protection is well below optimal, and frequently below a null model of elevational protection. Including less stringent PAs (IUCN categories V–VI and nondesignated PAs, n = 19,449) significantly enhances elevational protection for most continents, but several highly biodiverse ranges require new or expanded PAs to increase elevational protection. Ensuring conservation outcomes for PAs with lower IUCN designations as well as strategically placing PAs to better represent and connect elevational gradients will enhance ecological representation and facilitate species range shifts under climate change.

Emel, S. L., Olson, D. H., Knowles, L. L., & Storfer, A. (2019). Comparative landscape genetics of two endemic torrent salamander species, Rhyacotriton kezeri and R. variegatus: implications for forest management and species conservation. *Conservation Genetics*, *20*(4), 801-815. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064343134&doi=10.1007%2fs10592-019-01172-6&partnerID=40&md5=90a48d623a5742a66ea34e5f56659ebf. doi:10.1007/s10592-019-01172-6
Research Tags: Wildlife
Abstract: *Comparative landscape genetic studies provide insights into whether relationships between landscape features and patterns of spatial genetic structure differ among populations, species, habitat types, and regions. For species with fragmented distributions, especially when management practices contribute to fragmentation, tests of the factors structuring population connectivity are particularly important for understanding continued risks. We determined levels of genetic diversity and tested the relationships of landscape-scale vegetative, geographic, and climate variables with genetic distance in two congeneric, endemic salamander species with status of concern. Using microsatellite data for 326 Rhyacotriton kezeri and 557 Rhyacotriton variegatus individuals collected from 17 to 29 localities, respectively, we implemented a model of landscape resistance based on circuit theory. The northernmost portions of each species' range is more fragmented than areas to the south, leading to the prediction that these areas would have relatively lower genetic diversity in response. Due to reliance of both species upon cold-water habitats, we predicted that landscape variables maintaining cool, moist microhabitats would be correlated with gene flow. Genetic structure was high overall and trended toward increasing with the proportion of the forested landscape. Based on maximum likelihood population effects models across genetic clusters and species, land cover and roads were the best predictors of genetic distance, even though the degree of fragmentation differed across each species' geographic range. Our results suggest that forest cover is essential for dispersal in these salamanders, indicating negative effects of fragmentation resulting from timber harvest and other forest disturbances.*

Emmett, K. D., Renwick, K. M., & Poulter, B. (2018). Disentangling Climate and Disturbance Effects on Regional Vegetation Greening Trends. *Ecosystems*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056359575&doi=10.1007%2fs10021-018-0309-2&partnerID=40&md5=a3015d22e4ce0d408cecf5c0598b3fbb. doi:10.1007/s10021-018-0309-2
Research Tags: Forestry
Abstract: *Productivity of northern latitude forests is an important driver of the terrestrial carbon cycle and is already responding to climate change. Studies of the satellite-derived Normalized Difference Vegetation Index (NDVI) for northern latitudes indicate recent changes in plant productivity. These detected greening and browning trends are often attributed to a lengthening of the growing season from warming temperatures. Yet, disturbance-recovery dynamics are strong drivers of productivity and can mask direct effects of climate change. Here, we analyze 1-km resolution NDVI data from 1989 to 2014 for the northern latitude forests of the Greater Yellowstone Ecosystem for changes in plant productivity to address the following questions: (1) To what degree has greening taken place in the GYE over the past three decades? and (2) What is the relative importance of disturbance and climate in explaining NDVI trends? We found that the spatial extents of statistically significant productivity trends were limited to local greening and browning areas. Disturbance history, predominately fire disturbance, was a major driver of these detected NDVI trends. After accounting for fire-, insect-, and human-caused disturbances, increasing productivity trends remained. Productivity of northern latitude forests is*

generally considered temperature-limited; yet, we found that precipitation was a key driver of greening in the GYE.

Endale, D. M., Potter, T. L., Strickland, T. C., & Bosch, D. D. (2017). Sediment-bound total organic carbon and total organic nitrogen losses from conventional and strip tillage cropping systems. *Soil and Tillage Research, 171*, 25-34. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018356084&doi=10.1016%2fj.still.2017.04.004&partnerID=40&md5=a79295d1621e65ead119bbfe1fed08fe. doi:10.1016/j.still.2017.04.004
Research Tags: Soil, Crops
Abstract: *Global carbon (C) and nitrogen (N) cycles are closely linked to erosion and hydrologic processes. By reducing tillage erosion and runoff, sediment-bound C and N losses can be reduced. Published studies represent only a few soil types and regions and rarely directly compare tillage practices. The objective of this study was to quantify concentrations and sediment-bound total organic carbon (TOC) and nitrogen (TON) loads and enrichment ratios in runoff from 0.2-ha fields in rotational cotton (Gossypium hirsutum L.)-peanut (Arachis hypogea L.) production during a 7-yr study within a southeastern USA coastal plain landscape. The Ultisoils at the study site have loamy sand to sandy loam texture surface horizons. The fields were in either continuous conventional tillage (CT) or strip tillage (ST) and were at upper, middle, and lower landscape positions. Sediment-bound TON and TOC concentrations were significantly greater from ST than CT fields as were the TOC and TON enrichment ratios. However, due to greater surface runoff and sediment loss, TON and TOC loads were significantly greater from CT than ST fields. The CT and ST loads were significantly different at the upper and middle but not at the lower landscape position. Enrichment ratios, 14 to 19 for TON and 8 to 12 for TOC, were several-fold greater than reported in the limited available literature, where studies focused on finer textured surface soils. Our findings have highlighted the site-specific nature of erosion processes, how they affect sediment-bound C and N loss in agricultural landscapes, and how reducing tillage may impact sediment C and N dynamics. The observed enrichment ratios can be used to modify or adjust values used in current erosion models and improve their suitability for use in the region and elsewhere where surface soils have sandy texture and when practices like ST are implemented.*

Engeman, R. M., Laine, E., Allen, J., Preston, J., Pizzolato, W., Williams, B., . . . Teague, D. (2019). Invasive feral swine damage to globally imperiled steephead ravine habitats and influences from changes in population control effort, climate, and land use. *Biodiversity and Conservation, 28*(5), 1109-1127. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061714099&doi=10.1007%2fs10531-019-01713-y&partnerID=40&md5=6948745933fe95c08b6666e7749b7659. doi:10.1007/s10531-019-01713-y
Research Tags: Wildlife
Abstract: *Steephead ravines are unusual geological features primarily occurring in Florida's panhandle, a biodiversity hotspot. The unique habitats formed by steepheads are extremely valuable biodiversity resources within this larger area of great biodiversity. Eglin Air Force Base (EAFB) is essential for global conservation of steepheads because this vast area holds the greatest number under single ownership. Steepheads are significantly threatened by feral swine rooting damage. A decade-long investigation of EAFB's steepheads assessed the following: (1) severity of swine damage to steepheads, (2) changing levels of swine control on swine population and damage, (3) changing climatic conditions on damage, (4) changing military land use on damage (5) bioeconomics of damage. Swine damage to 21 EAFB steepheads was assessed 5 times over 10 years. Swine populations were indexed 8 times. Damage and population estimates were related to control effort, military land use, and climate variables to assess influences on damage levels. Monetary values were applied to estimates of total damage across all steepheads. Full control staffing rapidly reduced feral swine abundance and steephead damage. Reduced control staffing and reduced access from increased military activities allowed population rebound and increased damage. Drought possibly increased susceptibility to damage because steepheads provide a steady water source despite climatic circumstance. Estimated damage values across EAFB's steepheads (excluding other resources damaged) was 1.5–11.3 times more than annual control costs. Effective swine control greatly reduces steephead damage. Technological advances may overcome access issues from changing land use. Swine control is a cost-effective steephead conservation approach.*

Ergüner, Y., Kumar, J., Hoffman, F. M., Dalfes, H. N., & Hargrove, W. W. (2019). Mapping ecoregions under climate

change: a case study from the biological 'crossroads' of three continents, Turkey. *Landscape Ecology, 34*(1), 35-50. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059347038&doi=10.1007%2fs10980-018-0743-8&partnerID=40&md5=66cbdb83d7c50f385c2b0db5bacb56ea. doi:10.1007/s10980-018-0743-8
Research Tags: Research
Abstract: *Context*
Besides climate change vulnerability, most ecosystems are under threat from a history of improper land-use and conservation policies, yet there is little existing long-term ecological research infrastructure in Turkey. In regions with no ecological networks across large landscapes, ecoregion concept offers opportunities for characterizing the landscape under changing climate.
Objectives
Aim is to develop contemporary and future quantitative ecoregions for Turkey based on climate model outputs, to identify climate change-sensitive areas of biodiversity and conservation significance, and to provide a framework for a comprehensive ecological observatory network design.
Methods
Using Multivariate Spatio-Temporal Clustering and climate data contemporary and projected future distributions of Turkey's ecoregions are delineated at several division levels.
Results
Turkey's contemporary ecoregions generally show a northward shift by the end of this century and the lengthening of the growing season across the country, especially eastward and northward. The increase in growing season length, along with the shift in precipitation seasonality and increasing growing season precipitation, shape future conditions within the climate change-sensitive areas. Apart from transboundary ecological and socioeconomic significance, these potentially vulnerable ecosystems also constitute the majority of Turkey's biodiversity hotspots.
Conclusions
Our study marks the first 'ecoregionalization' study for Turkey based on both contemporary and future climate scenarios. For countries like Turkey, where large-scale ecological networks have not been established, using such quantitative methodology for delineation of optimal ecoclimatic regions, and for mapping environments at risk from climate change provides an invaluable perspective for conservation planning strategies, and a framework for a comprehensive ecological observatory network design.

Espeland, E. K., & Kettenring, K. M. (2018). Strategic plant choices can alleviate climate change impacts: A review. *Journal of Environmental Management, 222*, 316-324. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047838038&doi=10.1016%2fj.jenvman.2018.05.042&partnerID=40&md5=452c8e2369050551bb2d29debab0cdb6. doi:10.1016/j.jenvman.2018.05.042
Research Tags: Soil, Water
Abstract: *Ecosystem-based adaptation (EbA) uses biodiversity and ecosystem services to reduce climate change impacts to local communities. Because plants can alleviate the abiotic and biotic stresses of climate change, purposeful plant choices could improve adaptation. However, there has been no systematic review of how plants can be applied to alleviate effects of climate change. Here we describe how plants can modify climate change effects by altering biological and physical processes. Plant effects range from increasing soil stabilization to reducing the impact of flooding and storm surges. Given the global scale of plant-related activities such as farming, landscaping, forestry, conservation, and restoration, plants can be selected strategically—i.e., planting and maintaining particular species with desired impacts—to simultaneously restore degraded ecosystems, conserve ecosystem function, and help alleviate effects of climate change. Plants are a tool for EbA that should be more broadly and strategically utilized.*

Evans, M., Kholod, N., Kuklinski, T., Denysenko, A., Smith, S. J., Staniszewski, A., . . . Bond, T. C. (2017). Black carbon emissions in Russia: A critical review. *Atmospheric Environment, 163*, 9-21. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019559946&doi=10.1016%2fj.atmosenv.2017.05.026&partnerID=40&md5=14264da299314ec6219caee31a52094c. doi:10.1016/j.atmosenv.2017.05.026
Research Tags: Emissions
Abstract*: This study presents a comprehensive review of estimated black carbon (BC) emissions in Russia from*

a range of studies. Russia has an important role regarding BC emissions given the extent of its territory above the Arctic Circle, where BC emissions have a particularly pronounced effect on the climate. We assess underlying methodologies and data sources for each major emissions source based on their level of detail, accuracy and extent to which they represent current conditions. We then present reference values for each major emissions source. In the case of flaring, the study presents new estimates drawing on data on Russia's associated petroleum gas and the most recent satellite data on flaring. We also present estimates of organic carbon (OC) for each source, either based on the reference studies or from our own calculations. In addition, the study provides uncertainty estimates for each source. Total BC emissions are estimated at 688 Gg in 2014, with an uncertainty range 401 Gg-1453 Gg, while OC emissions are 9224 Gg with uncertainty ranging between 5596 Gg and 14,736 Gg. Wildfires dominated and contributed about 83% of the total BC emissions: however, the effect on radiative forcing is mitigated in part by OC emissions. We also present an adjusted estimate of Arctic forcing from Russia's BC and OC emissions. In recent years, Russia has pursued policies to reduce flaring and limit particulate emissions from on-road transport, both of which appear to significantly contribute to the lower emissions and forcing values found in this study.

Evans, M. E. K., Gugger, P. F., Lynch, A. M., Guiterman, C. H., Fowler, J. C., Klesse, S., & Riordan, E. C. (2018). Dendroecology meets genomics in the common garden: new insights into climate adaptation. *New Phytologist, 218*(2), 401-403. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044275612&doi=10.1111%2fnph.15094&partnerID=40&md5=e5134cbf8126294db0513cfea084f5ca. doi:10.1111/nph.15094

Research Tags: Research

Abstract: *In this issue of New Phytologist (pp. 630–645), Housset et al. bring together old and new tools to address an important global change problem: they combine a common garden experiment, association genetics, and dendroecology to gauge the adaptation of trees to climate variation, laying the foundation for a genotype-to-phenotype-level approach to managing forests of the future. Better anticipation and management of the effects of climate change on forests qualifies as one of the grand scientific and natural resource management challenges of the twenty-first century: among other ecosystem services, forests play an important role in the global carbon cycle, having sequestered approximately 30% of the excess greenhouse gasses added to the atmosphere by humans over the period 1959–2015 (Le Quéré et al., 2016). Trees are locally adapted with respect to climate (as are all organisms), and risk becoming maladapted if the rate of climate change exceeds their capacity to respond through migration, plasticity or in situ evolutionary adaptation. Maintaining key ecosystem services provided by forests thus involves adaptation in two senses of the word: better understanding the basis for evolutionary adaptation to climate in trees to help develop climate adaptation strategies – i.e. management actions that can be taken to mitigate the negative effects of climate change.*

Fabio, E. S., Volk, T. A., Miller, R. O., Serapiglia, M. J., Gauch, H. G., Van Rees, K. C. J., . . . Smart, L. B. (2017). Genotype × environment interaction analysis of North American shrub willow yield trials confirms superior performance of triploid hybrids. *GCB Bioenergy, 9*(2), 445-459. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84960393547&doi=10.1111%2fgcbb.12344&partnerID=40&md5=a28c8e6bcee3e898aaf093119bb28b5e. doi:10.1111/gcbb.12344

Research Tags: Forestry

Abstract: *Development of dedicated bioenergy crop production systems will require accurate yield estimates, which will be important for determining many of the associated environmental and economic impacts of their production. Shrub willow (Salix spp) is being promoted in areas of the USA and Canada due to its adaption to cool climates and wide genetic diversity available for breeding improvement. Willow breeding in North America is in an early stage, and selection of elite genotypes for commercialization will require testing across broad geographic regions to gain an understanding of how shrub willow interacts with the environment. We analyzed a dataset of first-rotation shrub willow yields of 16 genotypes across 10 trial environments in the USA and Canada for genotype-by-environment interactions using the additive main effects and multiplicative interactions (AMMI) model. Mean genotype yields ranged from 5.22 to 8.58 oven-dry Mg ha−1 yr−1. Analysis of the main effect of genotype showed that one round of breeding improved yields by as much as 20% over check cultivars and that triploid hybrids, most notably Salix viminalis × S. miyabeana, exhibited superior yields. We also found important variability in genotypic response to environments, which suggests specific adaptability* *could be exploited among 16 genotypes for yield gains. Strong positive correlations were found between environment main effects and AMMI parameters and growing environment temperatures. These findings demonstrate yield improvements are possible in one generation and will be important for developing cultivar recommendations and for future breeding efforts.*

Faburay, B., LaBeaud, A. D., McVey, D. S., Wilson, W. C., & Richt, J. A. (2017). Current status of rift valley fever vaccine development. *Vaccines, 5*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031101525&doi=10.3390%2fvaccines5030029&partnerID=40&md5=0b9656a50412df9b3780c896621313e4. doi:10.3390/vaccines5030029

Research Tags: Wildlife

Abstract: *Rift Valley Fever (RVF) is a mosquito-borne zoonotic disease that presents a substantial threat to human and public health. It is caused by Rift Valley fever phlebovirus (RVFV), which belongs to the genus Phlebovirus and the family Phenuiviridae within the order Bunyavirales. The wide distribution of competent vectors in non-endemic areas coupled with global climate change poses a significant threat of the transboundary spread of RVFV. In the last decade, an improved understanding of the molecular biology of RVFV has facilitated significant progress in the development of novel vaccines, including DIVA (differentiating infected from vaccinated animals) vaccines. Despite these advances, there is no fully licensed vaccine for veterinary or human use available in non-endemic countries, whereas in endemic countries, there is no clear policy or practice of routine/strategic livestock vaccinations as a preventive or mitigating strategy against potential RVF disease outbreaks. The purpose of this review was to provide an update on the status of RVF vaccine development and provide perspectives on the best strategies for disease control. Herein, we argue that the routine or strategic vaccination of livestock could be the best control approach for preventing the outbreak and spread of future disease.*

Falk, D. A., & Millar, C. I. (2017). The influence of climate variability and change on the science and practice of restoration ecology. In *Foundations of Restoration Ecology: Second Edition* (pp. 484-513).

Research Tags: Forestry

Abstract: *Variation in Earth's climate system has always been a primary driver of ecosystem processes and biological evolution. In recent decades, however, the prospect of anthropogenically driven change to the climate system has become an increasingly dominant concern for scientists and conservation biologists. Understanding how ecosystems may adapt to rapid contemporary and future change benefits from our knowledge of how they have responded to natural climatic variation across prehistoric time, especially during periods when Earth system conditions and ecosystems correspond to those of the modern era (e.g., Quaternary, the past 2.5 million years). Despite the dominant and pervasive influence of both climate variability and climate change, the restoration field is still learning how to accommodate these emerging influences. In this chapter we explore the consequences of climate variability and change for the science of restoration ecology and the practice of ecological restoration.*

Falkowski, M. J., Evans, J. S., Naugle, D. E., Hagen, C. A., Carleton, S. A., Maestas, J. D., . . . Lawrence, A. J. (2017). Mapping tree canopy cover in support of proactive prairie grouse conservation in western North America. *Rangeland Ecology and Management, 70*(1), 15-24. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009111961&doi=10.1016%2fj.rama.2016.08.002&partnerID=40&md5=62836fe59f094b6b7fe29070d858f044. doi:10.1016/j.rama.2016.08.002

Research Tags: Forestry, Wildlife

Abstract: *Invasive woody plant expansion is a primary threat driving fragmentation and loss of sagebrush (Artemisia spp.) and prairie habitats across the central and western United States. Expansion of native woody plants, including conifer (primarily Juniperus spp.) and mesquite (Prosopis spp.), over the past century is primarily attributable to wildfire suppression, historic periods of intensive livestock grazing, and changes in climate. To guide successful conservation programs aimed at reducing top-down stressors, we mapped invasive woody plants at regional scales to evaluate landscape level impacts, target restoration actions, and monitor restoration outcomes. Our overarching goal was to produce seamless regional products across sociopolitical boundaries with resolution fine enough to depict the spatial extent and degree of woody plant invasion relevant to greater sage-grouse (Centrocercus urophasianus) and lesser prairie-chicken (Tympanuchus pallidicinctus)*

conservation efforts. We mapped tree canopy cover at 1-m spatial resolution across an 11-state region (508 265 km2). Greater than 90% of occupied lesser prairie-chicken habitat was largely treeless for conifers (< 1% canopy cover), whereas > 67% was treeless for mesquite. Conifers in the higher canopy cover classes (16 − 50% and > 50% canopy cover) were scarce (< 2% and 1% canopy cover), as was mesquite (< 5% and 1% canopy cover). Occupied habitat by sage-grouse was more variable but also had a relatively large proportion of treeless areas (x−= 71, SE = 5%). Low to moderate levels of conifer cover (1 − 20%) were fewer (x−= 23, SE = 5%) as were areas in the highest cover class (> 50%; x−= 6, SE = 2%). Mapping indicated that a high proportion of invading woody plants are at a low to intermediate level. Canopy cover maps for conifer and mesquite resulting from this study provide the first and most geographically complete, high-resolution assessment of woody plant cover as a top-down threat to western sage-steppe and prairie ecosystems.

Fan, Y., Clark, M., Lawrence, D. M., Swenson, S., Band, L. E., Brantley, S. L., . . . Yamazaki, D. (2019). Hillslope Hydrology in Global Change Research and Earth System Modeling. *Water Resources Research*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062323142&doi=10.1029%2f2018WR023903&partnerID=40&md5=4d8f0706a2329e677bd9cb9287bffbf8. doi:10.1029/2018WR023903

Research Tags: Water

Abstract: *Hillslopes are key landscape features that organize water availability on land. Valley bottoms are wetter than hilltops, and sun-facing slopes are warmer and drier than shaded ones. This hydrologic organization leads to systematic differences in soil and vegetation between valleys and hilltops, and between sunny and shady slopes. Although these patterns are fundamental to understanding the structures and functions of water and terrestrial ecosystems, they are too fine grained to be represented in global-scale Earth System Models. Here we bring together Critical Zone scientists who study the interplay of vegetation, the porous upper layer of the continental crust from vegetation to bedrock, and moisture dynamics deep into the weathered bedrock underlying hillslopes and Earth System Model scientists who develop global models, to ask: Do hillslope-scale processes matter to predicting global change? The answers will help scientists understand where and why hillslopes matter, and to better predict how terrestrial ecosystems, including societies, may affect and be affected by our rapidly changing planet.*

Fan, Y., Keith Moser, W., & Cheng, Y. (2019). Growth and needle properties of young Pinus koraiensis Sieb. et Zucc. trees across an elevational gradient. *Forests, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060043409&doi=10.3390%2ff10010054&partnerID=40&md5=80d4402af19dee2bb76929d1a7b74984. doi:10.3390/f10010054

Research Tags:

Abstract: *A better understanding of the response of plant growth to elevational gradients may shed light on how plants respond to environmental variation and on the physiological mechanisms underlying these responses. This study analyzed whole plant growth and physiological and morphological properties of needles in young Pinus koraiensis Sieb. et Zucc. trees at thirteen points along an elevational gradient ranging from 750 to 1350 m above sea level (a.s.l.) at the end of a growing season on Changbai Mountain in northeastern China. Sampling and analyses indicated the following; (1) many needle properties of P. koraiensis varied with forest type along the elevational gradient though some needle properties (e.g., intrinsic water use efficiency, concentration of chlorophyll, and leaf mass per area) did not change with elevation and forest types; (2) growth was significantly influenced by both forest type and elevation and growth of saplings in P. koraiensis and mixed broadleaved forests was greater than that in evergreen forests and increased with elevation in both forest types; (3) in P. koraiensis and mixed broadleaved forests, there were significant correlations between growth properties and light saturation point, leaf water potential, mean within-crown humidity, annual precipitation, cumulative temperature (≥%∘ C), within-crown air temperature, and atmospheric pressure; while in evergreen forests, the leaf C, leaf P content, net rate of light saturation in photosynthesis, water content of soil, within-crown humidity, annual precipitation, cumulative temperature (≥5∘ C), within-crown air temperature, and total soil P content displayed a significant relationship with plant growth. These results may help illuminate how P. koraiensis responds to environmental variation and evaluate the adaptive potential of Pinus koraiensis to climate change. Data presented here could also contribute to the more accurate estimation of carbon stocks in this area and to refinement of a plant trait database.*

Fargione, J. E., Bassett, S., Boucher, T., Bridgham, S. D., Conant, R. T., Cook-Patton, S. C., . . . Griscom, B. W. (2018). Natural climate solutions for the United States. *Science Advances, 4*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056560283&doi=10.1126%2fsciadv.aat1869&partnerID=40&md5=3a885cef2f86958b0a447b59c2934d56. doi:10.1126/sciadv.aat1869

Research Tags: Emissions

Abstract: *Limiting climate warming to <2°C requires increased mitigation efforts, including land stewardship, whose potential in the United States is poorly understood. We quantified the potential of natural climate solutions (NCS)—21 conservation, restoration, and improved land management interventions on natural and agricultural lands—to increase carbon storage and avoid greenhouse gas emissions in the United States. We found a maximum potential of 1.2 (0.9 to 1.6) Pg CO2e year−1, the equivalent of 21% of current net annual emissions of the United States. At current carbon market prices (USD 10 per Mg CO2e), 299 Tg CO2e year−1 could be achieved. NCS would also provide air and water filtration, flood control, soil health, wildlife habitat, and climate resilience benefits.*

Fatoyinbo, T., Feliciano, E. A., Lagomasino, D., Lee, S. K., & Trettin, C. (2018). Estimating mangrove aboveground biomass from airborne LiDAR data: A case study from the Zambezi River delta. *Environmental Research Letters, 13*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046001044&doi=10.1088%2f1748-9326%2faa9f03&partnerID=40&md5=f642499932f00a7ebd26fef3637eb12f. doi:10.1088/1748-9326/aa9f03

Research Tags: Forestry, Water

Abstract: *Mangroves are ecologically and economically important forested wetlands with the highest carbon (C) density of all terrestrial ecosystems. Because of their exceptionally large C stocks and importance as a coastal buffer, their protection and restoration has been proposed as an effective mitigation strategy for climate change. The inclusion of mangroves in mitigation strategies requires the quantification of C stocks (both above and belowground) and changes to accurately calculate emissions and sequestration. A growing number of countries are becoming interested in using mitigation initiatives, such as REDD+ (reducing emissions from deforestation and forest degradation), in these unique coastal forests. However, it is not yet clear how methods to measure C traditionally used for other ecosystems can be modified to estimate biomass in mangroves with the precision and accuracy needed for these initiatives. Airborne Lidar (ALS) data has often been proposed as the most accurate way for larger scale assessments but the application of ALS for coastal wetlands is scarce, primarily due to a lack of contemporaneous ALS and field measurements. Here, we evaluated the variability in field and Lidar-based estimates of aboveground biomass (AGB) through the combination of different local and regional allometric models and standardized height metrics that are comparable across spatial resolutions and sensor types, the end result being a simplified approach for accurately estimating mangrove AGB at large scales and determining the uncertainty by combining multiple allometric models. We then quantified wall-to-wall AGB stocks of a tall mangrove forest in the Zambezi Delta, Mozambique. Our results indicate that the Lidar H100 height metric correlates well with AGB estimates, with R 2 between 0.80 and 0.88 and RMSE of 33% or less. When comparing Lidar H100 AGB derived from three allometric models, mean AGB values range from 192 Mg ha−1 up to 252 Mg ha−1. We suggest the best model to predict AGB was based on the East Africa specific allometry and a power-based regression that used Lidar H100 as the height input with an R 2 of 0.85 and an RMSE of 122 Mg ha−1 or 33%. The total AGB of the Lidar inventoried mangrove area (6654 ha) was 1 350 902 Mg with a mean AGB of 203 Mg ha−1 ±166 Mg ha−1. Because the allometry suggested here was developed using standardized height metrics, it is recommended that the models can generate AGB estimates using other remote sensing instruments that are more readily accessible over other mangrove ecosystems on a large scale, and as part of future carbon monitoring efforts in mangroves.*

Faust, D. R., Kröger, R., Moore, M. T., & Rush, S. A. (2018). Management Practices Used in Agricultural Drainage Ditches to Reduce Gulf of Mexico Hypoxia. *Bulletin of environmental contamination and toxicology, 100*(1), 32-40. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037977179&doi=10.1007%2fs00128-017-2231-2&partnerID=40&md5=0f0a9b3da457fd54819eaf0be7cb3357. doi:10.1007/s00128-017-2231-2

Research Tags: Water

Abstract: *Agricultural non-point sources of nutrients and sediments have caused eutrophication and other* *water quality issues in aquatic and marine ecosystems, such as the annual occurrence of hypoxia in the Gulf of Mexico. Management practices have been implemented adjacent to and in agricultural drainage ditches to promote their wetland characteristics and functions, including reduction of nitrogen, phosphorus, and sediment losses downstream. This review: (1) summarized studies examining changes in nutrient and total suspended solid concentrations and loads associated with management practices in drainage ditches (i.e., riser and slotted pipes, two-stage ditches, vegetated ditches, low-grade weirs, and organic carbon amendments) with emphasis on the Lower Mississippi Alluvial Valley, (2) quantified management system effects on nutrient and total suspended solid concentrations and loads and, (3) identified information gaps regarding water quality associated with these management practices and research needs in this area. In general, management practices used in drainage ditches at times reduced losses of total suspended solids, N, and P. However, management practices were often ineffective during storm events that were uncommon and intense in duration and volume, although these types of events could increase in frequency and intensity with climate change. Studies on combined effects of management practices on drainage ditch water quality, along with research towards improved nutrient and sediment reduction efficiency during intense storm events are urgently needed.*

Faust, D. R., Kumar, S., Archer, D. W., Hendrickson, J. R., Kronberg, S. L., & Liebig, M. A. (2018). Integrated crop-livestock systems and water quality in the Northern Great plains: Review of current practices and future research needs. *Journal of Environmental Quality, 47*(1), 1-15. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040454040&doi=10.2134%2fjeq2017.08.0306&partnerID=40&md5=2150d38ebd22b0a48f424e4509d9a1aa. doi:10.2134/jeq2017.08.0306

Research Tags: Livestock, Crops, Water

Abstract*: Integrated crop-livestock systems hold potential to achieve environmentally sustainable production of crop and livestock products. Although previous studies suggest that integrated crop-livestock systems improve soil health, impacts of integrated crop-livestock systems on water quality and aquatic ecosystems are largely unknown. This review (i) summarizes studies examining surface water quality and soil leachate for management practices commonly used in integrated crop-livestock systems (e.g., no-till, cover crops, livestock grazing) with emphasis on the Northern Great Plains ecoregion of North America, (ii) quantifies management system effects on nutrient and total suspended solids concentrations and loads, and (iii) identifies information gaps regarding water quality associated with integrated crop-livestock systems and research needs in this area. In general, management practices used in integrated crop-livestock systems reduced losses of total suspended solids, nitrogen (N), and phosphorus (P) in surface runoff and soil leachate. However, certain management practices (e.g., no-till or reduced tillage) reduced losses of total N (relative median change = −65%), whereas soluble P losses in runoff increased (57%). Conversely, practices such as grazing increased median total suspended solids (22%), nitrate (45%), total N (85%), and total P (25%) concentrations and loads in surface runoff and aquatic ecosystems. An improved understanding of the interactive effects of integrated crop-livestock management practices on surface water quality and soil leachate under current and future climate scenarios is urgently needed. To close this knowledge gap, future studies should focus on determining concentrations and loads of total suspended solids, N, P, and organic carbon in runoff and soil leachate from integrated crop-livestock systems.*

Fei, S., Desprez, J. M., Potter, K. M., Jo, I., Knott, J. A., & Oswalt, C. M. (2017). Divergence of species responses to climate change. *Science Advances, 3*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029571353&doi=10.1126%2fsciadv.1603055&partnerID=40&md5=f536d0b70e84c4d6ea0ea964ce12eb53. doi:10.1126/sciadv.1603055

Research Tags: Forestry

Abstract: *Climate change can have profound impacts on biodiversity and the sustainability of many ecosystems. Various studies have investigated the impacts of climate change, but large-scale, trait-specific impacts are less understood. We analyze abundance data over time for 86 tree species/groups across the eastern United States spanning the last three decades. We show that more tree species have experienced a westward shift (73%) than a poleward shift (62%) in their abundance, a trend that is stronger for saplings than adult trees. The observed shifts are primarily due to the changes of subpopulation abundances in the leading edges and are significantly associated with changes in moisture availability and successional processes. These spatial shifts are associated with species that have similar traits (drought tolerance, wood density, and seed*

weight) and evolutionary histories (most angiosperms shifted westward and most gymnosperms shifted poleward). Our results indicate that changes in moisture availability have stronger near-term impacts on vegetation dynamics than changes in temperature. The divergent responses to climate change by trait- and phylogenetic-specific groups could lead to changes in composition of forest ecosystems, putting the resilience and sustainability of various forest ecosystems in question.

Fei, S., Jo, I., Guo, Q., Wardle, D. A., Fang, J., Chen, A., . . . Brockerhoff, E. G. (2018). Impacts of climate on the biodiversity-productivity relationship in natural forests. *Nature Communications, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058920768&doi=10.1038%2fs41467-018-07880-w&partnerID=40&md5=40b0e8687b2d9375378df9024df6c129. doi:10.1038/s41467-018-07880-w
Research Tags: Forestry
Abstract: *Understanding biodiversity-productivity relationships (BPRs) is of theoretical importance, and has important management implications. Most work on BPRs has focused on simple and/or experimentally assembled communities, and it is unclear how these observed BPRs can be extended to complex natural forest ecosystems. Using data from over 115,000 forest plots across the contiguous United States, we show that the bivariate BPRs are positive in dry climates and hump-shaped in mesic climates. When considering other site characteristics, BPRs change to neutral in dry climates and remain hump-shaped in humid sites. Our results indicate that climatic variation is an underlying determinant of contrasting BPRs observed across a large spatial extent, while both biotic factors (e.g., stand age and density) and abiotic factors (e.g., soil properties) can impact BPRs within a given climate unit. These findings suggest that tradeoffs need be made when considering whether to maximize productivity vs. conserve biodiversity, especially in mesic climates.*

Feifarek, D. J., Shappell, N. W., & Schoenfuss, H. L. (2018). Do environmental factors affect male fathead minnow (Pimephales promelas) response to estrone? Part 1. Dissolved oxygen and sodium chloride. *Science of the Total Environment, 610-611*, 1262-1270. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028318853&doi=10.1016%2fj.scitotenv.2017.07.251&partnerID=40&md5=a8901f98d86f94dbaeac170e384fca56. doi:10.1016/j.scitotenv.2017.07.251
Research Tags: Wildlife
Abstract: *Laboratory exposures indicate that estrogens and their mimics can cause endocrine disruption in male fishes, yet while studies of resident fish populations in estrogen-polluted waters support these findings, biomarker expression associated with field versus laboratory exposure to estrogenic endocrine disruptors (EDs) often differ dramatically. Two of the environmental parameters often found to vary in dynamic aquatic ecosystems were chosen (dissolved oxygen [DO] and sodium chloride concentrations) to assess their potential impact on ED exposure. In separate experiments, male fathead minnows (Pimephales promelas) were exposed to estrone (E1) a natural ED, under either two concentrations of DO, or two concentrations of sodium chloride, in a laboratory flow-through system. Morphological and hematological parameters were assessed. While vitellogenin concentrations were elevated with exposure to estrone (29 to 390 ng/L), the effect on other indices were variable. Estrone exposure altered SSC, blood glucose, hematocrit, and hepatic and gonado-somatic index in 1 of 4 experiments, while it decreased body condition factor in 3 of 4 experiments. At the concentrations tested, no main effect differences (P < 0.05) were found associated with DO or sodium chloride treatments, except in one experiment low DO resulted in a decrease in secondary sex characteristic score (SSC). The combination of DO or sodium chloride and E1 altered blood glucose in one experiment each. These results indicate the variability of fathead minnow response to estrone, even within the confines of controlled laboratory conditions.*

Fellman, J. B., D'Amore, D. V., Hood, E., & Cunningham, P. (2017). Vulnerability of wetland soil carbon stocks to climate warming in the perhumid coastal temperate rainforest. *Biogeochemistry, 133*(2), 165-179. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016131187&doi=10.1007%2fs10533-017-0324-y&partnerID=40&md5=19856cb241b01e66358d13d5d095d0bf. doi:10.1007/s10533-017-0324-y
Research Tags: Soil, Water, Forestry
Abstract: *The perhumid coastal temperate rainforest (PCTR) of southeast Alaska has some of the densest soil organic carbon (SOC) stocks in the world (>300 Mg C ha−1) but the fate of this SOC with continued warming remains largely unknown. We quantified dissolved organic carbon (DOC) and carbon dioxide (CO2) yields from*

four different wetland types (rich fen, poor fen, forested wetland and cedar wetland) using controlled laboratory incubations of surface (10 cm) and subsurface (25 cm) soils incubated at 8 and 15 °C for 37 weeks. Furthermore, we used fluorescence characterization of DOC and laboratory bioassays to assess how climate-induced soil warming may impact the quality and bioavailability of DOC delivered to fluvial systems. Soil temperature was the strongest control on SOC turnover, with wetland type and soil depth less important in controlling CO2 flux and extractable DOC. The high temperature incubation increased average CO2 yield by ~40 and ~25% for DOC suggesting PCTR soils contain a sizeable pool of readily biodegradable SOC that can be mineralized to DOC and CO2 with future climate warming. Fluxes of CO2 were positively correlated to both extractable DOC and percent bioavailable DOC during the last few months of the incubation suggesting mineralization of SOC to DOC is a strong control of soil respiration rates. Whether the net result is increased export of either carbon form will depend on the balance between the land to water transport of DOC and the ability of soil microbial communities to mineralize DOC to CO2.

Fellows, A. W., Flerchinger, G. N., Lohse, K. A., & Seyfried, M. S. (2018). Rapid Recovery of Gross Production and Respiration in a Mesic Mountain Big Sagebrush Ecosystem Following Prescribed Fire. *Ecosystems, 21*(7), 1283-1294. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040684810&doi=10.1007%2fs10021-017-0218-9&partnerID=40&md5=542387e4bba73d4058b9d4761f8cfc71. doi:10.1007/s10021-017-0218-9

Research Tags: Weather, Grassland

Abstract: *The impact of land management actions such as prescribed fire remains a key uncertainty in understanding the spatiotemporal patterns of carbon cycling in the Western USA. We therefore quantified carbon exchange and aboveground carbon stocks following a prescribed fire in a mountain big sagebrush ecosystem located in the northern Great Basin, USA. Specifically, we examined the changes in plant functional type, leaf area index, standing aboveground carbon stocks, net ecosystem production (NEP), gross ecosystem production (GEP), and ecosystem-level respiration (Reco) for 2 years before and 7 of 9 years after a prescribed fire. Post-burn GEP and Reco exceeded pre-burn GEP and Reco within 2 years and remained elevated. The variation in GEP and Reco provided no evidence of a large and prolonged net efflux of carbon in the 9 years after the fire. Rather, NEP indicated the site was a sink before and after the fire, with little change in sink strength associated with the burn. Re-sprouting and recruitment of grasses and forbs drove the post-burn increase in GEP. Woody shrub growth was the dominant control on aboveground biomass accumulation after fire, with shrub aboveground biomass reaching ~ 11% of pre-burn biomass after 5 years. The rapid recovery of GEP and the growth of mid-successional shrubs suggest ecosystem-level carbon fluxes and stocks can recover rapidly after fire in mesic mountain big sagebrush ecosystems.*

Fellows, A. W., Flerchinger, G. N., Seyfried, M. S., Lohse, K. A., & Patton, N. R. (2019). Controls on gross production in an aspen–sagebrush vegetation mosaic. *Ecohydrology, 12*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054925822&doi=10.1002%2feco.2046&partnerID=40&md5=8a27064b59dd43c1c71f5520057e8581. doi:10.1002/eco.2046

Research Tags: Grassland

Abstract: *The critical zone (CZ; defined as the zone between the top of the vegetation canopy and the groundwater) mediates the impact of precipitation amount and timing on water availability and plant productivity. However, CZ structure, including soil and subsurface properties, are almost always unknown, leading to considerable uncertainty in the links between precipitation, plant water availability, and gross production. Using multiyear records of gross ecosystem CO2 exchange (GEE), micrometeorology, and streamflow, we examined the sensitivity of GEE to environmental controls in a sagebrush shrubland and an aspen forest. The sites were within 500 m of each other and had similar precipitation and temperature but marked differences in CZ structure. Cumulative growing season GEE was approximately two times greater at the aspen compared with the sagebrush, underscoring the importance of CZ properties in structuring spatial "hot spots" for carbon cycling. Larger soil water holding capacity and topography that produced lateral subsurface flow to the aspen enabled marked difference in plant functional type. Annual variability in growing season GEE within each site was not driven by annual precipitation; this lack of relationship was attributed to the CZ's limited ability to store water and an associated increase in water yield. Instead, both seasonal timing and cumulative growing season GEE for the sagebrush varied with spring and summer rain, whereas aspen GEE* *responded to spring snowpack conditions. These results emphasized how mapping and understanding CZ structure will help predict the spatial variability in plant functional type and temporal sensitivity of growing season GEE.*

Fellows, A. W., & Goulden, M. L. (2017). Mapping and understanding dry season soil water drawdown by California montane vegetation. *Ecohydrology, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84988382999&doi=10.1002%2feco.1772&partnerID=40&md5=03c8681cd320ba9b42117800d88572a6. doi:10.1002/eco.1772
Research Tags: Soil, Weather
Abstract: *The ability of soil to supply plant available water during dry periods is a poorly understood but critically important ecosystem property that affects vegetation health and regional hydrology. We estimated and analyzed the cumulative dry season drawdown of soil water across montane California using a spatially resolved water balance model that combined field, meteorological, and remote sensing observations. Dry season soil water drawdown varied markedly with elevation, increasing from <200 mm/yr below 500 m, to ~425 mm/yr at 1000 to 2000 m, before decreasing to <200 mm/yr above ~3000 m. Soil water drawdown was comparatively low at drier (mean annual precipitation < 1000 mm/yr) or colder (mean annual temperature < 4°C) locations; soil water drawdown was greater at wetter and warmer locations, including conifer forests. The reduced soil water drawdown at low-elevation dry locations may reflect inadequate precipitation to recharge the soil; the reduced water drawdown at high, cold locations presumably reflects limited storage capacity or sparse vegetation development. Soil water drawdown was reduced at locations that were glaciated during the Pleistocene and was only weakly related to rock type. The amount of soil water drawdown implies that many California ecosystems are deeply rooted, with conifer forest rooting to at least 3.6 m. Deep rooting allows many California ecosystems to limit current summer moisture limitation and suggests some of these ecosystems may be able to also limit future increased moisture stress with climate warming if they are able to support increased evaporative demand by further tapping belowground moisture.*

Felsmann, K., Baudis, M., Kayler, Z. E., Puhlmann, H., Ulrich, A., & Gessler, A. (2018). Responses of the structure and function of the understory plant communities to precipitation reduction across forest ecosystems in Germany. *Annals of Forest Science, 75*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039076119&doi=10.1007%2fs13595-017-0681-7&partnerID=40&md5=b7e124b76084b08ca5c5f0bd6d234699. doi:10.1007/s13595-017-0681-7
Research Tags: Forestry
Abstract: *Key message*
Understory plant communities are essential for the recruitment of trees making up future forests. Independent of plant diversity, the understory across different forest ecosystems shows considerable physiological acclimation and structural stability towards drought events, which are expected to occur more frequently in future.
Context
Understory plant communities are essential for the recruitment of trees making up the future forest. It is so far poorly understood how climate change will affect understory in beech and conifer forests managed at different intensity levels.
Aims
We hypothesized that drought would affect transpiration and carbon isotope discrimination but not species richness and diversity. Moreover, we assumed that forest management intensity will modify the responses to drought of the understory community.
Methods
We set up roofs in forests with a gradient of management intensities (unmanaged beech—managed beech—intensively managed conifer forests) in three regions across Germany. A drought event close to the 2003 drought was imposed in two consecutive years.
Results
After 2 years, the realized precipitation reduction was between 27% and 34%. The averaged water content in the top 20 cm of the soil under the roof was reduced by 2% to 8% compared with the control. In the 1st year, leaf level transpiration was reduced for different functional groups, which scaled to community transpiration

modified by additional effects of drought on functional group leaf area. Acclimation effects in most functional groups were observed in the 2nd year.
Conclusion
Forest understory shows high plasticity at the leaf and community level, and high structural stability to changing climate conditions with drought events.

Feng, X., Uriarte, M., González, G., Reed, S., Thompson, J., Zimmerman, J. K., & Murphy, L. (2018). Improving predictions of tropical forest response to climate change through integration of field studies and ecosystem modeling. *Global Change Biology, 24*(1), e213-e232. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030153161&doi=10.1111%2fgcb.13863&partnerID=40&md5=ac740393be30b058321c428eb4b63ef1. doi:10.1111/gcb.13863
Research Tags: Forestry
Abstract: *Tropical forests play a critical role in carbon and water cycles at a global scale. Rapid climate change is anticipated in tropical regions over the coming decades and, under a warmer and drier climate, tropical forests are likely to be net sources of carbon rather than sinks. However, our understanding of tropical forest response and feedback to climate change is very limited. Efforts to model climate change impacts on carbon fluxes in tropical forests have not reached a consensus. Here, we use the Ecosystem Demography model (ED2) to predict carbon fluxes of a Puerto Rican tropical forest under realistic climate change scenarios. We parameterized ED2 with species-specific tree physiological data using the Predictive Ecosystem Analyzer workflow and projected the fate of this ecosystem under five future climate scenarios. The model successfully captured interannual variability in the dynamics of this tropical forest. Model predictions closely followed observed values across a wide range of metrics including aboveground biomass, tree diameter growth, tree size class distributions, and leaf area index. Under a future warming and drying climate scenario, the model predicted reductions in carbon storage and tree growth, together with large shifts in forest community composition and structure. Such rapid changes in climate led the forest to transition from a sink to a source of carbon. Growth respiration and root allocation parameters were responsible for the highest fraction of predictive uncertainty in modeled biomass, highlighting the need to target these processes in future data collection. Our study is the first effort to rely on Bayesian model calibration and synthesis to elucidate the key physiological parameters that drive uncertainty in tropical forests responses to climatic change. We propose a new path forward for model-data synthesis that can substantially reduce uncertainty in our ability to model tropical forest responses to future climate.*

Fernandez, C. W., Heckman, K., Kolka, R., & Kennedy, P. G. (2019). Melanin mitigates the accelerated decay of mycorrhizal necromass with peatland warming. *Ecology Letters, 22*(3), 498-505. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059523618&doi=10.1111%2fele.13209&partnerID=40&md5=6bb76c2cf059f47c7723c0434f7b28b6. doi:10.1111/ele.13209
Research Tags: Soil
Abstract: *Despite being a significant input into soil carbon pools of many high-latitude ecosystems, little is known about the effects of climate change on the turnover of mycorrhizal fungal necromass. Here, we present results from the first experiment examining the effects of climate change on the long-term decomposition of mycorrhizal necromass, utilising the Spruce and Peatland Response Under Changing Environments (SPRUCE) experiment. Warming significantly increased necromass decomposition rates but was strongest in normally submerged microsites where warming caused water table drawdown. Necromass chemistry exerted the strongest control on the decomposition, with initial nitrogen content strongly predicting early decay rates (3 months) and initial melanin content determining mass remaining after 2 years. Collectively, our results suggest that as global temperatures rise, variation in species biochemical traits as well as microsites where mycorrhizal necromass is deposited will determine how these important inputs contribute to the belowground storage of carbon in boreal peatlands.*

Ferrero, R., Lima, M., Davis, A. S., & Gonzalez-Andujar, J. L. (2017). Weed diversity affects soybean and maize yield in a long term experiment in Michigan, USA. *Frontiers in Plant Science, 8*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014810646&doi=10.3389%2ffpls.2017.00236&partnerID=40&md5=d185e0a1f2eb2ad5fab5db0886f9e923. doi:10.3389/fpls.2017.00236

Research Tags: Crops
Abstract: *Managing production environments in ways that promote weed community diversity may enhance both crop production and the development of a more sustainable agriculture. This study analyzed data of productivity of maize (corn) and soybean in plots in the Main Cropping System Experiment (MCSE) at the W. K. Kellogg Biological Station Long-Term Ecological Research (KBS-LTER) in Michigan, USA, from 1996 to 2011. We used models derived from population ecology to explore how weed diversity, temperature, and precipitation interact with crop yields. Using three types of models that considered internal and external (climate and weeds) factors, with additive or non-linear variants, we found that changes in weed diversity were associated with changes in rates of crop yield increase over time for both maize and soybeans. The intrinsic capacity for soybean yield increase in response to the environment was greater under more diverse weed communities. Soybean production risks were greatest in the least weed diverse systems, in which each weed species lost was associated with progressively greater crop yield losses. Managing for weed community diversity, while suppressing dominant, highly competitive weeds, may be a helpful strategy for supporting long term increases in soybean productivity. In maize, there was a negative and non-additive response of yields to the interaction between weed diversity and minimum air temperatures. When cold temperatures constrained potential maize productivity through limited resources, negative interactions with weed diversity became more pronounced. We suggest that: (1) maize was less competitive in cold years allowing higher weed diversity and the dominance of some weed species; or (2) that cold years resulted in increased weed richness and prevalence of competitive weeds, thus reducing crop yields. Therefore, we propose to control dominant weed species especially in the years of low yield and extreme minimum temperatures to improve maize yields. Results of our study indicate that through the proactive management of weed diversity, it may be possible to promote both high productivity of crops and environmental sustainability.*

Fettig, C. J., Mortenson, L. A., Bulaon, B. M., & Foulk, P. B. (2019). Tree mortality following drought in the central and southern Sierra Nevada, California, U.S. *Forest Ecology and Management, 432*, 164-178. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053451938&doi=10.1016%2fj.foreco.2018.09.006&partnerID=40&md5=866e2a3c867c2616bb552a16c974bda4. doi:10.1016/j.foreco.2018.09.006
Research Tags: Weather, Forestry
Abstract: *Much of California, U.S. experienced a severe drought in 2012–2015 inciting a large tree mortality event in the central and southern Sierra Nevada. We assessed causal agents and rates of tree mortality, and short-term impacts to forest structure and composition based on a network of 11.3-m fixed-radius plots installed within three elevation bands on the Eldorado, Stanislaus, Sierra and Sequoia National Forests (914–1219, 1219–1524 and 1524–1829 m on the Eldorado, Stanislaus, Sierra; 1219–1524, 1524–1829, and 1829–2134 m on the Sequoia), where tree mortality was most severe. About 48.9% of trees died between 2014 and 2017. Tree mortality ranged from 46.1 ± 3.3% on the Eldorado National Forest to 58.7 ± 3.7% on the Sierra National Forest. Significantly higher levels of tree mortality occurred in the low elevation band (60.4 ± 3.0%) compared to the high elevation band (46.1 ± 2.9%). Ponderosa pine, Pinus ponderosa Dougl. ex Laws., exhibited the highest levels of tree mortality (89.6%), with 39.4% of plots losing all P. ponderosa. Mortality of P. ponderosa was highest at the lowest elevations, concentrated in larger-diameter trees, and attributed primarily to colonization by western pine beetle, Dendroctonus brevicomis LeConte. About 89% of P. ponderosa in the three largest diameter classes were killed, representing loss of an important structural component of these forests with implications to wildlife species of conservation concern. Sugar pine, P. lambertiana Dougl., exhibited the second highest levels of tree mortality (48.1%). Mortality of P. lambertiana was concentrated in the mid-diameter classes and attributed primarily to colonization by mountain pine beetle, D. ponderosae Hopkins. White fir, Abies concolor (Gord. & Glend.) Lindl. ex Hildebr., and incense cedar, Calocedrus decurrens (Torr.) Florin, exhibited 26.3% and 23.2% mortality, respectively. Only one Quercus died. Tree mortality (numbers of trees killed) was positively correlated with tree density and slope. A time lag was observed between the occurrence of drought and the majority of tree mortality. Tree regeneration (seedlings and saplings) was dominated by C. decurrens and Quercus spp., representing a potential long-term shift in composition from forests that were dominated by P. ponderosa. About 22.2% of plots contained plant species considered invasive, including cheatgrass, Bromus tectorum L., ripgut brome, Bromus diandrus Roth, bull thistle, Cirsium vulgare (Savi) Ten., and yellow star-thistle, Centaura solstitialis L. The implications of these and other results to recovery and management of drought-impacted forests in the central and southern Sierra Nevada are discussed.*

Fidel, R. B., Laird, D. A., & Parkin, T. B. (2017). Impact of six lignocellulosic biochars on C and N dynamics of two contrasting soils. *GCB Bioenergy, 9*(7), 1279-1291. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019855780&doi=10.1111%2fgcbb.12414&partnerID=40&md5=35f32b38218c431f9754cba1280575fa. doi:10.1111/gcbb.12414

Research Tags: Soil

Abstract: *Both soil and biochar properties are known to influence greenhouse gas emissions from biochar-amended soils, but poor understanding of underlying mechanisms challenges prediction and modeling. Here, we examine the effect of six lignocellulosic biochars produced from the pyrolysis of corn stover and wood feedstocks on CO2 and N2O emissions from soils collected from two bioenergy cropping systems. Effects of biochar on total accumulated CO2-C emissions were minimal (<0.45 mg C g−1 soil; <10% of biochar C), consistent with mineralization and hydrolysis of small labile organic and inorganic C fractions in the studied biochars. Comparisons of soil CO2 emissions with emissions from microbially inoculated quartz–biochar mixtures ('quartz controls') provide evidence of soil and biochar-specific negative priming. Five of six biochar amendments suppressed N2O emissions from at least one soil, and the magnitude of N2O emissions suppression varied with respect to both biochar and soil types. Biochar amendments consistently decreased final soil NO3− concentrations, while contrasting effects on pH, NH4+, and DOC highlighted the potential for formation of anaerobic microsites in biochar-amended soils and consequential shifts in the soil redox environment. Thus, results implicated both reduced substrate availability and redox shifts as potential factors contributing to N2O emission suppression. More research is needed to confirm these mechanisms, but overall our results suggest that soil biochar amendments commonly reduce N2O emissions and have little effect on CO2 emissions beyond the mineralization and/or hydrolysis of labile biochar C fractions. Considering the large C credit for the biochar C, we conclude that biochar amendments can reduce greenhouse gas emissions and enhance the climate change mitigation potential of bioenergy cropping systems.*

Finley, J. W., Dimick, D., Marshal, E., Nelson, G. C., Mein, J. R., & Gustafson, D. I. (2017). Nutritional sustainability: Aligning priorities in nutrition and public health with agricultural production. *Advances in Nutrition, 8*(5), 780-788. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029513390&doi=10.3945%2fan.116.013995&partnerID=40&md5=151e0f99dafd626dbe9ae28cc7631306. doi:10.3945/an.116.013995

Research Tags: Research

Abstract: *Nutrition science–based dietary advice urges changes that may have a great impact on agricultural systems. For example, the 2016 Dietary Guidelines for Americans (DGA) recommends greatly increased fruit and vegetable consumption, but the present domestic production is insufficient to accommodate large-scale adoption of these guidelines. Increasing production to the extent needed to meet the DGA will necessitate changes in an already stressed agriculture and food system and will require nutrition and agriculture professionals to come together in open and collegial discourse. All involved need to understand the stress placed on the food system by increasing populations, changing diets, and changing environments, and recognize the major diet-based public health challenges. Furthermore, there is a need to understand the intricate interplay of the myriad parts of the food system and the vast amount of work necessary to make even small changes. New systems approaches are needed, especially at the research level, where nutrition, public health, agriculture, and the food industry work together to solve interconnected problems. Future well-being depends on a sustainable food system that continues to deliver optimal health with minimal impact on the environment.*

Finley, K., & Zhang, J. (2019). Climate effect on ponderosa pine radial growth varies with tree density and shrub removal. *Forests, 10*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068834767&doi=10.3390%2ff10060477&partnerID=40&md5=5b1428d213b325769ce23b9c9cf46cdc. doi:10.3390/f10060477

Research Tags: Forestry

Abstract: *With increasing temperatures and projected changes in moisture availability for the Mediterranean climate of northern California, empirical evidence of the long-term responses of forests to climate are important for managing these ecosystems. We can assess forest treatment strategies to improve climate* *resilience by examining past responses to climate for both managed and unmanaged plantations. Using an experimental, long-term density and shrub removal study of ponderosa pine (Pinus ponderosa Lawson & C. Lawson) on a poor-quality site with low water-holding capacity and high runoff of the North Coastal mountain range in California, we examined the relationships between radial growth and climate for these trees over a common interval of 1977–2011. Resistance indices, defined here as the ratio between current year radial growth and the performance of the four previous years, were correlated to climatic variables during the same years. We found that all treatments' radial growth benefited from seasonal spring moisture availability during the current growing year. Conversely, high spring and early summer temperatures had detrimental effects on growth. High-density treatments with manzanita understories were sensitive to summer droughts while lower densities and treatments with full shrub removal were not. The explanatory power of the climate regression models was generally more consistent for the same shrub treatments across the four different densities. The resistance indices for the lower density and complete shrub removal treatment groups were less dependent on previous years' climatic conditions. We conclude that, for ponderosa pine plantations with significant manzanita encroachment, understory removal and heavy thinning treatments increase subsequent growth for remaining trees and decrease sensitivity to climate.*

Fisher, B., Herrera, D., Adams, D., Fox, H. E., Gallagher, L., Gerkey, D., . . . Ricketts, T. (2019). Can nature deliver on the sustainable development goals? *The Lancet Planetary Health, 3*(3), e112-e113. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063077641&doi=10.1016%2fS2542-5196%2818%2930281-X&partnerID=40&md5=e647fe4e07b3d783711885dd3b4e7c33. doi:10.1016/S2542-5196(18)30281-X
Research Tags:
No Abstract:

Fisher, J. B., Melton, F., Middleton, E., Hain, C., Anderson, M., Allen, R., . . . Wood, E. F. (2017). The future of evapotranspiration: Global requirements for ecosystem functioning, carbon and climate feedbacks, agricultural management, and water resources. *Water Resources Research, 53*(4), 2618-2626. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017522729&doi=10.1002%2f2016WR020175&partnerID=40&md5=1142c59b7e3993502462edd7b8e3dfd5. doi:10.1002/2016WR020175
Research Tags: Weather
Abstract: *The fate of the terrestrial biosphere is highly uncertain given recent and projected changes in climate. This is especially acute for impacts associated with changes in drought frequency and intensity on the distribution and timing of water availability. The development of effective adaptation strategies for these emerging threats to food and water security are compromised by limitations in our understanding of how natural and managed ecosystems are responding to changing hydrological and climatological regimes. This information gap is exacerbated by insufficient monitoring capabilities from local to global scales. Here, we describe how evapotranspiration (ET) represents the key variable in linking ecosystem functioning, carbon and climate feedbacks, agricultural management, and water resources, and highlight both the outstanding science and applications questions and the actions, especially from a space-based perspective, necessary to advance them.*

Flanagan, D. C., Srivastava, A., & Frankenberger, J. R. (2018). *Evaluation of WEPP model performance with various climate inputs.* Paper presented at the ASABE 2018 Annual International Meeting.
Research Tags: Research, Soil, Water
Abstract: *The Water Erosion Prediction Project (WEPP) model is a process-based soil erosion prediction system that simulates natural processes affecting hydrologic and erosional responses of a location, slope, soil, and management system. The main drivers of these processes are storm precipitation depth, duration, and rainfall intensities. WEPP was initially released in 1995, with a national climate database containing information from over 2600 stations with various periods of record. In 2015, an updated database was developed containing about 2700 stations with the same 40-year period of record (1974-2013). The databases have been under evaluation for use by the Natural Resources Conservation Service (NRCS) as they implement WEPP in their field offices. As part of the WEPP model interface development for NRCS, the option to utilize PRISM (Parameter-elevation Relationships on Independent Slopes Model) information to supplement the weather*

station data has been provided. In this paper, we will explore the impacts of utilizing the 1995 database, 2015 database, and PRISM-adjusted values on predicted precipitation, runoff, and soil loss at a number of selected locations.

Flanagan, D. C., Srivastava, A., Frankenberger, J. R., Poore, J. K., & Widman, N. L. (2017). *Updated soil Conservation practice simulation with the WEPP model.* Paper presented at the 2017 ASABE Annual International Meeting.
Research Tags: Research, Soil, Water
Abstract: *The USDA Water Erosion Prediction Project (WEPP) model is a process-based soil erosion prediction simulation model that has been developed by the United States Department of Agriculture (USDA) since 1985. WEPP is a continuous simulation, distributed parameter, computer program that simulates important physical processes including infiltration, runoff, soil detachment by raindrops and shallow overland flow, soil detachment by excess flow shear stress in rills, sediment transport, and sediment deposition. It also contains plant growth, soil tillage disturbance, residue management, and residue decomposition components. Recently the USDA Natural Resources Conservation Service (NRCS) has moved to incorporate WEPP as the erosion prediction technology for use by their field offices in conservation planning activities. During the past two years, new web-based model interfaces have been developed, and additional changes have been incorporated into the WEPP science model to better accommodate the needs of NRCS in representing various soil conservation practices. The interfaces are linked to NRCS climate, soils, and land management databases, allowing for rapid and easy user selection and modification of input scenarios, model simulations, and interpretation of output results. This presentation will detail the most recent status of the WEPP model, interfaces, databases, and improved ways to represent important NRCS soil conservation practices.*

Flaounas, E., Kotroni, V., Lagouvardos, K., Klose, M., Flamant, C., & Giannaros, T. M. (2017). Sensitivity of the WRF-Chem (V3.6.1) model to different dust emission parametrisation: Assessment in the broader Mediterranean region. *Geoscientific Model Development, 10*(8), 2925-2945. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027249442&doi=10.5194%2fgmd-10-2925-2017&partnerID=40&md5=7427d779a65d582c5ebee0b2d93ca28b. doi:10.5194/gmd-10-2925-2017
Research Tags: Research
Abstract: *In this study we aim to assess the WRF-Chem model capacity to reproduce dust transport over the eastern Mediterranean. For this reason, we compare the model aerosol optical depth (AOD) outputs to observations, focusing on three key regions: North Africa, the Arabian Peninsula and the eastern Mediterranean. Three sets of four simulations have been performed for the 6-month period of spring and summer 2011. Each simulation set uses a different dust emission parametrisation and for each parametrisation, the dust emissions are multiplied with various coefficients in order to tune the model performance. Our assessment approach is performed across different spatial and temporal scales using AOD observations from satellites and ground-based stations, as well as from airborne measurements of aerosol extinction coefficients over the Sahara.*
Assessment over the entire domain and simulation period shows that the model presents temporal and spatial variability similar to observed AODs, regardless of the applied dust emission parametrisation. On the other hand, when focusing on specific regions, the model skill varies significantly. Tuning the model performance by applying a coefficient to dust emissions may reduce the model AOD bias over a region, but may increase it in other regions. In particular, the model was shown to realistically reproduce the major dust transport events over the eastern Mediterranean, but failed to capture the regional background AOD. Further comparison of the model simulations to airborne measurements of vertical profiles of extinction coefficients over North Africa suggests that the model realistically reproduces the total atmospheric column AOD. Finally, we discuss the model results in two sensitivity tests, where we included finer dust particles (less than 1 µm) and changed accordingly the dust bins' mass fraction.

Fleisher, D. H., Condori, B., Quiroz, R., Alva, A., Asseng, S., Barreda, C., . . . Woli, P. (2017). A potato model intercomparison across varying climates and productivity levels. *Global Change Biology, 23*(3), 1258-1281. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-84991777004&doi=10.1111%2fgcb.13411&partnerID=40&md5=fb05c86d145cc4ec61ad0c4eaa27841c. doi:10.1111/gcb.13411

Research Tags: Crops
Abstract: *A potato crop multimodel assessment was conducted to quantify variation among models and evaluate responses to climate change. Nine modeling groups simulated agronomic and climatic responses at low-input (Chinoli, Bolivia and Gisozi, Burundi)- and high-input (Jyndevad, Denmark and Washington, United States) management sites. Two calibration stages were explored, partial (P1), where experimental dry matter data were not provided, and full (P2). The median model ensemble response outperformed any single model in terms of replicating observed yield across all locations. Uncertainty in simulated yield decreased from 38% to 20% between P1 and P2. Model uncertainty increased with interannual variability, and predictions for all agronomic variables were significantly different from one model to another (P < 0.001). Uncertainty averaged 15% higher for low- vs. high-input sites, with larger differences observed for evapotranspiration (ET), nitrogen uptake, and water use efficiency as compared to dry matter. A minimum of five partial, or three full, calibrated models was required for an ensemble approach to keep variability below that of common field variation. Model variation was not influenced by change in carbon dioxide (C), but increased as much as 41% and 23% for yield and ET, respectively, as temperature (T) or rainfall (W) moved away from historical levels. Increases in T accounted for the highest amount of uncertainty, suggesting that methods and parameters for T sensitivity represent a considerable unknown among models. Using median model ensemble values, yield increased on average 6% per 100-ppm C, declined 4.6% per °C, and declined 2% for every 10% decrease in rainfall (for nonirrigated sites). Differences in predictions due to model representation of light utilization were significant (P < 0.01). These are the first reported results quantifying uncertainty for tuber/root crops and suggest modeling assessments of climate change impact on potato may be improved using an ensemble approach.*

Flint, C. G., Dai, X., Jackson-Smith, D., Endter-Wada, J., Yeo, S. K., Hale, R., & Dolan, M. K. (2017). Social and Geographic Contexts of Water Concerns in Utah. *Society and Natural Resources, 30*(8), 885-902. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009960719&doi=10.1080%2f08941920.2016.1264653&partnerID=40&md5=9204dd938c6e2e8566005c81e365fb6e. doi:10.1080/08941920.2016.1264653
Research Tags: Water
Abstract: *Public concerns about water issues are key considerations in responding to changing hydrologic conditions. Literature is mixed on the social profiles associated with resource-related risks. Using data from a household survey, we compare concerns about water shortage, climate change impacts on water supply, poor water quality, and flooding. We assess the combined influence of social and locational factors on each concern and variations across three valleys in northern Utah. Generalized linear mixed modeling is used, given the ordinal nature of most variables. Water shortage was the greatest concern, and female, older, nonwhite, and recreationally active respondents were generally more concerned about water issues than their counterparts. Education, income, and religious identity presented more complicated relationships with water concerns, with significant interaction effects with valley geography. This study has implications for improving public involvement in risk management and engendering support for future water policy and planning strategies to address these risks.*

Flitcroft, R., Clinton, P., & Christiansen, K. (2018). Adding to the toolbox for tidal-inundation mapping in estuarine areas. *Journal of Coastal Conservation, 22*(4), 745-753. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043686593&doi=10.1007%2fs11852-018-0605-1&partnerID=40&md5=e8787d5c6cdbe85939441bcbb92751ae. doi:10.1007/s11852-018-0605-1
Research Tags: Water, Research
Abstract: *In estuaries, land-surface and tidal elevation conspire to influence the amount of salt-water inundation in a specific location, ultimately affecting the distribution of estuary vegetation. Plants vary in their tolerances to salinity and inundation. Understanding even small changes in land-surface elevation at a site scale provides relevant information to managers seeking to design effective long-term restoration projects. Restoration of estuary habitats has been identified as a tool to mediate some anticipated effects of climate change, including flooding from sea-level rise, precipitation regimes, and storminess. Further, habitat restoration that is effective in the face of climate uncertainty is critical to the sustainable production of seafood and maintenance of ecosystem functions. We offer a simple method that links tidal elevations to upslope topography, allowing managers to determine where tidal inundation of upslope areas may occur. This method does not require complex modeling, rather we combine existing high-accuracy tide-gage information with*

LiDAR imagery. However, we found that if LiDAR is not flown at low tide, or at consistent tidal heights, it poses significant challenges in the interpretation of tidal elevations. Where LiDAR is consistently collected at low tide, this method of linking the tidal datum to upslope topography is not data-intensive, and does not require long-term data collection. Along with locally specific information, the types of map products that can be developed using this method should identify places that may be potentially vulnerable to salt-water inundation, along with places that may be effective migration corridors for marshes and other habitats.

Flitcroft, R., Lewis, S., Arismendi, I., Davis, C., Giannico, G., Penaluna, B., . . . Snyder, J. (2019). Using expressed behaviour of coho salmon (Oncorhynchus kisutch) to evaluate the vulnerability of upriver migrants under future hydrological regimes: Management implications and conservation planning. *Aquatic Conservation: Marine and Freshwater Ecosystems, 29*(7), 1083-1094. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061183225&doi=10.1002%2faqc.3014&partnerID=40&md5=dbb45ac492a117592b8b9a8f25ce2b24. doi:10.1002/aqc.3014
Research Tags: Wildlife
Abstract: *Globally, river systems have been extensively modified through alterations in riverscapes and flow regimes, reducing their capacity to absorb geophysical and environmental changes.*
In western North America and elsewhere, alterations in natural flow regimes and swimways through dams, levees, and floodplain development, work in concert with fire regime, forest management practices, as well as agriculture and urban development, to change recovery trajectories of river systems.
Hydroregime scenarios for coho salmon, Oncorhynchus kisutch (Walbaum, 1792), were investigated in Washington and Oregon, USA, where long-term records of discharge, water temperature, and upstream fish passage are available. This novel approach combines hydrological and ecological data in a single visualization, providing empirical foundations for understanding upstream behavioural movement and tolerances of native fishes.
The timing of coho salmon movement with respect to temperature and discharge were compared with scenarios representing possible future hydrological conditions associated with a changing climate.
This approach provides a framework for the study of future hydrological alterations in other locations, and can inform local and regional conservation planning, particularly in view of water management policy.
Management implications and recommendations for action that may expand the capacity of riverscapes to absorb perturbations are discussed.

Flitcroft, R. L., Arismendi, I., & Santelmann, M. V. (2019). A Review of Habitat Connectivity Research for Pacific Salmon in Marine, Estuary, and Freshwater Environments. *Journal of the American Water Resources Association, 55*(2), 430-441. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058168629&doi=10.1111%2f1752-1688.12708&partnerID=40&md5=233455ee1e003b59befdd4c9da1457d8. doi:10.1111/1752-1688.12708
Research Tags: Wildlife
Abstract: *Long-term conservation planning for diadromous fishes would benefit from a better understanding of both the role of connectivity among environments and habitat variability in the expression of life-history diversity. Most of the scientific knowledge on habitat fragmentation and connectivity has been developed in terrestrial systems in the discipline of landscape ecology. Research on habitat connectivity in aquatic systems (e.g., salmonid research that spans the spectrum of habitats from freshwater to the sea) is uncommon and largely focused on barriers to fish passage. Here, we present a review of the literature characterizing current research patterns on habitat connectivity within and among environments for Pacific salmon. We found this topic is still incipient: the literature is dominated by studies of freshwaters, with few articles focusing on habitat needs in estuary and marine systems. Pan-environment studies are rare, pointing to a gap in our understanding of complex habitat relationships that might be significant in the development of long-term conservation and restoration plans for Pacific salmon, particularly in light of the potential impact of climate change.*

Flower, C. E., Dalton, J. E., Whelan, C. J., Brown, J. S., & Gonzalez-Meler, M. A. (2019). Patch use in the arctic ground squirrel: effects of micro-topography and shrub encroachment in the Arctic Circle. *Oecologia, 190*(1), 243-254. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064847975&doi=10.1007%2fs00442-019-04400-5&partnerID=40&md5=070a736f5484feafe71382b78a50ddd1. doi:10.1007/s00442-019-04400-5

Research Tags: Wildlife, Grassland

Abstract: *We investigated the roles of vegetation structure, micro-topographic relief, and predator activity patterns (time of day) on the perception of predatory risk of arctic ground squirrels (Urocitellus parryii), an abundant pan-Arctic omnivore, in Arctic Circle tundra on the North Slope of Alaska, where tundra vegetation structure has been predicted to change in response to climate. We quantified foraging intensity by measuring the giving-up densities (GUDs) of the arctic ground squirrels in experimental foraging patches along a heath–graminoid–shrub moist tundra gradient. We hypothesized that foraging intensity of arctic ground squirrels would be greatest and GUDs lowest, where low-stature vegetation or raised micro-topography improves sightlines for predator detection. Furthermore, GUDs should vary with time of day and reflect 24-h cycles of varying predation risk. Foraging intensity varied temporally, being highest in the afternoon and lowest overnight. During the morning, foraging intensity was inversely correlated with the normalized difference vegetation index (NDVI), a proxy for vegetation productivity and cover. Foraging was additionally measured within landscapes of fear, confirming that vegetative and topographic obstructions of sightlines reduces foraging intensity and increases GUDs. We conclude that arctic ground squirrels may affect Arctic Circle vegetation of tundra ecosystems, but these effects will vary spatially and temporally.*

Follstad Shah, J. J., Kominoski, J. S., Ardón, M., Dodds, W. K., Gessner, M. O., Griffiths, N. A., . . . Zeglin, L. H. (2017). Global synthesis of the temperature sensitivity of leaf litter breakdown in streams and rivers. *Global Change Biology, 23*(8), 3064-3075. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013945742&doi=10.1111%2fgcb.13609&partnerID=40&md5=5e665d74eed5c52bb6072078f2fdfc0c. doi:10.1111/gcb.13609

Research Tags: Water

Abstract: *Streams and rivers are important conduits of terrestrially derived carbon (C) to atmospheric and marine reservoirs. Leaf litter breakdown rates are expected to increase as water temperatures rise in response to climate change. The magnitude of increase in breakdown rates is uncertain, given differences in litter quality and microbial and detritivore community responses to temperature, factors that can influence the apparent temperature sensitivity of breakdown and the relative proportion of C lost to the atmosphere vs. stored or transported downstream. Here, we synthesized 1025 records of litter breakdown in streams and rivers to quantify its temperature sensitivity, as measured by the activation energy (Ea, in eV). Temperature sensitivity of litter breakdown varied among twelve plant genera for which Ea could be calculated. Higher values of Ea were correlated with lower-quality litter, but these correlations were influenced by a single, N-fixing genus (Alnus). Ea values converged when genera were classified into three breakdown rate categories, potentially due to continual water availability in streams and rivers modulating the influence of leaf chemistry on breakdown. Across all data representing 85 plant genera, the Ea was 0.34 ± 0.04 eV, or approximately half the value (0.65 eV) predicted by metabolic theory. Our results indicate that average breakdown rates may increase by 5–21% with a 1–4 °C rise in water temperature, rather than a 10–45% increase expected, according to metabolic theory. Differential warming of tropical and temperate biomes could result in a similar proportional increase in breakdown rates, despite variation in Ea values for these regions (0.75 ± 0.13 eV and 0.27 ± 0.05 eV, respectively). The relative proportions of gaseous C loss and organic matter transport downstream should not change with rising temperature given that Ea values for breakdown mediated by microbes alone and microbes plus detritivores were similar at the global scale.*

Ford, K. R., Breckheimer, I. K., Franklin, J. F., Freund, J. A., Kroiss, S. J., Larson, A. J., . . . HilleRisLambers, J. (2017). Competition alters tree growth responses to climate at individual and stand scales. *Canadian Journal of Forest Research, 47*(1), 53-62. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031110918&doi=10.1139%2fcjfr-2016-0188&partnerID=40&md5=f1190b4db01ab562aeed041d0162ee94. doi:10.1139/cjfr-2016-0188

Research Tags: Forestry

Abstract: *Understanding how climate affects tree growth is essential for assessing climate change impacts on forests but can be confounded by effects of competition, which strongly influences tree responses to climate. We characterized the joint influences of tree size, competition, and climate on diameter growth using hierarchical*

Bayesian methods applied to permanent sample plot data from the montane forests of Mount Rainier National Park, Washington State, USA, which are mostly comprised of Abies amabilis Douglas ex Forbes, Tsuga heterophylla (Raf.) Sarg., Pseudotsuga menziesii (Mirb.) Franco, and Thuja plicata Donn ex D. Don. Individual growth was sensitive to climate under low but not high competition, likely because tree ability to increase growth under more favorable climates (generally greater energy availability) was constrained by competition, with important variation among species. Thus, climate change will likely increase individual growth most in uncrowded stands with lower competition. However, crowded stands have more and (or) larger trees, conferring greater capacity for aggregate absolute growth increases. Due to these contrasting effects, our models predicted that climate change will lead to greater stand-scale growth increases in stands with medium compared with low crowding but similar increases in stands with medium and high crowding. Thus, competition will mediate the impacts of climate change on individual- and stand-scale growth in important but complex ways.

Ford, K. R., Harrington, C. A., & St. Clair, J. B. (2017). Photoperiod cues and patterns of genetic variation limit phenological responses to climate change in warm parts of species' range: Modeling diameter-growth cessation in coast Douglas-fir. *Global Change Biology, 23*(8), 3348-3362. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017657826&doi=10.1111%2fgcb.13690&partnerID=40&md5=ec9a790902b75fb0441db34eb390d045. doi:10.1111/gcb.13690

Research Tags: Forestry

Abstract: *The phenology of diameter-growth cessation in trees will likely play a key role in mediating species and ecosystem responses to climate change. A common expectation is that warming will delay cessation, but the environmental and genetic influences on this process are poorly understood. We modeled the effects of temperature, photoperiod, and seed-source climate on diameter-growth-cessation timing in coast Douglas-fir (an ecologically and economically vital tree) using high-frequency growth measurements across broad environmental gradients for a range of genotypes from different seed sources. Our model suggests that cool temperatures or short photoperiods can induce cessation in autumn. At cool locations (high latitude and elevation), cessation seems to be induced primarily by low temperatures in early autumn (under relatively long photoperiods), so warming will likely delay cessation and extend the growing season. But at warm locations (low latitude or elevation), cessation seems to be induced primarily by short photoperiods later in autumn, so warming will likely lead to only slight extensions of the growing season, reflecting photoperiod limitations on phenological shifts. Trees from seed sources experiencing frequent frosts in autumn or early winter tended to cease growth earlier in the autumn, potentially as an adaptation to avoid frost. Thus, gene flow into populations in warm locations with little frost will likely have limited potential to delay mean cessation dates because these populations already cease growth relatively late. In addition, data from an abnormal heat wave suggested that very high temperatures during long photoperiods in early summer might also induce cessation. Climate change could make these conditions more common in warm locations, leading to much earlier cessation. Thus, photoperiod cues, patterns of genetic variation, and summer heat waves could limit the capacity of coast Douglas-fir to extend its growing season in response to climate change in the warm parts of its range.*

Ford, P. L., Reeves, M. C., & Frid, L. (2019). A Tool for Projecting Rangeland Vegetation Response to Management and Climate. *Rangelands, 41*(1), 49-60. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059195995&doi=10.1016%2fj.rala.2018.10.010&partnerID=40&md5=bd467c9d3ecb8d91ec2d988532096382. doi:10.1016/j.rala.2018.10.010

Research Tags: Grassland

Abstract: *New technologies may enhance management by enabling quantitative testing of assumptions of vegetation response to climate and management. State-and-transition simulation models can keep track of interactions that are too complicated for us to comprehend using only conceptual models.*
This tool takes conceptual state-and-transition models to the next level, fostering greater communication and dialogue with stakeholders. Based on the models and climate data used here, increased drought may enhance transitions between vegetative states.
It is important to be as explicit and quantitative as possible as to how you expect vegetation states or ecosystem processes to transition between one another.

Formby, J. P., Rodgers, J. C., Koch, F. H., Krishnan, N., Duerr, D. A., & Riggins, J. J. (2018). Cold tolerance and invasive potential of the redbay ambrosia beetle (Xyleborus glabratus) in the eastern United States. *Biological Invasions, 20*(4), 995-1007. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032344256&doi=10.1007%2fs10530-017-1606-y&partnerID=40&md5=88ef4e66fefd15a2c6dc29f59f3ef96c. doi:10.1007/s10530-017-1606-y

Research Tags: Wildlife, Forestry

Abstract: *Native Lauraceae (e.g. sassafras, redbay) in the southeastern USA are being severely impacted by laurel wilt disease, which is caused by the pathogen Raffaelea lauricola T. C. Harr., Fraedrich and Aghayeva, and its symbiotic vector, the redbay ambrosia beetle (Xyleborus glabratus Eichhoff). Cold temperatures are currently the only viable limitation to the establishment of X. glabratus in northern populations of sassafras. The observed lower lethal temperature of X. glabratus (− 10.0 °C) is warmer than its supercooling point (− 22.0 °C), indicating the beetle is a freeze intolerant and chill susceptible species. Empirically derived X. glabratus lower lethal temperature thresholds were combined with host distribution and microhabitat-corrected climate data to produce species distribution models for X. glabratus in the eastern USA. Macroclimate data (30-year mean annual minimum temperature) were corrected (− 1.2 °C) to account for thermal buffering afforded to X. glabratus while living inside sassafras trees. Only 0.1% of the current US sassafras spatial extent experiences sufficiently harsh winters (locales where mean annual minimum winter temperatures ≤ − 6.2 °C for ≥ 12 h) to exclude X. glabratus establishment in our species distribution model. Minimum winter temperatures will likely cause some X. glabratus mortality in ~ 52% of the current spatial extent of sassafras, although current data do not allow a quantification of X. glabratus mortality in this zone. Conversely, ~ 48% of the current spatial extent of sassafras is unlikely to experience sufficiently cold winter temperatures to cause any significant impediment to X. glabratus spread or establishment. A modest climate change scenario (RCP4.5) of + 1.4 °C would result in 91% of the current spatial extent of sassafras in the eastern USA occurring where winter minimum temperatures are unlikely to cause any mortality to X. glabratus.*

Foster, A. C., Shuman, J. K., Shugart, H. H., Dwire, K. A., Fornwalt, P. J., Sibold, J., & Negron, J. (2017). Validation and application of a forest gap model to the southern Rocky Mountains. *Ecological Modelling, 351*, 109-128. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015032197&doi=10.1016%2fj.ecolmodel.2017.02.019&partnerID=40&md5=147509191b5072578aaddc33458aa642. doi:10.1016/j.ecolmodel.2017.02.019

Research Tags: Forestry

Abstract: *Rocky Mountain forests are highly important for their part in carbon cycling and carbon storage as well as ecosystem services such as water retention and storage and recreational values. These forests are shaped by complex interactions among vegetation, climate, and disturbances. Thus, climate change and shifting disturbances may lead to significant changes in species composition and biomass. Individual tree-based modeling allows various climate change scenarios and their effects on forest dynamics to be tested. We use an updated individual-based gap model, the University of Virginia Forest Model Enhanced (UVAFME) at four sites in the southern Rocky Mountains. UVAFME is quantitatively and qualitatively validated at these sites against inventory data and descriptions of vegetation zonation and successional dynamics. Results show that UVAFME can be used to reasonably simulate the expected change in species composition with elevation for the southern Rocky Mountains region. UVAFME output on size structure (stems size class−1 ha−1) and species-specific biomass (tonnes C ha−1) is comparable to forest inventory data at these locations. UVAFME can also simulate successional dynamics to accurately predict changes in species dominance with landscape age. We then perform a hypothetical climate sensitivity test in which temperature is first increased linearly by 2 °C over 100 years, stabilized for 200 years, cooled back to present climate values over 100 years, and again stabilized for 200 years. Results show that elevated temperatures within the southern Rocky Mountains may lead to decreases in biomass and shifts upslope in species composition, especially that of ponderosa pine (Pinus ponderosa), Douglas-fir (Pseudotsuga menziesii), and lodgepole pine (Pinus contorta). At some ecotones these changes are also likely to be fairly long lasting for at least 100 years. The results from these tests suggest that UVAFME and other individual-based gap models can be used to inform forest management and climate mitigation strategies for this region.*

Foster, A. C., Shuman, J. K., Shugart, H. H., & Negron, J. (2018). Modeling the interactive effects of spruce beetle

infestation and climate on subalpine vegetation. *Ecosphere, 9*(10). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055619079&doi=10.1002%2fecs2.2437&partnerID=40&md5=b453d97ec9aa76b502cba4f00264f710. doi:10.1002/ecs2.2437
Research Tags: Forestry, Wildlife
Abstract: *In the subalpine zone of the Rocky Mountains, climate change is predicted to result in an increase in the frequency and severity of spruce beetle outbreaks. Climate change itself may affect vegetation, potentially leading to changes in species composition. The direct and indirect effects of climate and disturbances on forest composition, biomass, and dynamics open the possibility for non-linear ecosystem responses. Modeling studies allow for the study of the interaction of these effects and their impact on the forest system. University of Virginia Forest Model Enhanced (UVAFME), an individual-based gap model that simulates forest dynamics and characteristics, is updated with a spruce beetle subroutine that calculates the probability for beetle infestation and potential mortality of each tree on a plot. The updated model is then run with multiple scenarios that combine beetle infestation with current or altered climate at sites across the southern Rocky Mountains. Results show that spruce beetle infestations acted to facilitate competition with invading lower-elevation species, resulting in an increase in the biomass of historically lower-elevation species and a further decline in Engelmann spruce biomass than occurred with solely bark beetle disturbance or solely climate change. We also found an initial enhancing effect between spruce beetle infestation and climate change; however, by the end of 100 yr of climate change and potential beetle infestation, climate had a dampening effect on spruce beetle infestation, through loss of host trees. These results are an important step in understanding the possible futures for vegetation of the Rocky Mountains as well as for spruce forests across the western United States and Canada.*

Fowler, J. F., Overby, S., & Smith, B. (2018). La Sal Daisy, Erigeron mancus, Density and Associated Species from Treeline Ecotone and Alpine Habitats. *Western North American Naturalist, 78*(2), 184-194. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052551385&doi=10.3398%2f064.078.0209&partnerID=40&md5=392c60b1ef27f55f6a3c28e98cb8a291. doi:10.3398/064.078.0209
Research Tags: Grassland
Abstract: *The La Sal daisy, Erigeron mancus, is endemic to treeline ecotone and alpine meadow habitats of the La Sal Mountains in Utah, an insular, laccolithic mountain range on the Colorado Plateau in southeastern Utah. From 2009 to 2011 we established elevational transects through upper spruce-fir forest, treeline ecotone, and alpine meadow habitats on Laurel Ridge in the Middle Mountain group of the La Sal Mountains to measure (1) periodic changes in E. mancus population density, (2) changes in the elevation of the E. mancus population centroid, (3) changes in patch size occupied by E. mancus, and (4) changes in frequency of occurrence in herbaceous plant species associated with E. mancus along these transects. We measured both E. mancus density and vascular plant species composition within 1-m × 1-m square frames in mid-July, near peak alpine plant flowering time. The E. mancus population density on Mt. Laurel ridge did not significantly change from 2009 to 2015, but the species was most abundant in alpine meadow habitat for both years. Changes in patch width, centroid elevation, and frequency of occurrence of 30 associated plant species were also not statistically significant. Like E. mancus, most species show changes in frequency of occurrence between upper spruce-fir forest, treeline ecotone, and alpine meadow habitats. Individual plants of E. mancus are probably long-lived perennials, so changes in population density and distribution due to global warming are expected to be gradual and/or have an unknown lag time. Although there is no evidence of ongoing change in the Laurel Ridge population of E. mancus, having this information will provide a solid statistical basis for determining significant future changes.*

Frank, A., Howe, G. T., Sperisen, C., Brang, P., Clair, J. B. S., Schmatz, D. R., & Heiri, C. (2017). Risk of genetic maladaptation due to climate change in three major European tree species. *Global Change Biology, 23*(12), 5358-5371. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034099917&doi=10.1111%2fgcb.13802&partnerID=40&md5=2e77ae9c3800b2e0275e10bfdd7b4a5b. doi:10.1111/gcb.13802
Research Tags: Forestry
Abstract: *Tree populations usually show adaptations to their local environments as a result of natural selection. As climates change, populations can become locally maladapted and decline in fitness. Evaluating the*

expected degree of genetic maladaptation due to climate change will allow forest managers to assess forest vulnerability, and develop strategies to preserve forest health and productivity. We studied potential genetic maladaptation to future climates in three major European tree species, Norway spruce (Picea abies), silver fir (Abies alba), and European beech (Fagus sylvatica). A common garden experiment was conducted to evaluate the quantitative genetic variation in growth and phenology of seedlings from 77 to 92 native populations of each species from across Switzerland. We used multivariate genecological models to associate population variation with past seed source climates, and to estimate relative risk of maladaptation to current and future climates based on key phenotypic traits and three regional climate projections within the A1B scenario. Current risks from climate change were similar to average risks from current seed transfer practices. For all three climate models, future risks increased in spruce and beech until the end of the century, but remained low in fir. Largest average risks associated with climate projections for the period 2061–2090 were found for spruce seedling height (0.64), and for beech bud break and leaf senescence (0.52 and 0.46). Future risks for spruce were high across Switzerland. However, areas of high risk were also found in drought-prone regions for beech and in the southern Alps for fir. Genetic maladaptation to future climates is likely to become a problem for spruce and beech by the end of this century, but probably not for fir. Consequently, forest management strategies should be adjusted in the study area for spruce and beech to maintain productive and healthy forests in the future.

Frank, A., Sperisen, C., Howe, G. T., Brang, P., Walthert, L., Clair, J. B. S., & Heiri, C. (2017). Distinct genecological patterns in seedlings of Norway spruce and silver fir from a mountainous landscape. *Ecology, 98*(1), 211-227. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008180735&doi=10.1002%2fecy.1632&partnerID=40&md5=42ea4bc5f4de1c688269d32c862feb6b. doi:10.1002/ecy.1632

Research Tags: Forestry

Abstract: *Understanding the genecology of forest trees is critical for gene conservation, for predicting the effects of climate change and climate change adaptation, and for successful reforestation. Although common genecological patterns have emerged, species-specific details are also important. Which species are most vulnerable to climate change? Which are the most important adaptive traits and environmental drivers of natural selection? Even though species have been classified as adaptive specialists vs. adaptive generalists, large-scale studies comparing different species in the same experiment are rare. We studied the genecology of Norway spruce (Picea abies) and silver fir (Abies alba), two co-occurring but ecologically distinct European conifers in Central Europe. For each species, we collected seed from more than 90 populations across Switzerland, established a seedling common-garden test, and developed genecological models that associate population variation in seedling growth and phenology to climate, soil properties, and site water balance. Population differentiation and associations between seedling traits and environmental variables were much stronger for Norway spruce than for silver fir, and stronger for seedling height growth than for bud phenology. In Norway spruce, height growth and second flushing were strongly associated with temperature and elevation, with seedlings from the lowlands being taller and more prone to second flush than seedlings from the Alps. In silver fir, height growth was more weakly associated with temperature and elevation, but also associated with water availability. Soil characteristics explained little population variation in both species. We conclude that Norway spruce has become an adaptive specialist because trade-offs between rapid juvenile growth and frost avoidance have subjected it to strong diversifying natural selection based on temperature. In contrast, because silver fir has a more conservative growth habit, it has evolved to become an adaptive generalist. This study demonstrates that co-occurring tree species can develop very different adaptive strategies under identical environmental conditions, and suggests that Norway spruce might be more vulnerable to future maladaptation due to rapid climate change than silver fir.*

Franklin, J., Andrade, R., Daniels, M. L., Fairbairn, P., Fandino, M. C., Gillespie, T. W., . . . Vennetier, M. (2018). Geographical ecology of dry forest tree communities in the West Indies. *Journal of Biogeography, 45*(5), 1168-1181. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043369635&doi=10.1111%2fjbi.13198&partnerID=40&md5=983f82fb51507703b7120cfaec5afee6. doi:10.1111/jbi.13198

Research Tags: Forestry

Abstract: *Aim*
Seasonally dry tropical forest (SDTF) of the Caribbean Islands (primarily West Indies) is floristically distinct from Neotropical SDTF in Central and South America. We evaluate whether tree species composition was associated with climatic gradients or geographical distance. Turnover (dissimilarity) in species composition of different islands or among more distant sites would suggest communities structured by speciation and dispersal limitations. A nested pattern would be consistent with a steep resource gradient. Correlation of species composition with climatic variation would suggest communities structured by broad-scale environmental filtering.
Location
The West Indies (The Bahamas, Cuba, Hispaniola, Jamaica, Puerto Rico, US Virgin Islands, Guadeloupe, Martinique, St. Lucia), Providencia (Colombia), south Florida (USA) and Florida Keys (USA).
Taxon
Seed plants—woody taxa (primarily trees).
Methods
We compiled 572 plots from 23 surveys conducted between 1969 and 2016. Hierarchical clustering of species in plots, and indicator species analysis for the resulting groups of sites, identified geographical patterns of turnover in species composition. Nonparametric analysis of variance, applied to principal components of bioclimatic variables, determined the degree of covariation in climate with location. Nestedness versus turnover in species composition was evaluated using beta diversity partitioning. Generalized dissimilarity modelling partitioned the effect of climate versus geographical distance on species composition.
Results
Despite a set of commonly occurring species, SDTF tree community composition was distinct among islands and was characterized by spatial turnover on climatic gradients that covaried with geographical gradients. Greater Antillean islands were characterized by endemic indicator species. Northern subtropical areas supported distinct, rather than nested, SDTF communities in spite of low levels of endemism.
Main conclusions
The SDTF species composition was correlated with climatic variation. SDTF on large Greater Antillean islands (Hispaniola, Jamaica and Cuba) was characterized by endemic species, consistent with their geological history and the biogeography of plant lineages. These results suggest that both environmental filtering and speciation shape Caribbean SDTF tree communities.

Franzluebbers, A. J., Chappell, J. C., Shi, W., & Cubbage, F. W. (2017). Greenhouse gas emissions in an agroforestry system of the southeastern USA. *Nutrient Cycling in Agroecosystems, 108*(1), 85-100. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84994453224&doi=10.1007%2fs10705-016-9809-7&partnerID=40&md5=9c550b4efbd38d9751cc0551561fdbff. doi:10.1007/s10705-016-9809-7

Research Tags: Forestry, Emissions

Abstract: *Agroforestry systems may provide diverse ecosystem services and economic benefits that conventional agriculture cannot, e.g. potentially mitigating greenhouse gas emissions by enhancing nutrient cycling, since tree roots can capture nutrients not taken up by crops. However, greenhouse gas emission data from agroforestry systems are not available in the southeastern USA, thus limiting our ability to optimize agroforestry management strategies for the region. We hypothesized that tree-crop interactions could prevent excess N from being released to the atmosphere as nitrous oxide (N2O). We determined N2O and carbon dioxide (CO2) emissions, soil temperature, water content, and surface-soil inorganic N in an 8-year-old agroforestry site at the Center for Environmental Farming Systems in Goldsboro, North Carolina, USA. The experimental design was a factorial arrangement of soil texture (loamy sand, sandy loam, and clay loam) and canopy cover (cropped alley, margin between crops and trees, and under Pinus palustris, Pinus taeda, and Quercus pagoda) with three replications. Sampling occurred 42 times within a year using static, vented chambers exposed to the soil for 1-h periods. Soil N2O emission was lower under tree canopies than in cropped alleys, and margin areas were intermediate. Soil texture, water content, and inorganic N were key determinants of the magnitude of N2O emission. Soil CO2 emission was controlled by temperature and water content as expected, but surprisingly not by their interaction. Soil temperature was 1.8 ± 1.3 °C lower and soil water content was 0.043 ± 0.15 m3 m−3 lower under tree canopy than in cropped alleys, which helped to reduce CO2 emission under trees relative to that in cropped alleys. Our results provide a foundation for reducing*

greenhouse gas emissions in complex agricultural landscapes with varying soil texture by introducing timber production without abandoning agricultural operations.

Fraterrigo, J. M., Ream, K., & Knoepp, J. D. (2018). Tree Mortality From Insect Infestation Enhances Carbon Stabilization in Southern Appalachian Forest Soils. *Journal of Geophysical Research: Biogeosciences, 123*(7), 2121-2134. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050629180&doi=10.1029%2f2018JG004431&partnerID=40&md5=e686940d0a9884cbfe1e2bead3215d4c. doi:10.1029/2018JG004431
Research Tags: Soil, Forestry, Wildlife
Abstract: *Forest insect and pathogen outbreaks may exacerbate anthropogenic climate change if they accelerate soil carbon loss to the atmosphere. We quantified soil respiration and carbon content for nearly a decade after girdling or natural infestation of hemlock (Tsuga canadensis L. Carr., a codominant species in southern Appalachian forests) by hemlock woolly adelgid (Adelges tsugae) to improve understanding of soil carbon response to disturbance from forest insect and pathogens. From 2005 to 2013, net soil respiration was similar among hemlock mortality (~50% basal area reduction) and reference hardwood plots, but both girdled and hemlock woolly adelgid-infested plots showed greater activities of β-glucosidase (a cellulose-hydrolyzing extracellular enzyme), decreased O-horizon, and decreased fine root biomass. During this period, mineral soil carbon accumulated at a higher rate in hemlock mortality plots than in reference plots in both surface (0–10 cm) and subsurface (10–30 cm) soils, driven by increases in the mineral-associated fraction of the soil organic matter. In contrast, particulate organic matter (POM) carbon accrued slowly in surface soils and declined in the subsurface of girdled plots. δ13C values of the POM fraction demonstrate increased microbial processing of surface soil organic matter over time, suggesting enhanced decomposition of organic matter in this pool. These findings indicate that hemlock mortality in this system has led to enhanced soil carbon stabilization through the transformation and translocation of carbon from detrital and POM pools to the mineral-associated organic matter pool. Accelerated responses in the girdled versus naturally infested treatments highlight limitations associated with using girdling to simulate natural mortality.*

Frauendorf, T. C., MacKenzie, R. A., Tingley, R. W., Frazier, A. G., Riney, M. H., & El-Sabaawi, R. W. (2019). Evaluating ecosystem effects of climate change on tropical island streams using high spatial and temporal resolution sampling regimes. *Global Change Biology, 25*(4), 1344-1357. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061998000&doi=10.1111%2fgcb.14584&partnerID=40&md5=83ccc59f23be7fce0ec15ba65682793b. doi:10.1111/gcb.14584
Research Tags:
Abstract:

Frazier, A. G., Elison Timm, O., Giambelluca, T. W., & Diaz, H. F. (2018). The influence of ENSO, PDO and PNA on secular rainfall variations in Hawai'i. *Climate Dynamics, 51*(5-6), 2127-2140. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034223641&doi=10.1007%2fs00382-017-4003-4&partnerID=40&md5=c543ced9c8862502702452eae624485e. doi:10.1007/s00382-017-4003-4
Research Tags: Weather
Abstract: *Climate change is expected to alter precipitation patterns worldwide, which will affect streamflow in riverine ecosystems. It is vital to understand the impacts of projected flow variations, especially in tropical regions where the effects of climate change are expected to be one of the earliest to emerge. Space-for-time substitutions have been successful at predicting effects of climate change in terrestrial systems by using a spatial gradient to mimic the projected temporal change. However, concerns have been raised that the spatial variability in these models might not reflect the temporal variability. We utilized a well-constrained rainfall gradient on Hawaii Island to determine (a) how predicted decreases in flow and increases in flow variability affect stream food resources and consumers and (b) if using a high temporal (monthly, four streams) or a high spatial (annual, eight streams) resolution sampling scheme would alter the results of a space-for-time substitution. Declines in benthic and suspended resource quantity (10- to 40-fold) and quality (shift from macrophyte to leaf litter dominated) contributed to 35-fold decreases in macroinvertebrate biomass with predicted changes in the magnitude and variability in the flow. Invertebrate composition switched from caddisflies and damselflies to taxa with faster turnover rates (mosquitoes, copepods). Changes in resource and*

consumer composition patterns were stronger with high temporal resolution sampling. However, trends and ranges of results did not differ between the two sampling regimes, indicating that a suitable, well-constrained spatial gradient is an appropriate tool for examining temporal change. Our study is the first to investigate resource to community wide effects of climate change on tropical streams on a spatial and temporal scale. We determined that predicted flow alterations would decrease stream resource and consumer quantity and quality, which can alter stream function, as well as biomass and habitat for freshwater, marine, and terrestrial consumers dependent on these resources.

Frelich, L. E., Reich, P. B., & Peterson, D. W. (2017). The changing role of fire in mediating the relationships among oaks, grasslands, mesic temperate forests, and boreal forests in the Lake States. *Journal of Sustainable Forestry, 36*(5), 421-432. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014676105&doi=10.1080%2f10549811.2017.1296777&partnerID=40&md5=16815bbf0acead354dc3d536433f5f57. doi:10.1080/10549811.2017.1296777

Research Tags: Forestry, Grassland, Weather

Abstract: *Historically, oak forests and woodlands intergraded with southern boreal forest, temperate mesic forest, and grassland biomes, forming complex fire-mediated relationships in the Great Lakes region of Minnesota, Wisconsin, and Michigan, USA. Variability in fire recurrence intervals allowed oaks to mix with grasses or with mesic forest species in areas with high (2–10 yr) or moderate (several decades) fire frequencies, respectively. In the southern boreal forest, oak colonization was limited by cold climate. In recent decades former savannas have been largely converted to agricultural fields and the fate of oak remnants is controlled by human fire use. In mesic temperate forests, fire exclusion, wetter climate, and deer browsing have led to mesophication and increasing maple dominance. With ongoing warming, however, mesophication could reverse due to increased drought and fire frequency, and earthworm invasion, which enhances the understory environment for oak seedlings. Oaks are also likely to invade large tracts of southern boreal forest. However, deer grazing on oak seedlings will partially negate the positive influence of warming and fire. On balance, oaks have a more positive future outlook in the Lake States, as the climate becomes more favorable to oaks compared to temperate mesic and boreal forests.*

Freschet, G. T., Valverde-Barrantes, O. J., Tucker, C. M., Craine, J. M., McCormack, M. L., Violle, C., . . . Roumet, C. (2017). Climate, soil and plant functional types as drivers of global fine-root trait variation. *Journal of Ecology, 105*(5), 1182-1196. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017479036&doi=10.1111%2f1365-2745.12769&partnerID=40&md5=dbf607419f46d16eee2cf9cbc29c3f71. doi:10.1111/1365-2745.12769

Research Tags: Soil

Abstract: *Ecosystem functioning relies heavily on below-ground processes, which are largely regulated by plant fine-roots and their functional traits. However, our knowledge of fine-root trait distribution relies to date on local- and regional-scale studies with limited numbers of species, growth forms and environmental variation. We compiled a world-wide fine-root trait dataset, featuring 1115 species from contrasting climatic areas, phylogeny and growth forms to test a series of hypotheses pertaining to the influence of plant functional types, soil and climate variables, and the degree of manipulation of plant growing conditions on species fine-root trait variation. Most particularly, we tested the competing hypotheses that fine-root traits typical of faster return on investment would be most strongly associated with conditions of limiting versus favourable soil resource availability. We accounted for both data source and species phylogenetic relatedness.*
We demonstrate that: (i) Climate conditions promoting soil fertility relate negatively to fine-root traits favouring fast soil resource acquisition, with a particularly strong positive effect of temperature on fine-root diameter and negative effect on specific root length (SRL), and a negative effect of rainfall on root nitrogen concentration; (ii) Soil bulk density strongly influences species fine-root morphology, by favouring thicker, denser fine-roots; (iii) Fine-roots from herbaceous species are on average finer and have higher SRL than those of woody species, and N2-fixing capacity positively relates to root nitrogen; and (iv) Plants growing in pots have higher SRL than those grown in the field.
Synthesis. This study reveals both the large variation in fine-root traits encountered globally and the relevance of several key plant functional types and soil and climate variables for explaining a substantial part of this variation. Climate, particularly temperature, and plant functional types were the two strongest predictors of

fine-root trait variation. High trait variation occurred at local scales, suggesting that wide-ranging below-ground resource economics strategies are viable within most climatic areas and soil conditions.

Fricker, G. A., Synes, N. W., Serra-Diaz, J. M., North, M. P., Davis, F. W., & Franklin, J. (2019). More than climate? Predictors of tree canopy height vary with scale in complex terrain, Sierra Nevada, CA (USA). *Forest Ecology and Management, 434*, 142-153. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058465266&doi=10.1016%2fj.foreco.2018.12.006&partnerID=40&md5=867e211fe6a1f5c56becd2e07084b831. doi:10.1016/j.foreco.2018.12.006

Research Tags: Forestry

Abstract: *Tall trees and vertical forest structure are associated with increased productivity, biomass and wildlife habitat quality. While climate has been widely hypothesized to control forest structure at broad scales, other variables could be key at fine scales, and are associated with forest management. In this study we identify the environmental conditions (climate, topography, soils) associated with increased tree height across spatial scales using airborne Light Detection and Ranging (LiDAR) data to measure canopy height. The study was conducted over a large elevational gradient from 200 to 3000 m in the Sierra Nevada Mountains (CA, USA) spanning sparse oak woodlands to closed canopy conifer forests. We developed Generalized Boosted Models (GBMs) of forest height, ranking predictor variable importance against Maximum Canopy Height (CHMax) at six spatial scales (25, 50, 100, 250, 500, 1000 m). In our study area, climate variables such as the climatic water deficit and mean annual precipitation were more strongly correlated with CHmax (18–52% relative importance) than soil and topographic variables, and models at intermediate (50–500 m) scales explained the most variance in CHMax (R2 0.77–0.83). Certain soil variables such as soil bulk density and pH, as well as topographic variables such as the topographic wetness index, slope curvature and potential solar radiation, showed consistent, strong associations with canopy structure across the gradient, but these relationships were scale dependent. Topography played a greater role in predicting forest structure at fine spatial scales, while climate variables dominated our models, particularly at coarse scales. Our results indicate that multiple abiotic factors are associated with increased maximum tree height; climatic water balance is most strongly associated with this component of forest structure but varies across all spatial scales examined (6.9–54.8% relative importance), while variables related to topography also explain variance in tree height across the elevational gradient, particularly at finer spatial scales (37.15%, 20.26% relative importance at 25, 50 m scales respectively).*

Frongillo, E. A., Nguyen, H. T., Smith, M. D., & Coleman-Jensen, A. (2019). Food Insecurity Is More Strongly Associated with Poor Subjective Well-Being in More-Developed Countries than in Less-Developed Countries. *Journal of Nutrition, 149*(2), 330-335. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062273582&doi=10.1093%2fjn%2fnxy261&partnerID=40&md5=6a53e3b26bb1d1c0b3086562d0150ed6. doi:10.1093/jn/nxy261

Research Tags: Economics

Abstract: *Background*
Food insecurity is strongly associated with subjective well-being. People compare their well-being to a subjective reference that adjusts over time, which is called hedonic adaptation.
Objective
We aimed to deepen understanding of the relation between food insecurity and subjective well-being among countries from the perspective of possible hedonic adaptation between food insecurity and subjective well-being.
Methods
Global data from the Gallup World Poll 2014 were collected from 152,206 individuals in 147 countries. Telephone and face-to-face surveys were conducted in 37 and 111 countries, respectively, collecting data on law and order; food and shelter; institutions and infrastructure; job climate; and financial, social, physical, and evaluative well-being, including the Food Insecurity Experience Scale. Data were aggregated to country level and merged with economic and social measures from World Bank and United Nations sources: infant mortality, gross domestic product, economic inequality, agricultural value added, fertility, maternal mortality, female schooling, and female participation in the labor force. Multilevel linear regression was used to examine associations between well-being and food insecurity.
Results

Experiencing moderate or severe food insecurity was prevalent among countries, with a mean probability of 0.273 ± 0.220. Countries that were less developed economically and socially had a higher probability of experiencing food insecurity, lower subjective well-being as measured by the daily experience index, and less negative slopes for the relation between daily experience index and food insecurity. Food insecurity was the strongest predictor of daily experience from among the measures of economic and social development.
Conclusions
The prevalence of food insecurity was strongly and negatively associated with subjective well-being across 147 countries. The association between food insecurity and poor subjective well-being within countries was stronger for more-developed countries, providing evidence of hedonic adaptation between food insecurity and subjective well-being. Food insecurity explained substantial variation in subjective well-being both among and within countries.

Fu, C., Wang, G., Bible, K., Goulden, M. L., Saleska, S. R., Scott, R. L., & Cardon, Z. G. (2018). Hydraulic redistribution affects modeled carbon cycling via soil microbial activity and suppressed fire. *Global Change Biology, 24*(8), 3472-3485. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047468918&doi=10.1111%2fgcb.14164&partnerID=40&md5=9d3dcb19b277953cfbc7c4ce326126ae. doi:10.1111/gcb.14164
Research Tags: Soil, Water
Abstract: *Hydraulic redistribution (HR) of water from moist to drier soils, through plant roots, occurs world-wide in seasonally dry ecosystems. Although the influence of HR on landscape hydrology and plant water use has been amply demonstrated, HR's effects on microbe-controlled processes sensitive to soil moisture, including carbon and nutrient cycling at ecosystem scales, remain difficult to observe in the field and have not been integrated into a predictive framework. We incorporated a representation of HR into the Community Land Model (CLM4.5) and found the new model improved predictions of water, energy, and system-scale carbon fluxes observed by eddy covariance at four seasonally dry yet ecologically diverse temperate and tropical AmeriFlux sites. Modeled plant productivity and microbial activities were differentially stimulated by upward HR, resulting at times in increased plant demand outstripping increased nutrient supply. Modeled plant productivity and microbial activities were diminished by downward HR. Overall, inclusion of HR tended to increase modeled annual ecosystem uptake of CO2 (or reduce annual CO2 release to the atmosphere). Moreover, engagement of CLM4.5's ground-truthed fire module indicated that though HR increased modeled fuel load at all four sites, upward HR also moistened surface soil and hydrated vegetation sufficiently to limit the modeled spread of dry season fire and concomitant very large CO2 emissions to the atmosphere. Historically, fire has been a dominant ecological force in many seasonally dry ecosystems, and intensification of soil drought and altered precipitation regimes are expected for seasonally dry ecosystems in the future. HR may play an increasingly important role mitigating development of extreme soil water potential gradients and associated limitations on plant and soil microbial activities, and may inhibit the spread of fire in seasonally dry ecosystems.*

Fu, X., & Meinzer, F. C. (2018). Metrics and proxies for stringency of regulation of plant water status (iso/anisohydry): A global data set reveals coordination and trade-offs among water transport traits. *Tree Physiology, 39*(1), 122-134. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060381660&doi=10.1093%2ftreephys%2ftpy087&partnerID=40&md5=ebaa91225b53b01294542cbcc0d7a859. doi:10.1093/treephys/tpy087
Research Tags: Weather
Abstract: *Plants operate along a continuum of stringency of regulation of plant water potential from isohydry to anisohydry. However, most metrics and proxies of plant iso/anisohydric behavior have been developed from limited sets of site-specific experiments. Understanding the underlying mechanisms that determine species' operating ranges along this continuum, independent of site and growing conditions, remains challenging. We compiled a global database to assess the global patterns of metrics and proxies of plant iso/anisohydry and then explored some of the underlying functional traits and trade-offs associated with stringency of regulation that determines where species operate along the continuum. Our results showed that arid and semi-arid biomes were associated with greater anisohydry than more mesic biomes, and angiosperms showed marginally greater anisohydry than gymnosperms. Leaf water potential at the turgor loss point (Ψtlp) and wood density*

were the two most powerful proxies for ranking the degree of plant iso/anisohydry for a wide range of species and biomes. Both of these simple traits can be easily and rapidly determined, and therefore show promise for a priori mapping and understanding of the global distribution pattern of the degree of plant iso/anisohydry. Generally, the most anisohydric species had the most negative values of Ψtlp and highest wood density, greatest resistance to embolism, lowest hydraulic capacitance and lowest leaf-specific hydraulic conductivity of their branches. Wood density in particular appeared to be central to a coordinated series of traits, trade-offs and behaviors along a continuum of iso/anisohydry. Quantification of species' operating ranges along a continuum of iso/anisohydry and identification of associated trade-offs among functional traits may hold promise for mechanistic modeling of species-specific responses to the anticipated more frequent and severe droughts under global climate change scenarios.

Fullerton, A. H., Torgersen, C. E., Lawler, J. J., Steel, E. A., Ebersole, J. L., & Lee, S. Y. (2018). Longitudinal thermal heterogeneity in rivers and refugia for coldwater species: effects of scale and climate change. *Aquatic Sciences, 80*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035143901&doi=10.1007%2fs00027-017-0557-9&partnerID=40&md5=4cd41d31e0e6370c1cbdddef4a6a116e. doi:10.1007/s00027-017-0557-9

Research Tags: Water, Wildlife

Abstract: *Climate-change driven increases in water temperature pose challenges for aquatic organisms. Predictions of impacts typically do not account for fine-grained spatiotemporal thermal patterns in rivers. Patches of cooler water could serve as refuges for anadromous species like salmon that migrate during summer. We used high-resolution remotely sensed water temperature data to characterize summer thermal heterogeneity patterns for 11,308 km of second–seventh-order rivers throughout the Pacific Northwest and northern California (USA). We evaluated (1) water temperature patterns at different spatial resolutions, (2) the frequency, size, and spacing of cool thermal patches suitable for Pacific salmon (i.e., contiguous stretches ≥ 0.25 km, ≤ 15 °C and ≥ 2 °C, aooler than adjacent water), and (3) potential influences of climate change on availability of cool patches. Thermal heterogeneity was nonlinearly related to the spatial resolution of water temperature data, and heterogeneity at fine resolution (< 1 km) would have been difficult to quantify without spatially continuous data. Cool patches were generally > 2.7 and < 13.0 km long, and spacing among patches was generally > 5.7 and < 49.4 km. Thermal heterogeneity varied among rivers, some of which had long uninterrupted stretches of warm water ≥ 20 °C, and others had many smaller cool patches. Our models predicted little change in future thermal heterogeneity among rivers, but within-river patterns sometimes changed markedly compared to contemporary patterns. These results can inform long-term monitoring programs as well as near-term climate-adaptation strategies.*

Galko, J., Dzurenko, M., Ranger, C. M., Kulfan, J., Kula, E., Nikolov, C., . . . Zach, P. (2018). Distribution, habitat preference, and management of the invasive ambrosia beetle xylosandrus germanus (Coleoptera: Curculionidae, Scolytinae) in European forests with an emphasis on the West Carpathians. *Forests, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059432005&doi=10.3390%2ff10010010&partnerID=40&md5=2b7897b09e4c4df18d807f365bfd28aa. doi:10.3390/f10010010

Research Tags: Forestry, Wildlife

Abstract: *The black timber bark beetle Xylosandrus germanus (Blandford) is an invasive ambrosia beetle that originates from Southeast Asia and has become successfully established within Europe and North America. Herein, we provide a review of the spread and distribution of this tree and timber pest species across Europe, before and after 2000, along with a review of its habitat preferences. Since the spread of X. germanus across Europe has accelerated rapidly post-2000, emphasis is placed on this period. X. germanus was first recorded in Germany in 1951 and since then in 21 other European countries along with Russia. Ethanol-baited traps were deployed in oak, beech, and spruce forest ecosystems in the Western Carpathians, Central Europe, Slovakia, to characterize the distribution and habitat preferences of this non-native ambrosia beetle. Captures of X. germanus within Slovakia have been rising rapidly since its first record in 2010, and now this species dominates captures of ambrosia beetles. X. germanus has spread throughout Slovakia from south-southwest to north-northeast over a period of 5–10 years, and has also spread vertically into higher altitudes within the country. While living but weakened trees in Europe and North America are attacked by X. germanus, the*

greatest negative impact within Slovakia is attacks on recently felled logs of oak, beech and spruce trees, which provide high quality timber/lumber. We suggest that the recent rapid spread of X. germanus in Central Europe is being facilitated by environmental changes, specifically global warming, and the increasing frequency of timber trade. Recommendations for the management of X. germanus in forest ecosystems are proposed and discussed, including early detection, monitoring, sanitary measures, etc.

Gallego-Tévar, B., Infante-Izquierdo, M. D., Figueroa, E., Nieva, F. J. J., Muñoz-Rodríguez, A. F., Grewell, B. J., & Castillo, J. M. (2019). Some like it hot: Maternal-switching with climate change modifies formation of invasive spartina hybrids. *Frontiers in Plant Science, 10*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067369606&doi=10.3389%2ffpls.2019.00484&partnerID=40&md5=eacb38d5054e24a022cafbd2db973470. doi:10.3389/fpls.2019.00484

Research Tags: Water

Abstract: *Climate change can induce temporary, spatial or behavioral changes in species, so that only some species can adapt to the new climatic conditions. In the case of invasive species, it is expected that they will be promoted in a context of global change, given their high tolerance to environmental factors and phenotypic plasticity. Once in the invaded range, these species can hybridize with native species thus introducing their genotype in the native biota. However, the effects that climate change will have on this process of invasion by hybridization remain unclear. We evaluated the historical establishment of the reciprocal hybrids between the native Spartina maritima and the invasive S. densiflora in the Gulf of Cadiz (SW Iberian Peninsula) and we related it to climatic changes during the period 1955–2017. Our results showed that, according to their dating based on their rate of lateral expansion rates, the establishment of S. maritima × densiflora and S. densiflora × maritima in the Gulf of Cadiz has occurred in the last two centuries and has been related to changes in air temperature and rainfall during the flowering periods of their parental species, with antagonist impacts on both hybrids. Thus, the hybrid S. densiflora × maritima has been established in years with mild ends of spring and beginning of summer when the flowering of S. maritima lengthened and its pollen production was higher, and it coincided with the beginning of the flowering period of S. densiflora. Moreover, the establishment of this hybrid was related to higher spring/summer rainfalls, probably due to the reduction in salinity in middle marshes. However, the hybrid S. maritima × densiflora, was established mainly in warmer spring/summers in which the proportion of pollen:ovule of S. maritima was reduced favoring its pollination by S. densiflora. As a consequence of the promotion of S. maritima × densiflora with climate change, the native and endangered species S. maritima would be threatened, as both taxa share the same habitat and the hybrid shows a remarkably higher competitive potential.*

Galliart, M., Bello, N., Knapp, M., Poland, J., St Amand, P., Baer, S., . . . Johnson, L. (2019). Local adaptation, genetic divergence, and experimental selection in a foundation grass across the US Great Plains' climate gradient. *Global Change Biology, 25*(3), 850-868. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059576498&doi=10.1111%2fgcb.14534&partnerID=40&md5=bd9a4e5311a95dfa5d41e978b8bda006. doi:10.1111/gcb.14534

Research Tags: Grassland

Abstract: *Many prior studies have uncovered evidence for local adaptation using reciprocal transplant experiments. However, these studies are rarely conducted for a long enough time to observe succession and competitive dynamics in a community context, limiting inferences for long-lived species. Furthermore, the genetic basis of local adaptation and genetic associations with climate has rarely been identified. Here, we report on a long-term (6-year) experiment conducted under natural conditions focused on Andropogon gerardii, the dominant grass of the North American Great Plains tallgrass ecosystem. We focus on this foundation grass that comprises 80% of tallgrass prairie biomass and is widely used in 20,000 km2 of restoration. Specifically, we asked the following questions: (a) Whether ecotypes are locally adapted to regional climate in realistic ecological communities. (b) Does adaptive genetic variation underpin divergent phenotypes across the climate gradient? (c) Is there evidence of local adaptation if the plants are exposed to competition among ecotypes in mixed ecotype plots? Finally, (d) are local adaptation and genetic divergence related to climate? Reciprocal gardens were planted with 3 regional ecotypes (originating from dry, mesic, wet climate sources) of Andropogon gerardii across a precipitation gradient (500–1,200 mm/year) in the US Great Plains. We demonstrate local adaptation and differentiation of ecotypes in wet and dry environments. Surprisingly, the* *apparent generalist mesic ecotype performed comparably under all rainfall conditions. Ecotype performance was underpinned by differences in neutral diversity and candidate genes corroborating strong differences among ecotypes. Ecotype differentiation was related to climate, primarily rainfall. Without long-term studies, wrong conclusions would have been reached based on the first two years. Further, restoring prairies with climate-matched ecotypes is critical to future ecology, conservation, and sustainability under climate change.*

Galloza, M. S., López-Santos, A., & Martínez-Santiago, S. (2017). Predicting land at risk from wind erosion using an index-based framework under a climate change scenario in Durango, Mexico. *Environmental Earth Sciences, 76*(16). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027698365&doi=10.1007%2fs12665-017-6751-1&partnerID=40&md5=66a78927785ed032f8ad5011229d577d. doi:10.1007/s12665-017-6751-1

Research Tags: Soil

Abstract: *Land degradation takes place primarily in drylands which make up for almost 50% of the cultivated lands, globally. The 90% of Mexican territory is currently experiencing land deterioration mainly due to anthropogenic land use changes and still expecting further deterioration. While efforts have been directed toward the impact of land use changes on wind erosion in dryland ecosystems, there is still high uncertainty on the nature of wind erosion sources. This challenge was addressed by developing and evaluating a method for completing spatial assessments of vulnerable zones currently experiencing accelerated soil erosion and to predict those areas where soil erosion is likely to occur in the near future. This approach is tested over a study area in the Comarca Lagunera, Durango, Mexico. Spatiotemporal patterns and variability in soil erosion and aridity were evaluated, as well as the identification of key characteristics driving soil degradation in the area. Results demonstrate that the suggested methodology can be effectively used to spatially delineate potential locations susceptible to soil degradation (e.g., moderate-risk zones and/or high-risk zones), not only in the present time but also to predict those locations in the near future. This provides the opportunity of spatially defined areas of interest based on specific relationships between edaphological properties and its vulnerability to climate variability. This type of approach could be valuable to identify critical locations that should be treated as a priority for monitoring and managing accelerated soil degradation.*

Gamble, J. D., Feyereisen, G. W., Papiernik, S. K., Wente, C., & Baker, J. (2017). Regression-kriged soil organic carbon stock changes in manured corn silage-alfalfa production systems. *Soil Science Society of America Journal, 81*(6), 1557-1566. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040599326&doi=10.2136%2fsssaj2017.04.0138&partnerID=40&md5=3b3eed2324bba89ca7879351e6c5fb2b. doi:10.2136/sssaj2017.04.0138

Research Tags: Soil, Crops

Abstract: *Accurate measurement of soil organic C (SOC) stock changes over time is essential to verify management effects on C sequestration. This study quantified spatial and temporal changes in SOC stocks on adjacent 65-ha corn (Zea mays L.) silage–alfalfa (Medicago sativa L.) fields receiving liquid dairy manure in west central Minnesota. We used regression kriging to interpolate SOC in four soil layers in 2006 and 2015, and calculated stock changes over time. Regression kriging with elevation, topographic wetness index, field (west vs. east), and irrigation (yes vs. no) accurately predicted SOC in the 0 to 15-cm (R2 = 0.89) and 15 to 30-cm layers (R2 = 0.51–0.95), where variogram analysis indicated moderate to strong spatial correlation. From 0 to 15 cm, SOC in the west field increased by 7% (+4.5 Mg C ha–1) over the study period caused by gains in irrigated portions of the field. No changes were found in the east field or from 15 to 30 cm in either field. Below 30 cm, a lack of spatial structure and a lack of relationships between SOC and auxiliary variables was found, but simple means indicated SOC gains of 13% (+4.7 Mg C ha–1) in the 30 to 60-cm layer and 24% (+3.9 Mg C ha–1) in the 60 to 90-cm layer across both fields. Regression kriging with easily acquired auxiliary variables offers a highly accurate method of monitoring SOC stock changes over time to 30 cm depth. Current management practices maintain or increase SOC in these fields.*

Gamm, C. M., Sullivan, P. F., Buchwal, A., Dial, R. J., Young, A. B., Watts, D. A., . . . Post, E. (2018). Declining growth of deciduous shrubs in the warming climate of continental western Greenland. *Journal of Ecology, 106*(2), 640-654. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041956310&doi=10.1111%2f1365-2745.12882&pa

rtnerID=40&md5=e25d2106c403b6bbb7752b78e67cd132. doi:10.1111/1365-2745.12882
Research Tags: Forestry
Abstract: *Observational and experimental studies have generally shown that warming is associated with greater growth and abundance of deciduous shrubs in arctic ecosystems. It is uncertain, however, if this trend will persist in the future.*
Our study examined growth responses of deciduous shrubs to climate change over the late 20th and early 21st centuries near Kangerlussuaq in western Greenland. We combined shrub dendrochronology, stable isotope analysis and weekly measurements of leaf gas exchange to examine the drivers of secondary growth in two widespread and dominant deciduous shrub species: Salix glauca and Betula nana.
Betula showed a dramatic growth decline beginning in the early 1990s, when correlations between growing season air temperature and growth shifted from neutral to strongly negative. Salix also showed a growth decline, but it began slightly later and was more pronounced among older stems. May–August mean air temperature of c. 7°C appeared to be an important threshold.
Carbon isotope discrimination (Δ13C) in α-cellulose of Salix growth rings declined strongly during the period of reduced growth, suggesting drought-induced stomatal closure as a possible cause. Leaf gas exchange of Salix was also highly sensitive to seasonal variation in moisture availability. Betula growth declined more dramatically than Salix, but leaf gas exchange was less sensitive to moisture availability and there was less evidence of a Δ13C trend. We hypothesize that the dramatic Betula growth decline might reflect the combined effects of increasing moisture limitation, repeated defoliation during recent moth outbreaks and greater browsing by a growing muskoxen population.
Synthesis. Our findings contrast with widespread observations of increasing shrub growth in the Arctic and instead point to a potential decline in the flux of carbon into a pool with a long mean residence time (wood). While our study area is warmer and drier than much of the Arctic, our results may serve as an early indicator of potential effects of rising temperature in other arctic ecosystems.

Ganey, J. L., Iniguez, J. M., Sanderlin, J. S., & Block, W. M. (2017). Developing a monitoring program for bird populations in the chiricahua mountains, Arizona, using citizen observers: Initial stages. *USDA Forest Service - General Technical Report RMRS-GTR, 2017*(368). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026995369&partnerID=40&md5=bf5ea84ed2efeddc44067f1299f3d3fa.
Research Tags: Wildlife
Abstract: *The Madrean Sky Island region is an ecologically important area harboring exceptional biodiversity, including a unique avifauna that supports a thriving ecotourism industry in southeastern Arizona. This area has been impacted by several large wildfires in recent decades. These wildfires have altered vegetation composition and structure in forests and woodlands, and the effects of these changes on bird populations and distribution are not well understood. We studied occupancy and habitat associations of forest and woodland birds within five mountain ranges in southeastern Arizona from 1991 to 1995, before these fires occurred. The resulting data provide a unique opportunity to compare postfire bird populations with populations in these ranges during the 1990s, but funding to accomplish the necessary postfire bird sampling has been limited. Consequently, we are exploring the feasibility of using skilled citizen observers to monitor bird occupancy and distribution. This report documents the early stages of an effort to sample bird populations in the Chiricahua Mountains, Arizona using citizen observers. It describes field methods, presents preliminary results, summarizes early lessons learned, and outlines future steps necessary to design and implement a rigorous monitoring program using citizen observers to sample bird populations in the Madrean Sky Islands.*

Ganey, J. L., & Vojta, S. C. (2017). Comparative Trends in Log Populations in Northern Arizona Mixed-Conifer and Ponderosa Pine Forests Following Severe Drought. *Western North American Naturalist, 77*(3), 281-292. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034640812&doi=10.3398%2f064.077.0302&partnerID=40&md5=2f44626a80967a3d91d9f4a5fc7485f5. doi:10.3398/064.077.0302
Research Tags: Forestry, Weather
Abstract: *Logs provide an important form of coarse woody debris in forest systems, contributing to numerous ecological processes and affecting wildlife habitat and fuel complexes. Despite this, little information is*

available on the dynamics of log populations in southwestern ponderosa pine (Pinus ponderosa) and especially mixed-conifer forests. A recent episode of elevated tree mortality in these forest types in northern Arizona caused a pulse in log inputs as dead trees broke and fell. We documented changes in these log populations from 2004 to 2009 in an earlier paper. Here, we extended that work to evaluate changes in log abundance and volume between 2009 and 2014, compare trends in log abundance and volume between this period and the preceding 5-year period, estimate overall change in log abundance and volume over the period from 2004 to 2014, and describe temporal relationships between log abundance and changes in populations of snags (standing dead trees) during the study. Trends in log populations differed between forest types. Increases in log abundance were more widespread and larger in magnitude in mixed-conifer forest than in ponderosa pine forest. Over the entire 10-year study period, log abundance increased by 52% and 30% in mixed-conifer and ponderosa pine forest, respectively. Most of that increase occurred in the first 5 years, especially in ponderosa pine forest. Log abundance and volume continued to increase from 2009 to 2014 in mixed-conifer forest, whereas these parameters showed little change in ponderosa pine forest over this period. Log abundance lagged snag abundance, which peaked in 2007 but remained elevated in 2012 relative to pre-2007 levels in both forest types. Thus, log abundance may continue to increase as those snags break and fall. The ultimate magnitude and duration of this drought-mediated pulse in log inputs to these systems thus remains unknown. Understanding how these systems respond to drought-related mortality pulses may aid forest ecologists and managers charged with adapting forest management strategies in an era of changing climate.

Ganey, J. L., & Witt, C. (2017). Changes in snag populations on national forest system lands in Arizona, 1990s to 2000s. *Journal of Forestry, 115*(2), 103-111. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014640139&doi=10.5849%2fjof.2016-062&partnerID=40&md5=dfde6206c48877fb015e2bea76c02050. doi:10.5849/jof.2016-062
Research Tags: Forestry
Abstract: *Snags receive special management attention as important components of forest systems. We used data from the US Department of Agriculture (USDA) Forest Service Forest Inventory and Analysis Program, collected during two recent time periods (1995 to 1999 and 2001 to 2010), to evaluate trends in snag populations in two forest types in Arizona. Densities of snags ≥4 in. dbh increased by 21 and 72% between these time periods in mixed conifer and ponderosa pine (Pinus ponderosa) forest, respectively. Proportions of plots meeting USDA Forest Service guidelines for density of large snags (defined as snags ≥18 in. dbh and ≥30 ft tall) increased between time periods in both forest types (from 19 to 45% in mixed conifer and from 5 to 17% in ponderosa pine forest), but large snags remained relatively sparse, especially in less productive ponderosa pine forests. More than 50 and 75% of sampled plots lacked large snags entirely in mixed conifer and ponderosa pine forest, respectively.*
Management and Policy Implications Snags are important components of forest systems, providing resources for numerous wildlife species and contributing to decay dynamics and other ecological processes. Overall, snag numbers are increasing and species composition of snag populations is changing within mixed conifer and ponderosa pine forests in Arizona due to drought-mediated mortality. Despite increases in overall snag numbers, the large snags most important to native wildlife remained relatively sparse, especially in ponderosa pine forest, and large snags generally were most abundant in areas of reduced human access. Managers and interested public groups should recognize that not all areas can or should support high densities of large snags. In other areas, managers should emphasize retention of large snags and recruitment of the large trees that provide a source for large snags, ensure that large snags remain well (but not uniformly) distributed across heterogeneous landscapes, explicitly consider human disturbance in snag management plans, limit salvage logging of larger snags after disturbance events, and incorporate climate-mediated changes in forest composition and structure and adaptive strategies to address those changes in management plans.

Gangurde, S. S., Kumar, R., Pandey, A. K., Burow, M., Laza, H. E., Nayak, S. N., . . . Pandey, M. K. (2019). Climate-smart groundnuts for achieving high productivity and improved quality: Current status, challenges, and opportunities. In *Genomic Designing of Climate-Smart Oilseed Crops* (pp. 133-172).
Research Tags: Crops
Abstract: *About 90% of total groundnut is cultivated in the semi-arid tropic (SAT) regions of the world as a major oilseed and food crop and provides essential nutrients required by human diet. Climate change is the*

main threat to yield and quality of the produce in the SAT regions, and effects are already being seen in some temperate areas also. Rising CO2 levels, erratic rainfall, humidity, short episodes of high temperature and salinity hamper the physiology, disease resistance, fertility and yield as well as seed nutrient levels of groundnut. To meet growing demands of the increasing population against the threats of climate change, it is necessary to develop climate-smart varieties with enhanced and stable genetic improvements. Identifying key traits affected by climate change in groundnut will be important for developing an appropriate strategy for developing new varieties. Fast-changing scenarios of product ecologies as a consequence of climate change need faster development and replacement of improved varieties in the farmers' fields to sustain yield and quality. Use of modern genomics technology is likely to help in improved understanding and efficient breeding for climate-smart traits such as tolerance to drought and heat, and biotic stresses such as foliar diseases, stem rot, peanut bud necrosis disease, and preharvest aflatoxin contamination. The novel promising technologies such as genomic selection and genome editing need to be tested for their potential utility in developing climate-smart groundnut varieties. System modeling may further improve the understanding and characterization of the problems of target ecologies for devising strategies to overcome the problem. The combination of conventional breeding techniques with genomics and system modeling approaches will lead to a new era of system biology assisted breeding for sustainable agricultural production to feed the ever-growing population.

Gao, J., Cahill, C. M., Huang, X., Roffman, J. L., Lamon-Fava, S., Fava, M., . . . Rogers, J. T. (2018). S-Adenosyl Methionine and Transmethylation Pathways in Neuropsychiatric Diseases Throughout Life. *Neurotherapeutics, 15*(1), 156-175. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040538891&doi=10.1007%2fs13311-017-0593-0&partnerID=40&md5=02af7c167f37d6ed754af4b0ed704cc7. doi:10.1007/s13311-017-0593-0

Research Tags: None

Abstract: *S-Adenosyl methionine (SAMe), as a major methyl donor, exerts its influence on central nervous system function through cellular transmethylation pathways, including the methylation of DNA, histones, protein phosphatase 2A, and several catecholamine moieties. Based on available evidence, this review focuses on the lifelong range of severe neuropsychiatric and neurodegenerative diseases and their associated neuropathologies, which have been linked to the deficiency/load of SAMe production or/and the disturbance in transmethylation pathways. Also included in this review are the present-day applications of SAMe in the treatment in these diseases in each age group.*

Gao, J., Sheshukov, A. Y., Yen, H., Douglas-Mankin, K. R., White, M. J., & Arnold, J. G. (2019). Uncertainty of hydrologic processes caused by bias-corrected CMIP5 climate change projections with alternative historical data sources. *Journal of Hydrology, 568*, 551-561. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056846208&doi=10.1016%2fj.jhydrol.2018.10.041&partnerID=40&md5=6f362b304982150c2b492a0870b8a513. doi:10.1016/j.jhydrol.2018.10.041

Research Tags: Water

Abstract: *Uncertainty in simulating hydrologic response to future climate is generally assumed to result from the combined uncertainties of the General Circulation Model (GCM), representative concentration pathway (RCP), downscaling method, and hydrologic model used. However, another source of uncertainty, the observed climate data source used to statistically downscale and bias-correct GCM projections, has largely been overlooked. This study assessed the shifts, variability, and uncertainty in streamflow simulation from three downscaling data sources (NCDC land-based weather stations, NEXRAD spatial grid, and PRISM spatial grid) relative to those introduced by six GCMs and three RCPs in west-central Kansas, U.S. Streamflow simulated by the Soil and Water Assessment Tool (SWAT) hydrologic model was found to be more sensitive to future precipitation than to maximum and minimum temperatures. The greatest uncertainty in simulated streamflow was associated with selection of the GCM. Uncertainty in simulated streamflow associated with the observed bias-correction data source (NCDC, PRISM, NEXRAD) was greater than with RCPs and was primarily related to uncertainty in precipitation. This study highlighted the importance of recognizing uncertainty from bias-correction data sources in representing future climate scenarios in hydrologic simulations.*

Gao, J., Sheshukov, A. Y., Yen, H., & White, M. J. (2017). Impacts of alternative climate information on hydrologic

processes with SWAT: A comparison of NCDC, PRISM and NEXRAD datasets. *Catena, 156*, 353-364. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018991829&doi=10.1016%2fj.catena.2017.04.010&partnerID=40&md5=046e046699333365d457e1891a261029. doi:10.1016/j.catena.2017.04.010
Research Tags: Water, Research, Weather
Abstract: *Precipitation and temperature are two primary drivers that significantly affect hydrologic processes in a watershed. A network of land-based National Climatic Data Center (NCDC) weather stations has been typically used as a primary source of climate input for agro-ecosystem models. However, the network may lack the density to adequately capture spatial climate variability throughout large watersheds. High-resolution weather datasets based on 4 km × 4 km grid, such as Next Generation Weather Radar (NEXRAD) and Parameter–Elevation Regressions on Independent Slopes Model (PRISM), have become increasingly available as alternatives to conventional land-based networks. The goal of this study was to evaluate impacts of the three weather datasets, NCDC, NEXRAD, and PRISM, on hydrologic processes in an agricultural catchment in Kansas. A method of collecting and processing three sets of weather input datasets was developed and applied to a calibrated Soil and Water Assessment Tool (SWAT) model for the Smoky Hill River watershed (SHRW) in west-central Kansas, which is sparsely covered by NCDC weather stations with fair to poor range of NEXRAD coverage. SHRW is a typical agricultural catchment in the Central Great Plains; research findings here may be applicable to large areas of the US with similar topography and climate conditions. The SWAT model based on PRISM dataset was able to capture daily streamflow alterations with a greater accuracy compared to NCDC and NEXRAD based SWAT models. With three different weather inputs, SWAT with NCDC consistently overestimated monthly stream discharges, while the SWAT models based on NEXRAD and PRISM datasets tended to underestimate monthly high flows of over 8 m3 s− 1 and overestimate monthly low flows of below 1 m3 s− 1. In general, all models overestimated streamflow in dry years and underestimated streamflow in wet years, however, the PRISM-based model generated smaller bias than the models utilizing NEXRAD or NCDC. The use of PRISM resulted in better statistical performance metrics for streamflow. The conducted study suggests that gridded weather datasets can significantly improve simulated streamflow at daily, monthly and yearly scales as compared to traditional land-based networks.*

Gao, L., Lee, J. S., Hübner, S., Hulke, B. S., Qu, Y., & Rieseberg, L. H. (2019). Genetic and phenotypic analyses indicate that resistance to flooding stress is uncoupled from performance in cultivated sunflower. *New Phytologist, 223*(3), 1657-1670. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068060713&doi=10.1111%2fnph.15894&partnerID=40&md5=f752db96def44ecca94243e1944285d4. doi:10.1111/nph.15894
Research Tags: Water, Crops
Abstract: *Given the rising risk of extreme weather caused by climate change, enhancement of abiotic stress resistance in crops is increasingly urgent. But will the development of stress-resistant cultivars come at the cost of yield under ideal conditions? We hypothesize that this need not be inevitable, because resistance alleles with minimal pleiotropic costs may evade artificial selection and be retained in crop germplasm.*
Genome-wide association (GWA) analyses for variation in plant performance and flooding response were conducted in cultivated sunflower, a globally important oilseed.
We observed broad variation in flooding responses among genotypes. Flooding resistance was not strongly correlated with performance in control conditions, suggesting no inherent trade-offs. Consistent with this finding, we identified a subset of loci conferring flooding resistance, but lacking antagonistic effects on growth. Genetic diversity loss at candidate genes underlying these loci was significantly less than for other resistance genes during cultivated sunflower evolution.
Despite bottlenecks associated with domestication and improvement, low-cost resistance alleles remain within the cultivated sunflower gene pool. Thus, development of cultivars that are both flooding-tolerant and highly productive should be straightforward. Results further indicate that estimates of pleiotropic costs from GWA analyses explain, in part, patterns of diversity loss in crop genomes.

Gao, S., Gurian, P. L., Adler, P. R., Spatari, S., Gurung, R., Kar, S., . . . Del Grosso, S. J. (2018). Framework for improved confidence in modeled nitrous oxide estimates for biofuel regulatory standards. *Mitigation and Adaptation Strategies for Global Change, 23*(8), 1281-1301. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042126944&doi=10.1007%2fs11027-018-9784-1&partnerID=40&md5=06165fa7e361842d4703ef3c745c337c. doi:10.1007/s11027-018-9784-1
Research Tags: Emissions
Abstract: *Biofuels vary greatly in their carbon intensity, depending on the specifics of how they are produced. Policy frameworks are needed to ensure that biofuels actually achieve intended reductions in greenhouse gas emissions. Current approaches do not account for important variables during cultivation that influence emissions. Estimating emissions based on biogeochemical models would allow accounting of farm-specific conditions, which in turn provides an incentive for producers to adopt low emissions practices. However, there are substantial uncertainties in the application of biogeochemical models. This paper proposes a policy framework that manages this uncertainty while retaining the ability of the models to account for (and hence incentivize) low emissions practices. The proposed framework is demonstrated on nitrous oxide (N2O) emissions from the cultivation of winter barley. The framework aggregates uncertainties over time, which (1) avoids penalizing producers for uncertainty in weather, (2) allows for a high degree of confidence in the emissions reductions achieved, and (3) attenuates the uncertainty penalties borne by producers within a timescale of several years. Results indicate that with effective management, N2O emissions from feedstock cultivation may be < 5% of the carbon intensity of gasoline, whereas the existing policy approach estimates emissions > 20% of the carbon intensity of gasoline. If these emissions reductions are monetized, the framework can provide up to $0.002 per liter credits (0.8 cents per gallon) to fuel producers, which could incentivize emissions mitigation practices by biofuel feedstock suppliers, such as avoiding fall N application on silty clay loam soils. The conservatism in the current approach fails to incentivize the adoption of biofuels, while the lack of specificity fails to incentivize site-level mitigation practices. Improved uncertainty accounting and consideration of farm-level practices will incentivize mitigation efforts at landscape to global scales.*

Garcia, A. G., Ferreira, C. P., Godoy, W. A. C., & Meagher, R. L. (2019). A computational model to predict the population dynamics of Spodoptera frugiperda. *Journal of Pest Science, 92*(2), 429-441. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055340751&doi=10.1007%2fs10340-018-1051-4&partnerID=40&md5=1f560cc524f1d80f0635ea77e5ef5fa8. doi:10.1007/s10340-018-1051-4
Research Tags: Wildlife, Crops, Weather
Abstract: *Among lepidopteran insects, the fall armyworm, Spodoptera frugiperda, deserves special attention because of its agricultural importance. Different computational approaches have been proposed to clarify the dynamics of fall armyworm populations, but most of them have not been tested in the field and do not include one of the most important variables that influence insect development: the temperature. In this study, we developed a computational model that is able to represent the spatio-temporal dynamics of fall armyworms in agricultural landscapes composed of Bt and non-Bt areas, allowing the user to define different input variables, such as the crop area, thermal requirements of S. frugiperda, migration rate, rate of larval movement, and insect resistance to transgenic crops. In order to determine the efficiency of the proposed model, we fitted it using a 4-year (2012–2015) FAW monitoring data for an area located in northern Florida, USA. Simulations were run to predict the number of adults in 2016 and examine possible scenarios involving climate change. The model satisfactorily described the main outbreaks of fall armyworms, estimating values for parameters associated with insect dynamics, i.e., resistance-allele frequency (0.15), migration rate (0.48) and rate of larval movement (0.04). A posterior sensitivity analysis indicated that the frequency of the resistance allele most influenced the model, followed by the migration rate. Our simulations indicated that an increase of 1 °C in weekly mean temperatures could almost double the levels of fall armyworm populations, drawing attention to the possible consequences of temperature rises for pest dynamics.*

Garcia, A. G., Godoy, W. A. C., Thomas, J. M. G., Nagoshi, R. N., & Meagher, R. L. (2018). Delimiting strategic zones for the development of fall armyworm (Lepidoptera: Noctuidae) on corn in the State of Florida. *Journal of Economic Entomology, 111*(1), 120-126. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045945663&doi=10.1093%2fjee%2ftox329&partnerID=40&md5=69b8d795f5d929489e387ef12167a8d0. doi:10.1093/jee/tox329
Research Tags: Wildlife, Crops, Weather
Abstract: *The fall armyworm, Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae), cannot survive prolonged periods of freezing temperatures, thereby limiting where it can overwinter in North America. Climate*

change is anticipated to reduce the frequency of freeze days in Florida over the decades, with the potential consequence of a significant expansion of the overwintering range, whose northern limit in North America was assessed between 27 and 28°N in the last century. To assess this possibility, the development of the fall armyworm on corn leaves, one of the main host plants in the United States, was determined at five constant temperatures ranging from 14 to 30°C. Based on the development time, the thermal constant and the lower threshold temperature were used to estimate the number of generations of fall armyworm at 42 locations in the state of Florida, from 2006 to 2016. Maps were constructed to provide a visual description of the interpolated data, using GIS (Geographic Information System). The highest number of generations was observed in the counties farther south, an area that showed the highest temperatures during the years and plays a strategic role in maintaining fall armyworm populations in corn fields. Additionally, we conclude that in the absence of freeze periods, the northern limit for fall armyworm overwintering should be between 28 and 29°N.

Garcia, M., Saatchi, S., Casas, A., Koltunov, A., Ustin, S., Ramirez, C., . . . Balzter, H. (2017). Quantifying biomass consumption and carbon release from the California Rim fire by integrating airborne LiDAR and Landsat OLI data. *Journal of Geophysical Research: Biogeosciences, 122*(2), 340-353. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013421242&doi=10.1002%2f2015JG003315&partnerID=40&md5=4b234ab02e1296720861cfe50f05da78. doi:10.1002/2015JG003315

Research Tags: Weather, Forestry

Abstract: *Quantifying biomass consumption and carbon release is critical to understanding the role of fires in the carbon cycle and air quality. We present a methodology to estimate the biomass consumed and the carbon released by the California Rim fire by integrating postfire airborne LiDAR and multitemporal Landsat Operational Land Imager (OLI) imagery. First, a support vector regression (SVR) model was trained to estimate the aboveground biomass (AGB) from LiDAR-derived metrics over the unburned area. The selected model estimated AGB with an R2 of 0.82 and RMSE of 59.98 Mg/ha. Second, LiDAR-based biomass estimates were extrapolated to the entire area before and after the fire, using Landsat OLI reflectance bands, Normalized Difference Infrared Index, and the elevation derived from LiDAR data. The extrapolation was performed using SVR models that resulted in R2 of 0.73 and 0.79 and RMSE of 87.18 (Mg/ha) and 75.43 (Mg/ha) for the postfire and prefire images, respectively. After removing bias from the AGB extrapolations using a linear relationship between estimated and observed values, we estimated the biomass consumption from postfire LiDAR and prefire Landsat maps to be 6.58 ± 0.03 Tg (1012 g), which translate into 12.06 ± 0.06 Tg CO2e released to the atmosphere, equivalent to the annual emissions of 2.57 million cars.*

Garcia, M., Saatchi, S., Ferraz, A., Silva, C. A., Ustin, S., Koltunov, A., & Balzter, H. (2017). Impact of data model and point density on aboveground forest biomass estimation from airborne LiDAR. *Carbon Balance and Management, 12*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013354732&doi=10.1186%2fs13021-017-0073-1&partnerID=40&md5=de374c6488f4a2c5b2b7655ae678f834. doi:10.1186/s13021-017-0073-1

Research Tags: Forestry, Weather, Research

Abstract: *Background*
Accurate estimation of aboveground forest biomass (AGB) and its dynamics is of paramount importance in understanding the role of forest in the carbon cycle and the effective implementation of climate change mitigation policies. LiDAR is currently the most accurate technology for AGB estimation. LiDAR metrics can be derived from the 3D point cloud (echo-based) or from the canopy height model (CHM). Different sensors and survey configurations can affect the metrics derived from the LiDAR data. We evaluate the ability of the metrics derived from the echo-based and CHM data models to estimate AGB in three different biomes, as well as the impact of point density on the metrics derived from them.
Results
Our results show that differences among metrics derived at different point densities were significantly different from zero, with a larger impact on CHM-based than echo-based metrics, particularly when the point density was reduced to 1 point m−2. Both data models-echo-based and CHM-performed similarly well in estimating AGB at the three study sites. For the temperate forest in the Sierra Nevada Mountains, California, USA, R2 ranged from 0.79 to 0.8 and RMSE (relRMSE) from 69.69 (35.59%) to 70.71 (36.12%) Mg ha−1 for the

echo-based model and from 0.76 to 0.78 and 73.84 (37.72%) to 128.20 (65.49%) Mg ha−1 for the CHM-based model. For the moist tropical forest on Barro Colorado Island, Panama, the models gave R2 ranging between 0.70 and 0.71 and RMSE between 30.08 (12.36%) and 30.32 (12.46) Mg ha−1 [between 0.69–0.70 and 30.42 (12.50%) and 61.30 (25.19%) Mg ha−1] for the echo-based [CHM-based] models. Finally, for the Atlantic forest in the Sierra do Mar, Brazil, R2 was between 0.58–0.69 and RMSE between 37.73 (8.67%) and 39.77 (9.14%) Mg ha−1 for the echo-based model, whereas for the CHM R2 was between 0.37–0.45 and RMSE between 45.43 (10.44%) and 67.23 (15.45%) Mg ha−1.
Conclusions
Metrics derived from the CHM show a higher dependence on point density than metrics derived from the echo-based data model. Despite the median of the differences between metrics derived at different point densities differing significantly from zero, the mean change was close to zero and smaller than the standard deviation except for very low point densities (1 point m−2). The application of calibrated models to estimate AGB on metrics derived from thinned datasets resulted in less than 5% error when metrics were derived from the echo-based model. For CHM-based metrics, the same level of error was obtained for point densities higher than 5 points m−2. The fact that reducing point density does not introduce significant errors in AGB estimates is important for biomass monitoring and for an effective implementation of climate change mitigation policies such as REDD + due to its implications for the costs of data acquisition. Both data models showed similar capability to estimate AGB when point density was greater than or equal to 5 point m−2.

Garza, S. J., Tabak, M. A., Miller, R. S., Farnsworth, M. L., & Burdett, C. L. (2018). Abiotic and biotic influences on home-range size of wild pigs (Sus scrofa). *Journal of Mammalogy, 99*(1), 97-107. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041551550&doi=10.1093%2fjmammal%2fgyx154&partnerID=40&md5=3b6856996bbfd2aab21873a44117166f. doi:10.1093/jmammal/gyx154
Research Tags: Wildlife
Abstract: *Wild pigs (Sus scrofa) are among the most widespread and destructive invasive mammals in the world. Understanding the spatial ecology of this species is foundational to effectively mitigating further range expansion. We compiled size estimates of home ranges of wild pigs from 30 locations worldwide and modeled the relationship between home-range size and both abiotic (evapotranspiration, latitude, precipitation, and temperature) and biotic (vegetation productivity and mammal species richness) environmental factors. Size of home ranges varied markedly, ranging from 0.62 to 48.3 km2. Mammal species richness was positively correlated with home-range size and was the only predictor in the best model; other abiotic factors typically correlated with richness, i.e., latitude and evapotranspiration, were not significant predictors of wild pig home-range size. Despite indicating correlation rather than cause, our analyses were conducted at the scale of the home range and therefore may support the invasion paradox hypothesis for mammals, which states that biotic interactions have a greater influence on invasive species at finer spatial scales. While we do not suggest that mammal species richness can preclude populations of wild pigs from continuing to spread in their native or non-native ranges, our correlative results suggest that areas with a diverse mammal community may be more resistant to invasion. This finding supports the intrinsic value of conserving native species and highlights the need for future work exploring the specific mechanisms by which species richness and biodiversity can influence the ecology of invasive species.*

Gateau-Rey, L., Tanner, E. V. J., Rapidel, B., Marelli, J. P., & Royaert, S. (2018). Climate change could threaten cocoa production: Effects of 2015-16 El Niño-related drought on cocoa agroforests in Bahia, Brazil. *PLoS ONE, 13*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049645673&doi=10.1371%2fjournal.pone.0200454&partnerID=40&md5=b1451be3dad7b4d0b63a59312e697c0c. doi:10.1371/journal.pone.0200454
Research Tags: Crops
Abstract: *Climate models predict a possible increase in the frequency of strong climate events such as El Niño-Southern Oscillation (ENSO), which in parts of the tropics are the cause of exceptional droughts, these threaten global food production. Agroforestry systems are often suggested as promising diversification options to increase farmers' resilience to extreme climatic events. In the Northeastern state of Bahia, where most Brazilian cocoa is grown in wildlife-friendly agroforests, ENSOs cause severe droughts which negatively affect forest and agriculture. Cocoa (Theobroma cacao) is described as being sensitive to drought but there are no*

field-studies of the effect of ENSO-related drought on adult cocoa trees in the America's; there is one study of an experimentally-imposed drought in Indonesia which resulted in 10 to 46% yield loss. In our study, in randomly chosen farms in Bahia, Brazil, we measured the effect of the 2015–16 severe ENSO, which caused an unprecedented drought in cocoa agroforests. We show that drought caused high cocoa tree mortality (15%) and severely decreased cocoa yield (89%); the drought also increased infection rate of the chronic fungal disease witches' broom (Moniliophthora perniciosa). Ours findings showed that Brazilian cocoa agroforests are at risk and that increasing frequency of strong droughts are likely to cause decreased cocoa yields in the coming decades. Furthermore, because cocoa, like many crops, is grown somewhat beyond its climatic limits, it and other crops could be the 'canaries in the coalmine' warning of forthcoming major drought effects on semi-natural and natural vegetation.

Gautam, S., Costello, C., Baffaut, C., Thompson, A., Svoma, B. M., Phung, Q. A., & Sadler, E. J. (2018). Assessing long-term hydrological impact of climate change using an ensemble approach and comparison with global gridded model-A case study on Goodwater Creek Experimental Watershed. *Water (Switzerland), 10*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046645120&doi=10.3390%2fw10050564&partnerID=40&md5=23dd0f80de705fd98e23a6355863e636. doi:10.3390/w10050564

Research Tags: Water, Research

Abstract: *Potential impacts of climate change on the hydrological components of the Goodwater Creek Experimental Watershed were assessed using climate datasets from the Coupled Model Intercomparison Project Phase 5 and Soil and Water Assessment Tool (SWAT). Historical and future ensembles of downscaled precipitation and temperature, and modeled water yield, surface runoff, and evapotranspiration, were compared. Ensemble SWAT results indicate increased springtime precipitation, water yield, surface runoff and a shift in evapotranspiration peak one month earlier in the future. To evaluate the performance of model spatial resolution, gridded surface runoff estimated by Lund–Potsdam–Jena managed Land (LPJmL) and Jena Diversity-Dynamic Global Vegetation model (JeDi-DGVM) were compared to SWAT. Long-term comparison shows a 6–8% higher average annual runoff prediction for LPJmL, and a 5–30% lower prediction for JeDi-DGVM, compared to SWAT. Although annual runoff showed little change for LPJmL, monthly runoff projection under-predicted peak runoff and over-predicted low runoff for LPJmL compared to SWAT. The reasons for these differences include differences in spatial resolution of model inputs and mathematical representation of the physical processes. Results indicate benefits of impact assessments at local scales with heterogeneous sets of parameters to adequately represent extreme conditions that are muted in global gridded model studies by spatial averaging over large study domains.*

Geiser, L. H., Nelson, P. R., Jovan, S. E., Root, H. T., & Clark, C. M. (2019). Assessing ecological risks from atmospheric deposition of nitrogen and sulfur to US forests using epiphytic macrolichens. *Diversity, 11*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067252941&doi=10.3390%2fd11060087&partnerID=40&md5=7b18c639557b1fde24d8e23be312903d. doi:10.3390/d11060087

Research Tags: Emissions, Forestry

Abstract: *Critical loads of atmospheric deposition help decision-makers identify levels of air pollution harmful to ecosystem components. But when critical loads are exceeded, how can the accompanying ecological risk be quantified? We use a 90% quantile regression to model relationships between nitrogen and sulfur deposition and epiphytic macrolichens, focusing on responses of concern to managers of US forests: Species richness and abundance and diversity of functional groups with integral ecological roles. Analyses utilized national-scale lichen survey data, sensitivity ratings, and modeled deposition and climate data. We propose 20, 50, and 80% declines in these responses as cut-offs for low, moderate, and high ecological risk from deposition. Critical loads (low risk cut-off) for total species richness, sensitive species richness, forage lichen abundance and cyanolichen abundance, respectively, were 3.5, 3.1, 1.9, and 1.3 kg N and 6.0, 2.5, 2.6, and 2.3 kg S ha−1 yr−1. High environmental risk (80% decline), excluding total species richness, occurred at 14.8, 10.4, and 6.6 kg N and 14.1, 13, and 11 kg S ha−1 yr−1. These risks were further characterized in relation to geography, species of conservation concern, number of species affected, recovery timeframes, climate, and effects on interdependent biota, nutrient cycling, and ecosystem services.*

Genet, H., He, Y., Lyu, Z., McGuire, A. D., Zhuang, Q., Clein, J., . . . Zhu, Z. (2018). The role of driving factors in historical and projected carbon dynamics of upland ecosystems in Alaska. *Ecological Applications, 28*(1), 5-27. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040240096&doi=10.1002%2feap.1641&partnerID=40&md5=15d095f81fe6591badec77761d8482e3. doi:10.1002/eap.1641

Research Tags: Forestry, Weather

Abstract: *It is important to understand how upland ecosystems of Alaska, which are estimated to occupy 84% of the state (i.e., 1,237,774 km2), are influencing and will influence state-wide carbon (C) dynamics in the face of ongoing climate change. We coupled fire disturbance and biogeochemical models to assess the relative effects of changing atmospheric carbon dioxide (CO2), climate, logging and fire regimes on the historical and future C balance of upland ecosystems for the four main Landscape Conservation Cooperatives (LCCs) of Alaska. At the end of the historical period (1950–2009) of our analysis, we estimate that upland ecosystems of Alaska store ~50 Pg C (with ~90% of the C in soils), and gained 3.26 Tg C/yr. Three of the LCCs had gains in total ecosystem C storage, while the Northwest Boreal LCC lost C (−6.01 Tg C/yr) because of increases in fire activity. Carbon exports from logging affected only the North Pacific LCC and represented less than 1% of the state's net primary production (NPP). The analysis for the future time period (2010–2099) consisted of six simulations driven by climate outputs from two climate models for three emission scenarios. Across the climate scenarios, total ecosystem C storage increased between 19.5 and 66.3 Tg C/yr, which represents 3.4% to 11.7% increase in Alaska upland's storage. We conducted additional simulations to attribute these responses to environmental changes. This analysis showed that atmospheric CO2 fertilization was the main driver of ecosystem C balance. By comparing future simulations with constant and with increasing atmospheric CO2, we estimated that the sensitivity of NPP was 4.8% per 100 ppmv, but NPP becomes less sensitive to CO2 increase throughout the 21st century. Overall, our analyses suggest that the decreasing CO2 sensitivity of NPP and the increasing sensitivity of heterotrophic respiration to air temperature, in addition to the increase in C loss from wildfires weakens the C sink from upland ecosystems of Alaska and will ultimately lead to a source of CO2 to the atmosphere beyond 2100. Therefore, we conclude that the increasing regional C sink we estimate for the 21st century will most likely be transitional.*

Gessler, A., Roy, J., Kayler, Z., Ferrio, J. P., Alday, J. G., Bahn, M., . . . Resco de Dios, V. (2017). Night and day – Circadian regulation of night-time dark respiration and light-enhanced dark respiration in plant leaves and canopies. *Environmental and Experimental Botany, 137*, 14-25. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011601735&doi=10.1016%2fj.envexpbot.2017.01.014&partnerID=40&md5=f81fcee3d0a430310259df86eca1dae1. doi:10.1016/j.envexpbot.2017.01.014

Research Tags: Forestry

Abstract: *The potential of the vegetation to sequester C is determined by the balance between assimilation and respiration. Respiration is under environmental and substrate-driven control, but the circadian clock might also contribute.*

To assess circadian control on night-time dark respiration (RD) and on light enhanced dark respiration (LEDR) – the latter providing information on the metabolic reorganization in the leaf during light-dark transitions – we performed experiments in macrocosms hosting canopies of bean and cotton. Under constant darkness (plus constant air temperature and air humidity), we tested whether circadian regulation of RD scaled from leaf to canopy respiration. Under constant light (plus constant air temperature and air humidity), we assessed the potential for leaf-level circadian regulation of LEDR.

There was a clear circadian oscillation of leaf-level RD in both species and circadian patterns scaled to the canopy. LEDR was under circadian control in cotton, but not in bean indicating species-specific controls.

The circadian rhythm of LEDR in cotton might indicate variable suppression of the normal cyclic function of the tricarboxylic-acid-cycle in the light. Since circadian regulation is assumed to act as an adaptive memory to adjust plant metabolism based on environmental conditions from previous days, circadian control of RD may help to explain temporal variability of ecosystem respiration.

Ghaley, B. B., Rusu, T., Sandén, T., Spiegel, H., Menta, C., Visioli, G., . . . Henriksen, C. B. (2018). Assessment of benefits of conservation agriculture on soil functions in arable production systems in Europe. *Sustainability (Switzerland), 10*(3). Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043704845&doi=10.3390%2fsu10030794&partnerID=40&md5=b521ef2399830ac740961b8941ac6864. doi:10.3390/su10030794
Research Tags: Soil, Crops
Abstract: *Conventional farming (CONV) is the norm in European farming, causing adverse effects on some of the five major soil functions, viz. primary productivity, carbon sequestration and regulation, nutrient cycling and provision, water regulation and purification, and habitat for functional and intrinsic biodiversity. Conservation agriculture (CA) is an alternative to enhance soil functions. However, there is no analysis of CA benefits on the five soil functions as most studies addressed individual soil functions. The objective was to compare effects of CA and CONV practices on the five soil functions in four major environmental zones (Atlantic North, Pannonian, Continental and Mediterranean North) in Europe by applying expert scoring based on synthesis of existing literature. In each environmental zone, a team of experts scored the five soil functions due to CA and CONV treatments and median scores indicated the overall effects on five soil functions. Across the environmental zones, CONV had overall negative effects on soil functions with a median score of 0.50 whereas CA had overall positive effects with median score ranging from 0.80 to 0.83. The study proposes the need for field-based investigations, policies and subsidy support to benefit from CA adoption to enhance the five soil functions.*

Ghimire, R., Lamichhane, S., Acharya, B. S., Bista, P., & Sainju, U. M. (2017). Tillage, crop residue, and nutrient management effects on soil organic carbon in rice-based cropping systems: A review. *Journal of Integrative Agriculture, 16*(1), 1-15. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009080422&doi=10.1016%2fS2095-3119%2816%2961337-0&partnerID=40&md5=72af352b4b235211d50b5bc29245b9fa. doi:10.1016/S2095-3119(16)61337-0
Research Tags: Soil, Crops
Abstract: *Soil organic carbon (SOC) sequestration is one of the major agricultural strategies to mitigate greenhouse gas (GHG) emissions, enhance food security, and improve agricultural sustainability. This paper synthesizes the much-needed state-of-knowledge on the effects of tillage, crop residue, and nutrient management practices on SOC sequestration and identifies potential research gap, opportunities, and challenges in studying SOC dynamics in rice (Oryza sativa L.)-based cropping systems in South Asia, mainly in Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka. Improved management practices such as reduced- and no-tillage management, nitrogen (N) fertilizer and farmyard manure (FYM) application, and crop residue addition can improve SOC accumulation. Positive effects of no-tillage, crop residue addition, N addition through manure or compost application, and integration of organic and chemical fertilizers on SOC accumulation in rice-based cropping systems have been documented from South Asia. However, limited data and enormous discrepancies in SOC measurements across the region exist as the greatest challenge in increasing SOC sequestration and improving agricultural sustainability. More research on SOC as influenced by alternative tillage, crop residue, and nutrient management systems, and development of SOC monitoring system for existing long-term experiments will advance our understanding of the SOC dynamics in rice-based cropping systems and improve agricultural system sustainability in South Asia.*

Gilbert, M. K., Medina, A., Mack, B. M., Lebar, M. D., Rodríguez, A., Bhatnagar, D., . . . Payne, G. (2018). Carbon dioxide mediates the response to temperature and water activity levels in Aspergillus flavus during infection of Maize Kernels. *Toxins, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038934743&doi=10.3390%2ftoxins10010005&partnerID=40&md5=e0a19a102cd1bcaf686bdade94d4bef4. doi:10.3390/toxins10010005
Research Tags: Crops
Abstract: *Aspergillus flavus is a saprophytic fungus that may colonize several important crops, including cotton, maize, peanuts and tree nuts. Concomitant with A. flavus colonization is its potential to secrete mycotoxins, of which the most prominent is aflatoxin. Temperature, water activity (aw) and carbon dioxide (CO2) are three environmental factors shown to influence the fungus-plant interaction, which are predicted to undergo significant changes in the next century. In this study, we used RNA sequencing to better understand the transcriptomic response of the fungus to aw, temperature, and elevated CO2 levels. We demonstrate that aflatoxin (AFB1) production on maize grain was altered by water availability, temperature and CO2. RNA-Sequencing data indicated that several genes, and in particular those involved in the biosynthesis of*

secondary metabolites, exhibit different responses to water availability or temperature stress depending on the atmospheric CO2 content. Other gene categories affected by CO2 levels alone (350 ppm vs. 1000 ppm at 30 °C/0.99 aw), included amino acid metabolism and folate biosynthesis. Finally, we identified two gene networks significantly influenced by changes in CO2 levels that contain several genes related to cellular replication and transcription. These results demonstrate that changes in atmospheric CO2 under climate change scenarios greatly influences the response of A. flavus to water and temperature when colonizing maize grain.

Gillard, M., Grewell, B. J., Deleu, C., & Thiébaut, G. (2017). Climate warming and water primroses: Germination responses of populations from two invaded ranges. *Aquatic Botany, 136*, 155-163. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84993917475&doi=10.1016%2fj.aquabot.2016.10.001&partnerID=40&md5=f47d9590e4c3754a0165e4fd6ac41120. doi:10.1016/j.aquabot.2016.10.001

Research Tags: Water

Abstract: *Environmental temperature is the primary regulator of germination. Global climatic warming may substantially change seed dormancy and germination responses of wetland and riparian plant species. The potential for increased germination capacity, seed dispersal and geographic range expansion of invasive plant species is a particular concern relevant to the conservation of native biodiversity. The aim of this study was to compare the germination capacity of Ludwigia hexapetala and Ludwigia peploides subsp. montevidensis from two invaded ranges under 3 °C warming predicted in climate change models. Germination of seeds collected from two invaded ranges was tested in controlled conditions at two air temperature regimes, 24 °C/14 °C and 27 °C/17 °C. Regardless of temperatures, the germination rates of studied species were greater than 80% for L. hexapetala from California, and for two populations of L. peploides from France. Seeds of L. hexapetala from California germinated two-fold more than seeds from France, while L. peploides from California germinated less quickly and at lower rates than two of three populations from France. The variation observed between invaded ranges could be interpreted as an adjustment of the germination responses of water primroses populations due to provenance environmental characteristics. The 3 °C warming treatment accelerated the time to germination of water primrose seeds from California and France, and was a driving factor in final germination percentage for L. hexapetala populations from France. This study confirms that sexual reproduction can contribute to invasiveness of Ludwigia spp. and germination capacity will be maintained with 3 °C temperature warming.*

Gillard, M., Grewell, B. J., Futrell, C. J., Deleu, C., & Thiébaut, G. (2017). Germination and seedling growth of water primroses: A cross experiment between two invaded ranges with contrasting climates. *Frontiers in Plant Science, 8*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030835520&doi=10.3389%2ffpls.2017.01677&partnerID=40&md5=f1934e55b005d22467f0d5652d9a61af. doi:10.3389/fpls.2017.01677

Research Tags: Water

Abstract: *Aquatic ecosystems are vulnerable to biological invasions, and will also be strongly impacted by climate change, including temperature increase. Understanding the colonization dynamics of aquatic invasive plant species is of high importance for preservation of native biodiversity. Many aquatic invasive plants rely on clonal reproduction to spread, but mixed reproductive modes are common. Under future climate changes, these species may favor a sexual reproductive mode. The aim of this study was to test the germination capacity and the seedling growth of two water primrose species, Ludwigia hexapetala and Ludwigia peploides, both invasive in Europe and in the United States. We performed a reciprocal transplant of seeds of L. hexapetala and L. peploides from two invasive ranges into experimental gardens characterized by Oceanic and Mediterranean-type climates. Our results showed that higher temperatures increased or maintained germination percentages and velocity, decreased survivorship of germinants, but increased their production of biomass. The origin of the seeds had low impact on L. hexapetala responses to temperature, but greatly influenced those of L. peploides. The invasiveness of water primroses in ranges with Oceanic climates might increase with temperature. The recruitment from seed banks by these species should be considered by managers to improve the conservation of native aquatic and wetland plant species.*

Gillette, K., Malone, R. W., Kaspar, T. C., Ma, L., Parkin, T. B., Jaynes, D. B., . . . Kersebaum, K. C. (2018). N loss to drain flow and N<inf>2</inf>O emissions from a corn-soybean rotation with winter rye. *Science of the Total*

Environment, 618, 982-997. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032186336&doi=10.1016%2fj.scitotenv.2017.09.054&partnerID=40&md5=a2cbee2196ede4c7933c81fe0df397bc. doi:10.1016/j.scitotenv.2017.09.054
Research Tags: Crops, Emissions
Abstract: *Anthropogenic perturbation of the global nitrogen cycle and its effects on the environment such as hypoxia in coastal regions and increased N2O emissions is of increasing, multi-disciplinary, worldwide concern, and agricultural production is a major contributor. Only limited studies, however, have simultaneously investigated NO3− losses to subsurface drain flow and N2O emissions under corn-soybean production. We used the Root Zone Water Quality Model (RZWQM) to evaluate NO3− losses to drain flow and N2O emissions in a corn-soybean system with a winter rye cover crop (CC) in central Iowa over a nine year period. The observed and simulated average drain flow N concentration reductions from CC were 60% and 54% compared to the no cover crop system (NCC). Average annual April through October cumulative observed and simulated N2O emissions (2004–2010) were 6.7 and 6.0 kg N2O-N ha− 1 yr− 1 for NCC, and 6.2 and 7.2 kg N ha− 1 for CC. In contrast to previous research, monthly N2O emissions were generally greatest when N loss to leaching were greatest, mostly because relatively high rainfall occurred during the months fertilizer was applied. N2O emission factors of 0.032 and 0.041 were estimated for NCC and CC using the tested model, which are similar to field results in the region. A local sensitivity analysis suggests that lower soil field capacity affects RZWQM simulations, which includes increased drain flow nitrate concentrations, increased N mineralization, and reduced soil water content. The results suggest that 1) RZWQM is a promising tool to estimate N2O emissions from subsurface drained corn-soybean rotations and to estimate the relative effects of a winter rye cover crop over a nine year period on nitrate loss to drain flow and 2) soil field capacity is an important parameter to model N mineralization and N loss to drain flow.*

Gilmanov, T. G., Morgan, J. A., Hanan, N. P., Wylie, B. K., Rajan, N., Smith, D. P., & Howard, D. M. (2017). Productivity and CO2 Exchange of Great Plains Ecoregions. I. Shortgrass Steppe: Flux Tower Estimates. *Rangeland Ecology and Management, 70*(6), 700-717. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032870707&doi=10.1016%2fj.rama.2017.06.007&partnerID=40&md5=84bd7eeffb1bf246025e8f020ea360c1. doi:10.1016/j.rama.2017.06.007
Research Tags: Grassland
Abstract: *The shortgrass steppe (SGS) occupies the southwestern part of the Great Plains. Half of the land is cultivated, but significant areas remain under natural vegetation. Despite previous studies of the SGS carbon cycle, not all aspects have been completely addressed, including gross productivity, ecosystem respiration, and ecophysiological parameters. Our analysis of 1998 − 2007 flux tower measurements at five Bowen ratio–energy balance (BREB) and three eddy covariance (EC) sites characterized seasonal and interannual variability of gross photosynthesis and ecosystem respiration. Identification of the nonrectangular hyperbolic equation for the diurnal CO2 exchange, with vapor pressure deficit (VPD) limitation and exponential temperature response, quantified quantum yield α, photosynthetic capacity Amax, and respiration rate rd with variation ranges (19 < α < 51 mmol mol− 1, 0.48 < Amax < 2.1 mg CO2 m− 2 s− 1, 0.15 < rd < 0.49 mg CO2 m− 2 s− 1). Gross photosynthesis varied from 1 100 to 2 700 g CO2 m− 2 yr− 1, respiration from 900 to 3,000 g CO2 m− 2 yr− 1, and net ecosystem production from − 900 to + 700 g CO2 m− 2 yr− 1, indicating that SGS may switch from a sink to a source depending on weather. Comparison of the 2004 − 2006 measurements at two BREB and two parallel EC flux towers located at comparable SGS sites showed moderately higher photosynthesis, lower respiration, and higher net production at the BREB than EC sites. However, the difference was not related only to methodologies, as the normalized difference vegetation index at the BREB sites was higher than at the EC sites. Overall magnitudes and seasonal patterns at the BREB and the EC sites during the 3-yr period were similar, with trajectories within the ± 1.5 standard deviation around the mean of the four sites and mostly reflecting the effects of meteorology.*

Giri, A., Heckathorn, S., Mishra, S., & Krause, C. (2017). Heat stress decreases levels of nutrient-uptake and -assimilation proteins in tomato roots. *Plants, 6*(1), 443-448. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85010773993&doi=10.3390%2fplants6010006&partnerID=40&md5=7bcc19a959c795124c9e70acb243c509. doi:10.3390/plants6010006
Research Tags: Crops

Abstract: *Global warming will increase root heat stress, which is already common under certain conditions. Effects of heat stress on root nutrient uptake have rarely been examined in intact plants, but the limited results indicate that heat stress will decrease it; no studies have examined heat-stress effects on the concentration of nutrient-uptake proteins. We grew Solanum lycopersicum (tomato) at 25 °C/20 °C (day/night) and then transferred some plants for six days to 35 °C /30 °C (moderate heat) or 42 °C/37 °C (severe heat) (maximum root temperature = 32 °C or 39 °C, respectively); plants were then moved back to control conditions for seven days to monitor recovery. In a second experiment, plants were grown for 15 days at 28 °C/23 °C, 32 °C/27 °C, 36 °C/31 °C, and 40 °C/35 °C (day/night). Concentrations of nutrient-uptake and -assimilation proteins in roots were determined using protein-specific antibodies and ELISA (enzyme-linked immunosorbent assay). In general, (1) roots were affected by heat more than shoots, as indicated by decreased root:shoot mass ratio, shoot vs. root %N and C, and the level of nutrient metabolism proteins vs. less sensitive photosynthesis and stomatal conductance; and (2) negative effects on roots were large and slow-to-recover only with severe heat stress (40 °C–42 °C). Thus, short-term heat stress, if severe, can decrease total protein concentration and levels of nutrient-uptake and -assimilation proteins in roots. Hence, increases in heat stress with global warming may decrease crop production, as well as nutritional quality, partly via effects on root nutrient relations.*

Glenn, E. M., Lesmeister, D. B., Davis, R. J., Hollen, B., & Poopatanapong, A. (2017). Estimating density of a territorial species in a dynamic landscape. *Landscape Ecology, 32*(3), 563-579. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84997712895&doi=10.1007%2fs10980-016-0467-6&partnerID=40&md5=2c3ef0b1992961e8949d90669af67fd7. doi:10.1007/s10980-016-0467-6

Research Tags: Wildlife

Abstract: *Context*

Conservation planning for at-risk species requires understanding of where species are likely to occur, how many individuals are likely to be supported on a given landscape, and the ability to monitor those changes through time.

Objectives

We developed a distribution model for northern spotted owls that incorporates both habitat suitability and probability of territory occupancy while accounting for interspecies competition.

Methods

We developed range-wide habitat suitability maps for two time periods (1993 and 2012) for northern spotted owls that accounted for regional differences in habitat use and home range size. We used these maps for a long-term demographic monitoring study area to assess habitat change and estimate the number of potential territories based on available habitat for both time periods. We adjusted the number of potential territories using known occupancy rates to estimate owl densities for both time periods. We evaluated our range-wide habitat suitability model using independent survey data.

Results

Our range-wide habitat maps predicted areas suitable for territorial spotted owl presence well. On the demographic study area, the amount of habitat declined 19.7% between 1993 and 2012, while our estimate of the habitat-based carrying capacity declined from 150 to 146 territories. Estimated number of occupied territories declined from 94 to 57.

Conclusions

Conservation and recovery of at-risk species depends on understanding how habitat changes over time in response to factors such as wildfire, climate change, biological invasions, and interspecies competition, and how these changes influence species distribution. We demonstrate a model-based approach that provides an effective planning tool.

Glenny, W. R., Runyon, J. B., & Burkle, L. A. (2018). Drought and increased CO<inf>2</inf> alter floral visual and olfactory traits with context-dependent effects on pollinator visitation. *New Phytologist, 220*(3), 785-798. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044379271&doi=10.1111%2fnph.15081&partnerID=40&md5=e895cde4c43ac5eaa2177d65b8b9dc29. doi:10.1111/nph.15081

Research Tags: Wildlife, Weather

Abstract: *Climate change can alter species interactions essential for maintaining biodiversity and ecosystem*

function, such as pollination. Understanding the interactive effects of multiple abiotic conditions on floral traits and pollinator visitation are important to anticipate the implications of climate change on pollinator services.

Floral visual and olfactory traits were measured from individuals of four forb species subjected to drought or normal water availability, and elevated or ambient concentrations of CO2 in a factorial design. Pollinator visitation rates and community composition were observed in single-species and multi-species forb assemblages.

Drought decreased floral visual traits and pollinator visitation rates but increased volatile organic compound (VOC) emissions, whereas elevated CO2 positively affected floral visual traits, VOC emissions and pollinator visitation rates. There was little evidence of interactive effects of drought and CO2 on floral traits and pollinator visitation. Interestingly, the effects of climate treatments on pollinator visitation depended on whether plants were in single- or multi-species assemblages.

Components of climate change altered floral traits and pollinator visitation, but effects were modulated by plant community context. Investigating the response of floral traits, including VOCs, and context-dependency of pollinator attraction provides additional insights and may aid in understanding the overall effects of climate change on plant–pollinator interactions.

Godsey, S. E., Marks, D., Kormos, P. R., Seyfried, M. S., Enslin, C. L., Winstral, A. H., . . . Link, T. E. (2018). Eleven years of mountain weather, snow, soil moisture and streamflow data from the rain-snow transition zone - The Johnston Draw catchment, Reynolds Creek Experimental Watershed and Critical Zone Observatory, USA. *Earth System Science Data, 10*(3), 1207-1216. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049409723&doi=10.5194%2fessd-10-1207-2018&partnerID=40&md5=d7646c720da6dc21390284352a59220d. doi:10.5194/essd-10-1207-2018

Research Tags: Weather

Abstract: *Detailed hydrometeorological data from the rain-to-snow transition zone in mountain regions are limited. As the climate warms, the transition from rain to snow is moving to higher elevations, and these changes are altering the timing of downslope water delivery. To understand how these changes impact hydrological and biological processes in this climatologically sensitive region, detailed observations from the rain-to-snow transition zone are required. We present a complete hydrometeorological dataset for water years 2004 through 2014 for a watershed that spans the rain-to-snow transition zone (https://doi.org/10.15482/usda.adc/1402076). The Johnston Draw watershed (1.8 km2), ranging from 1497 to 1869 m in elevation, is a sub-watershed of the Reynolds Creek Experimental Watershed (RCEW) in southwestern Idaho, USA. The dataset includes continuous hourly hydrometeorological variables across a 372 m elevation gradient, on north- and south-facing slopes, including air temperature, relative humidity, and snow depth from 11 sites in the watershed. Hourly measurements of incoming shortwave radiation, precipitation, wind speed and direction, soil moisture, and soil temperature are available at selected stations. The dataset includes hourly stream discharge measured at the watershed outlet. These data provide the scientific community with a unique dataset useful for forcing and validating hydrological models and will allow for better representation and understanding of the complex processes that occur in the rain-to-snow transition zone.*

Goeking, S. A., Izlar, D. K., & Edwards, T. C. (2019). A Landscape-Level Assessment of Whitebark Pine Regeneration in the Rocky Mountains, USA. *Forest Science, 65*(1), 87-99. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062176150&doi=10.1093%2fforsci%2ffxy029&partnerID=40&md5=91008f0e2babd571ab1b4f98ec32bdda. doi:10.1093/forsci/fxy029

Research Tags: Forestry

Abstract: *Whitebark pine (Pinus albicaulis Engelm.) has recently experienced high mortality due to multiple stressors, and future population viability may rely on natural regeneration. We assessed whitebark pine seedling densities throughout the US Rocky Mountains and identified stand, site, and climatic variables related to seedling presence based on data from 1,217 USDA Forest Service Forest Inventory and Analysis plots. Although mean densities were highest in the whitebark pine forest type, 83% of sites with seedlings present occurred in non-whitebark pine forest types, and the highest densities occurred in the lodgepole pine forest type. To identify factors related to whitebark pine seedling presence, we compared the results generated from three statistical models: logistic regression, classification tree, and random forests. All three models identified* *cover of grouse whortleberry (Vaccinium scoparium Leiberg ex Coville) as an important predictor, two models distinguished live and dead whitebark pine basal area and elevation, and one model recognized seasonal temperature. None of the models identified forest type as an important predictor. Understanding these factors may help managers identify areas where natural regeneration of whitebark pine is likely to occur, including sites in non-whitebark pine forest types.*

Gollany, H. T., & Elnaggar, A. A. (2017). Simulating soil organic carbon changes across toposequences under dryland agriculture using CQESTR. *Ecological Modelling, 355*, 97-104. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018560462&doi=10.1016%2fj.ecolmodel.2017.03.024&partnerID=40&md5=eeb99b315d89c193c473a6ef04d06a26. doi:10.1016/j.ecolmodel.2017.03.024

Research Tags: Soil, Crops

Abstract: *Soil organic carbon (SOC) and its management under dryland cropping systems are very critical for both crop productivity and environment health. The objective of this study was to evaluate the performance of CQESTR, a process-based C model, in simulating SOC changes across toposequences of selected fields and agriculture management practices along a precipitation gradient in a dryland region of Oregon, USA. Geo-referenced soil samples were collected from summit (SU), shoulder (SH), backslope (BS), footslope (FS), and toeslope (TS) positions during early 1980s and early 2000s. Simulation scenarios were developed based on field management practices, crop rotations, soil properties, and climatic data. CQESTR simulated results were compared with the measured SOC from each landscape position. Significant (P < 0.0001) correlations (r = 0.93) were found between the measured and the simulated SOC at SU, SH (r = 0.91), BS (r = 0.83), FS (r = 0.89), and TS (r = 0.89). The smallest correlation value at BS could be from soil deposition due to erosion. No significant changes in SOC were found between SU, SH, BS, and FS landscape positions; however, TS had the highest SOC (10.8 ± .8 g C kg−1). CQESTR successfully simulated SOC at most of the studied sites and landscape positions, except at TS for a location with high annual deposition of C-rich soil eroded from the upper landscape position. CQESTR could be used to predict SOC changes across toposequence and at the landscape scale level with reasonable accuracy. The results were supported by a linear relation with an r2 of 0.89 and a low mean square deviation (MSD = 0.24) between the measured and the simulated SOC.*

Gollany, H. T., & Polumsky, R. W. (2018). Simulating soil organic carbon responses to cropping intensity, tillage, and climate change in Pacific Northwest Dryland. *Journal of Environmental Quality, 47*(4), 625-634. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049459328&doi=10.2134%2fjeq2017.09.0374&partnerID=40&md5=3bac5c8440170f23daf2f43fc6334932. doi:10.2134/jeq2017.09.0374

Research Tags: Soil, Crops, Weather

Abstract: *Managing dryland cropping systems to increase soil organic C (SOC) under changing climate is challenging after decades of winter wheat (Triticum aestivum L.)–fallow and moldboard plow tillage (W–F/MP). The objective was to use CQESTR, a process-based C model, and SOC data collected in 2004, 2008, and 2012 to predict the best management to increase SOC under changing climate in four cropping systems, which included continuous wheat under no tillage (W–W/NT), wheat and sorghum × sudangrass [Sorghum bicolor (L.) Moench. × Sorghum sudanese L.] under no tillage, wheat–fallow under sweep tillage, and W–F/MP. Since future yields and climate are uncertain, 20 scenarios for each cropping system were simulated with four climate projections and five crop yield scenarios (current crop yields, and 10 or 30% greater or lesser yields). Measured and simulated SOC were significantly (p < 0.0001) correlated (r = 0.98) at all soil depths. Predicted SOC changes ranged from −12.03 to 2.56 Mg C ha−1 in the 1-m soil depth for W–F/MP and W–W/NT, respectively, during the 2012 to 2052 predictive period. Only W–W/NT sequestered SOC at a rate of 0.06 Mg C ha−1 yr−1 under current crop yields and climate. Under climate change and yield scenarios, W–W/NT lost SOC except with a 30% wheat yield increase for 40 yr. Predicted SOC increases in W–W/NT were 0.71, 1.16, and 0.88 Mg C ha−1 under the Oregon Climate Assessment Reports for low emissions and high emissions and the Regional Climate Model version 3 with boundary conditions from the Third Generation Coupled Global Climate Model, respectively, with 30% yield increases. Continuous no-till cropping would increase SOC and improve soil health and resiliency to lessen the impact of extreme weather.*

Gollany, H. T., & Venterea, R. T. (2018). Measurements and models to identify agroecosystem practices that Enhance

soil organic carbon under changing climate. *Journal of Environmental Quality, 47*(4), 579-587. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049482732&doi=10.2134%2fjeq2018.05.0213&partnerID=40&md5=a15371a375a1af65aeb50ed2c2f533e8. doi:10.2134/jeq2018.05.0213
Research Tags: Soil, Crops
Abstract: *Adapting to the anticipated impacts of climate change is a pressing issue facing agriculture, as precipitation and temperature changes are expected to have major effects on agricultural production in many regions of the world. These changes will also affect soil organic matter decomposition and associated stocks of soil organic C (SOC), which have the potential to feed back to climate change and affect agroecosystem resiliency. This special section brings together multiple efforts to assess effects of climate change on SOC stocks around the globe in grassland, pasture, and crop agroecosystems under varying management practices. The overall goal of these efforts is to identify optimum practices to enhance SOC accumulation. In this article, we summarize the highlights of these papers and assess their broader implications for future research to enhance agroecosystem SOC accumulation and resiliency to climate change. Fourteen of the twenty contributions apply dynamic process-based models to assess climate and/or long-term management impacts on SOC stocks, and four papers use statistical SOC models across landscapes or regions. Also included are one meta-analysis and one long-term study. The models applied in this collection performed well when reliable input data were available, underlining the usefulness of modeling efforts to inform management decisions that enhance SOC stocks. Overall, the findings confirm that most agroecosystems have the potential to store SOC through improved management. However, this will be challenging, particularly for dryland agriculture, unless crop yield and crop biomass increase under projected climate change.*

Gomez-Casanovas, N., Delucia, N. J., Bernacchi, C. J., Boughton, E. H., Sparks, J. P., Chamberlain, S. D., & Delucia, E. H. (2018). Grazing alters net ecosystem C fluxes and the global warming potential of a subtropical pasture. *Ecological Applications, 28*(2), 557-572. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042700630&doi=10.1002%2feap.1670&partnerID=40&md5=8c4ac11459d25876b31a5091b4428b28. doi:10.1002/eap.1670
Research Tags: Livestock, Grassland, Soil
Abstract: *The impact of grazing on C fluxes from pastures in subtropical and tropical regions and on the environment is uncertain, although these systems account for a substantial portion of global C storage. We investigated how cattle grazing influences net ecosystem CO2 and CH4 exchange in subtropical pastures using the eddy covariance technique. Measurements were made over several wet-dry seasonal cycles in a grazed pasture, and in an adjacent pasture during the first three years of grazer exclusion. Grazing increased soil wetness but did not affect soil temperature. By removing aboveground biomass, grazing decreased ecosystem respiration (Reco) and gross primary productivity (GPP). As the decrease in Reco was larger than the reduction in GPP, grazing consistently increased the net CO2 sink strength of subtropical pastures (55, 219 and 187 more C/m2 in 2013, 2014, and 2015). Enteric ruminant fermentation and increased soil wetness due to grazers, increased total net ecosystem CH4 emissions in grazed relative to ungrazed pasture (27–80%). Unlike temperate, arid, and semiarid pastures, where differences in CH4 emissions between grazed and ungrazed pastures are mainly driven by enteric ruminant fermentation, our results showed that the effect of grazing on soil CH4 emissions can be greater than CH4 produced by cattle. Thus, our results suggest that the interactions between grazers and soil hydrology affecting soil CH4 emissions play an important role in determining the environmental impacts of this management practice in a subtropical pasture. Although grazing increased total net ecosystem CH4 emissions and removed aboveground biomass, it increased the net storage of C and decreased the global warming potential associated with C fluxes of pasture by increasing its net CO2 sink strength.*

Gomez-Casanovas, N., DeLucia, N. J., Hudiburg, T. W., Bernacchi, C. J., & DeLucia, E. H. (2018). Conversion of grazed pastures to energy cane as a biofuel feedstock alters the emission of GHGs from soils in Southeastern United States. *Biomass and Bioenergy, 108*, 312-322. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037644923&doi=10.1016%2fj.biombioe.2017.11.020&partnerID=40&md5=173f3b56a877084001a643d318c9df9b. doi:10.1016/j.biombioe.2017.11.020
Research Tags: Grassland, Crops, Emissions, Energy, Soil
Abstract: *The cultivation of energy cane throughout the Southeastern United States may displace grazed*

pastures on organic soil (Histosols) to meet growing demands for biofuels. We combined results from a field experiment with a biogeochemical model to improve our understanding of how the conversion of pasture to energy cane during early crop establishment affected soil GHG (CO2, CH4, and N2O) exchange with the atmosphere. GHG fluxes were measured under both land uses during wet, hot and cool, dry times of year, and following a fertilization event. We also simulated the impact of changes in precipitation on GHG exchange. Higher fertilization of cane contributed to greater emission of N2O than pasture during warmer and wetter times of the year. The model predicted that energy cane emitted more nitrogen than pasture during simulated wetter than drier years. The modeled emission factor for N2O was 20 to 30-fold higher than the default value from IPCC (1%), suggesting that the default IPCC value could dramatically underestimate the consequences of this land conversion on the climate system. Predicted soil CH4 and CO2 fluxes were higher in pasture than energy cane, and this difference was not affected by increasing precipitation. Model simulations predicted that soils under first year cane emit more GHGs than pasture, particularly during wet years, but this difference disappeared two years after energy cane establishment. Our results suggest that management practices may be important in determining soil GHG emissions from energy cane on organic soils particularly during the first year of cane establishment.

Gonzalez-Andujar, J. L., Aguilera, M. J., Davis, A. S., & Navarrete, L. (2019). Disentangling weed diversity and weather impacts on long-term crop productivity in a wheat-legume rotation. *Field Crops Research, 232*, 24-29. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058799462&doi=10.1016%2fj.fcr.2018.12.005&partnerID=40&md5=9ebbccbb9aa61d1e6bc490b093f34a3e. doi:10.1016/j.fcr.2018.12.005

Research Tags: Crops, Weather

Abstract: *Weeds can harm crop growth and yield by competing for light, water, and nutrients and can produce high global potential yield losses if not controlled. However, the effects of weed diversity have not been fully examined. Here, we have used long-term data (31 years) of a cereal–legume rotation from a locality in central Spain to determine the importance of internal and external (weather and weed diversity) factors on crop yield. We used a novel methodology based on dynamic systems to explore how weed diversity and weather factors interact with crop yields. The dynamic model used here integrated internal and external factors with additive or non-linear variants. We showed that internal processes (self-regulation) are involved in wheat and legume yield temporal fluctuations. The self-regulation of crop production appears to be stronger in cereal (85%) than in legume (45%) systems, and therefore legumes seem to be more sensitive to external variations. The legume crop was not affected by weed diversity but was instead negatively influenced by average temperature for the growing season. In wheat, there was a negative, non-linear response of yield to the interaction between richness and minimum temperature for the growing season. An improved understanding of the influence of weed diversity on crop yield may help to anticipate the effects of climate change and guide management practices to maintain crop productivity under sustainable agriculture.*

Gonzalez-Benecke, C. A., Zhao, D., Samuelson, L. J., Martin, T. A., Leduc, D. J., & Jack, S. B. (2018). Local and general above-ground biomass functions for pinus palustris trees. *Forests, 9*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047833488&doi=10.3390%2ff9060310&partnerID=40&md5=58d43445a01ac59760f78a05f01524d6. doi:10.3390/f9060310

Research Tags: Forestry

Abstract: *There is an increasing interest in estimating biomass for longleaf pine (Pinus palustris Mill.), an important tree species in the southeastern U.S. Most of the individual-tree allometric models available for the species are local, relying on stem diameter outside bark at breast height (DBH) and total tree height (HT), but seldom include stand-level variables such as stand age, basal area or stand density. Using the biomass dataset of 296 longleaf pine trees sampled in the southeastern U.S. by different forestry research institutions, we developed a set of local and general systems of tree biomass equations to predict total tree total above-stump biomass, bole biomass outside bark, live branch biomass and live foliage biomass. The local systems were based on DBH or DBH and HT, and the general systems included in addition to DBH and HT, stand-level variables such as age, basal area and stand density. This paper reports the first set of general allometric equations reported for longleaf pine trees. These systems of biomass equations provide tools to support managers in making management decisions for the species in a variety of ecological, silvicultural and*

economics applications. The systems can be applied to trees growing over a large geographical area and having a wide range of ages and stand characteristics.

Goodrich, B. A., & Waring, K. M. (2017). Pinus strobiformis seedling growth in southwestern US mixed conifer forests in managed and non-managed stands. *Forestry, 90*(3), 393-403. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020693950&doi=10.1093%2fforestry%2fcpw057&partnerID=40&md5=fe54d96f13aae4aeb774e530b35ad223. doi:10.1093/forestry/cpw057
Research Tags: Forestry
Abstract: *Resources available for tree regeneration growth vary within and between stands. Understanding variation can help land managers choose appropriate sites and management strategies for desired regeneration. We measured southwestern white pine (Pinus strobiformis, SWWP) age, annual height growth, stem diameter, crown widths and lengths, needle lengths and branch morphology to determine geographic variation and effects of different silvicultural treatments on seedling height growth in southwestern US mixed conifer stands. We hypothesized both between- and within-stand variables would be related to mean and recent height growth. Thirty-seven per cent of the variance in mean annual growth (cm yr−1) was explained; growth increased with Douglas-fir site index and on north-facing slopes, and decreased with increasing ponderosa pine densities and per cent ground cover of litter. Recent 3-year height growth increased with site index and decreased with per cent ground cover of litter, increasing canopy closure and in the presence of a nearby microsite object. Height growth was less near downed-woody debris and next to the base of overstory trees. Land managers can use results by regenerating SWWP (natural or planted) on higher productivity sites and north-facing slopes, and avoiding areas with thick layers of litter/duff or planting in areas with high ponderosa pine seedling densities. Stimulating natural regeneration or outplanting seedlings may be necessary to sustain SWWP with the dual threats of climate change and an invasive pathogen.*

Goodwell, A. E., Kumar, P., Fellows, A. W., & Flerchinger, G. N. (2018). Dynamic process connectivity explains ecohydrologic responses to rainfall pulses and drought. *Proceedings of the National Academy of Sciences of the United States of America, 115*(37), E8604-E8613. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052992817&doi=10.1073%2fpnas.1800236115&partnerID=40&md5=cdf5eb97a7793a58044b95ce977f8ea3. doi:10.1073/pnas.1800236115
Research Tags: Water, Weather
Abstract: *Ecohydrologic fluxes within atmosphere, vegetation, and soil systems exhibit a joint variability that arises from forcing and feedback interactions. These interactions cause fluctuations to propagate between variables at many time scales. In an ecosystem, this connectivity dictates responses to climate change, land-cover change, and weather events and must be characterized to understand resilience and sensitivity. We use an information theory-based approach to quantify connectivity in the form of information flow associated with the propagation of fluctuations between variables. We apply this approach to study ecosystems that experience changes in dry-season moisture availability due to rainfall and drought conditions. We use data from two transects with flux towers located along elevation gradients and quantify redundant, synergistic, and unique flow of information between lagged sources and targets to characterize joint asynchronous time dependencies. At the Reynolds Creek Critical Zone Observatory in Idaho, a dry-season rainfall pulse leads to increased connectivity from soil and atmospheric variables to heat and carbon fluxes. At the Southern Sierra Critical Zone Observatory in California, separate sets of dominant drivers characterize two sites at which fluxes exhibit different drought responses. For both cases, our information flow-based connectivity characterizes dominant drivers and joint variability before, during, and after disturbances. This approach to gauge the responsiveness of ecosystem fluxes under multiple sources of variability furthers our understanding of complex ecohydrologic systems.*

Gosejohan, M. C., Weisberg, P. J., & Merriam, K. E. (2017). Hydrologic Influences on Plant Community Structure in Vernal Pools of Northeastern California. *Wetlands, 37*(2), 257-268. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006354891&doi=10.1007%2fs13157-016-0863-3&partnerID=40&md5=ba9d2506d9be4a6c6606ec87e18f3894. doi:10.1007/s13157-016-0863-3
Research Tags: Water
Abstract: *Plant communities in vernal pools are distributed along continuous elevation gradients associated*

with subtle variations in microtopography, reflected in spatially heterogeneous hydrologic regimes. We quantified the role of hydrologic and environmental variables for influencing species assemblages within two vernal pool landscapes in northeastern California. A novel combination of approaches including remote photography of water depth stage gauges, vegetation sampling along elevation gradients, and topographic surveys were used to measure hydrology and plant community composition at precise locations. Multivariate analyses were used to classify vernal pool plant communities and classification tree analysis was used to model plant community distribution across hydrologic thresholds. Three plant community groups were distinguished according to localized hydrologic regimes. Inundation period and maximum depth were the only variables found to be predictive of plant distribution. Hydrologic thresholds for the three community groups were based on inundation period: Short (< 71 days), Medium (≥ 71 days but <209 days), and Long (≥ 209 days). The distribution of plant assemblages was strongly correlated with key hydrologic gradients. Quantification of such relationships will be useful in forecasting ecohydrological responses of vernal pool vegetation to climate change, helping to guide future monitoring, management and restoration efforts for these unique ecosystems.

Goslee, S. C., Gonet, J. M., & Skinner, R. H. (2017). Freeze tolerance of perennial ryegrass and implications for future species distribution. *Crop Science, 57*(5), 2875-2880. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029606537&doi=10.2135%2fcropsci2017.02.0135&partnerID=40&md5=8320bdfe0f3c6287936792babc512882. doi:10.2135/cropsci2017.02.0135

Research Tags: Crops, Weather

Abstract: *Poor winter hardiness is one of the factors limiting the use of the palatable and productive cool-season forage grass perennial ryegrass (Lolium perenne L) in the northeastern United States. We compared freeze tolerance among seedlings of 13 commercial cultivars of perennial ryegrass in a controlled environment chamber. After a 14-d acclimation period, plants were chilled to −10, −15, or −20°C for 1 h, then gradually warmed. After 36 d, surviving plants were counted then harvested and weighed. Mortality rate varied significantly among cultivars (0–13% at −10°C, 47–100% at −20°C). The temperature at which 50% of plants would die (LT50) ranged from −12.9 to −20.8°C. Hardiness ratings provided by the breeder did not match well with LT50 except for the most hardy cultivars. Extreme minimum temperature predictions were extracted from regional climate forecasts for three 30-yr periods: baseline (1960–1989), short-term future (2015–2044), and long-term future (2070–2099). During the baseline period, only 2 to 33% of the northeastern United States was warm enough for these cultivars to survive during at least 50% of winters. Potential tolerable area may increase to 57 to 88% by 2099. Although other factors such as snow cover and variability of winter temperatures affect winter survival in the field, breeding for freeze tolerance has increased the potential extent of perennial ryegrass. Further improvements and the changing climate may greatly increase the utility of perennial ryegrass as a forage in the northeastern United States.*

Graham, R. C., Schoeneberger, P. J., & Breiner, J. M. (2017). Genesis and physical behavior of soils on sandstone and shale in Southern California. *Soil Science, 182*(6), 216-226. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044046928&doi=10.1097%2fSS.0000000000000212&partnerID=40&md5=b113438a35d8ba12fcfe3204d725cbd9. doi:10.1097/SS.0000000000000212

Research Tags: Soil

Abstract: *Sandstone- and shale-derived soils are common in southern California where they function in watersheds, support wildland ecosystems, and are subject to residential and infrastructure development. Because little is known about these soils on texturally contrasting parent materials, this study was designed to interpret their pedogenesis and accompanying soil physical behavior. The study area is in the chaparral-covered foothills of the San Gabriel Mountains, where the 400-mm mean annual precipitation comes as rain during the winter and summers are hot and dry. The soil on sandstone is an Alfisol with a fine-loamy argillic horizon and mixed mineralogy. It is leached of carbonates and has pH values of 5.7 to 6.8. The shale-derived soil is a clayey, smectitic Vertisol with accumulated calcium carbonate, indicating less leaching than the Alfisol. Soil organic carbon storage in the Alfisol (7.96 kg m−2) and Vertisol (9.87 kg m−2) is similar, but the Vertisol has additional carbon (4.88 kg m−2) in the form of calcium carbonate. The Vertisol has high shrink-swell potential, with coefficient of linear extensibility values mostly 0.09 to 0.12. The Alfisol has minimal shrink-swell potential. Available water capacities for the Alfisol soil horizons (4%–20%) range higher than those of the Vertisol (4%–11%), but the thicker regolith profile of the Vertisol means it can store more plant-available* *water overall. Field saturated hydraulic conductivity was similar for the soils during the wet season (0.2–1.6 cm h−1), but was higher in the extensively cracked Vertisol during the dry season. The available water capacities (4%) and saturated hydraulic conductivities (0.2–0.4 cm h−1) of the Cr horizons of both soils indicate that these weathered bedrocks are functional parts of the soil hydrologic system. The divergent properties of the soils are related to the nature of the parent material and its evolution in response to soil-water dynamics.*

Green, T. R., & Anapalli, S. S. (2018). Irrigation variability and climate change affect derived distributions of simulated water recharge and nitrate leaching. *Water International, 43*(6), 829-845. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055082392&doi=10.1080%2f02508060.2018.1515568&partnerID=40&md5=28af534c23de5fda9702f89255c5c74d. doi:10.1080/02508060.2018.1515568
Research Tags: Water
Abstract: *Irrigation ('blue') water has high value as municipalities seek water security under growing populations and projected climates, but spatial variability makes estimating return flows to groundwater challenging. We demonstrate a framework for simulating spatially variable infiltration and derived distributions of return flows using an agricultural and vadose zone model to simulate recharge and nitrate leaching under irrigated corn in semi-arid northeastern Colorado, USA. Derived distributions indicated increased historical recharge (2–42%) as the spatial variability of applied irrigation increased. Projected climate in 2050 increased recharge above historical rates by up to 58%, but climatic effects decreased with increasing irrigation variability.*

Greenberg, C. H., Zarnoch, S. J., & Austin, J. D. (2017). Weather, hydroregime, and breeding effort influence juvenile recruitment of anurans: Implications for climate change. *Ecosphere, 8*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019889074&doi=10.1002%2fecs2.1789&partnerID=40&md5=defaf34a5c22f1e1c32c1b88ac92acc5. doi:10.1002/ecs2.1789
Research Tags: Wildlife
Abstract: *Amphibians that primarily breed in ephemeral wetlands are especially vulnerable to climate change because they rely on rainfall or temperature to initiate breeding and create suitable hydroregimes (water duration, timing, frequency, depth) for reproductive success. Hydroregime effects on reproductive success are likely to differ among species because of differences in reproductive strategies: the length and timing of breeding period, rate of larval development, and timing of metamorphosis. We applied an information-theoretic approach to 22 consecutive years of continuous amphibian trapping data at eight ephemeral wetlands to test hypotheses regarding environmental (hydroregime, weather) and biological (adult breeding effort) factors affecting juvenile recruitment (JR) by six focal species representing four reproductive strategies. We hypothesized that (1) JR by species with similar reproductive strategies would be influenced by similar variables; (2) JR would be higher for all species when models encompassed the maximum time span of potential tadpole occurrence and development; and (3) JR rates within individual wetlands and breeding cycles would correlate most closely between species with similar breeding strategies. The best model for all focal species (except Scaphiopus holbrookii) encompassed the maximum time span and indicated that ≥1 hydroregime variable, total precipitation, or both were important drivers of reproductive success; average air temperature was not. Continuous hydroperiod through peak juvenile emigration was an important predictor of JR for species with prolonged breeding periods, slow larval development, and a "fixed" late spring start date for juvenile emigration (regardless of when oviposition occurred, or cohort age; Lithobates capito, Lithobates sphenocephalus), but not for species with rapid larval development and continual emigration as cohorts complete metamorphosis (Anaxyrus terrestris, Anaxyrus quercicus, Gastrophryne carolinensis, S. holbrookii). Total rainfall was positively associated with recruitment for most species; depth characteristics affected species differently. Annual JR was positively correlated among species with similar reproductive strategies. Our results indicate that weather and hydroregime characteristics interact with reproductive strategies that differ among amphibian species and influence reproductive plasticity, opportunity, and success. Effects of altered weather patterns associated with climate change on amphibian reproductive success may correspond more closely among species having similar reproductive strategies, with critical implications for population trends and assemblages.*

Greer, B. T., Still, C., Cullinan, G. L., Brooks, J. R., & Meinzer, F. C. (2018). Polyploidy influences plant–environment

interactions in quaking aspen (Populus tremuloides Michx.). *Tree Physiology, 38*(4), 630-640. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050581499&doi=10.1093%2ftreephys%2ftpx120&partnerID=40&md5=b866e7de747a94e778ee7a2ae655365c. doi:10.1093/treephys/tpx120
Research Tags: Forestry
Abstract: *Quaking aspen (Populus tremuloides Michx.), a widespread and keystone tree species in North America, experienced heat and drought stress in the years 2002 and 2003 in the southwestern United States. This led to widespread aspen mortality that has altered the composition of forests, and is expected to occur again if climate change continues. Understanding interactions between aspen and its environments is essential to understanding future mortality risk in forests. Polyploidy, which is common in aspen, can modify plant structure and function and therefore plant–environment interactions, but the influence of polyploidy on aspen physiology is still not well understood. Furthermore, the ploidy types of aspen have different biogeographies, with triploids being most frequent at lower latitudes in generally warmer and drier climates, while the northerly populations are virtually 100% diploid. This suggests that ploidy–environment interactions differ, and could mean that the ploidy types have different vulnerabilities to environmental stress. In this study, to understand aspen ploidy–environment interactions, we measured 38 different traits important to carbon uptake, water loss and water-use efficiency in diploid and triploid aspen in Colorado. We found that triploid aspen had lower stand density, and greater leaf area, leaf mass, leaf mass per area, percent nitrogen content, chlorophyll content and stomatal size. These differences corresponded to greater potential net carbon assimilation (A, measured using A/Ci curves, and chlorophyll fluorescence) and stomatal conductance (gs) in triploids than diploids. While triploid aspen had higher intrinsic water-use efficiency (iWUE, calculated from measurements of δ13C in leaf tissue), they also had greater potential water loss from higher measured gs and lower stomatal sensitivity to increasing vapor pressure deficit. Therefore, despite greater iWUE, triploids may have lower resilience to climate-induced stress. We conclude that ploidy type strongly influences physiological traits and function, and mediates drought stress responses in quaking aspen.*

Griffin-Nolan, R. J., Carroll, C. J. W., Denton, E. M., Johnston, M. K., Collins, S. L., Smith, M. D., & Knapp, A. K. (2018). Legacy effects of a regional drought on aboveground net primary production in six central US grasslands. *Plant Ecology, 219*(5), 505-515. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045017225&doi=10.1007%2fs11258-018-0813-7&partnerID=40&md5=e0949b7f17e898226b614c9f6053a4a6. doi:10.1007/s11258-018-0813-7
Research Tags: Weather, Grassland
Abstract: *Global climate models predict increases in the frequency and severity of drought worldwide, directly affecting most ecosystem types. Consequently, drought legacy effects (drought-induced alterations in ecosystem function postdrought) are expected to become more common in ecosystems varying from deserts to grasslands to forests. Drought legacies in grasslands are usually negative and reduce ecosystem function, particularly after extended drought. Moreover, ecosystems that respond strongly to drought (high sensitivity) might be expected to exhibit the largest legacy effects the next year, but this relationship has not been established. We quantified legacy effects of a severe regional drought in 2012 on postdrought (2013) aboveground net primary productivity (ANPP) in six central US grasslands. We predicted that (1) the magnitude of drought legacy effects measured in 2013 would be positively related to the sensitivity of ANPP to the 2012 drought, and (2) drought legacy effects would be negative (reducing 2013 ANPP relative to that expected given normal precipitation amounts). The magnitude of legacy effects measured in 2013 was strongly related (r2 = 0.88) to the sensitivity of ANPP to the 2012 drought across these six grasslands. However, contrary to expectations, positive legacy effects (greater than expected ANPP) were more commonly observed than negative legacy effects. Thus, while the sensitivity of ANPP to drought may be a useful predictor of the magnitude of legacy effects, short-term (1-year) severe droughts may cause legacy effects that are more variable than those observed after multiyear droughts.*

Griffin-Nolan, R. J., Ocheltree, T. W., Mueller, K. E., Blumenthal, D. M., Kray, J. A., & Knapp, A. K. (2019). Extending the osmometer method for assessing drought tolerance in herbaceous species. *Oecologia, 189*(2), 353-363. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059839667&doi=10.1007%2fs00442-019-04336-w&partnerID=40&md5=aa625c71aeaffe21e06c92b5308f8103. doi:10.1007/s00442-019-04336-w

Research Tags: Weather
Abstract: *Community-scale surveys of plant drought tolerance are essential for understanding semi-arid ecosystems and community responses to climate change. Thus, there is a need for an accurate and rapid methodology for assessing drought tolerance strategies across plant functional types. The osmometer method for predicting leaf osmotic potential at full turgor (πo), a key metric of leaf-level drought tolerance, has resulted in a 50-fold increase in the measurement speed of this trait; however, the applicability of this method has only been tested in woody species and crops. Here, we assess the osmometer method for use in herbaceous grassland species and test whether πo is an appropriate plant trait for understanding drought strategies of herbaceous species as well as species distributions along climate gradients. Our model for predicting leaf turgor loss point (πTLP) from πo (πTLP = 0.80πo–0.845) is nearly identical to the model previously presented for woody species. Additionally, πo was highly correlated with πTLP for graminoid species (πtlp = 0.944πo–0.611; r2 = 0.96), a plant functional group previously flagged for having the potential to cause erroneous measurements when using an osmometer. We report that πo, measured with an osmometer, is well correlated with other traits linked to drought tolerance (namely, leaf dry matter content and leaf vulnerability to hydraulic failure) as well as climate extremes linked to water availability. The validation of the osmometer method in an herb-dominated ecosystem paves the way for rapid community-scale surveys of drought tolerance across plant functional groups, which could improve trait-based predictions of ecosystem responses to climate change.*

Griffis, T. J., Chen, Z., Baker, J. M., Wood, J. D., Millet, D. B., Lee, X., . . . Turner, P. A. (2017). Nitrous oxide emissions are enhanced in a warmer and wetter world. *Proceedings of the National Academy of Sciences of the United States of America, 114*(45), 12081-12085. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033794225&doi=10.1073%2fpnas.1704552114&partnerID=40&md5=5a97676a3c522aa5fa275dde5dc36c42. doi:10.1073/pnas.1704552114
Research Tags: Emissions
Abstract: *Nitrous oxide (N2O) has a global warming potential that is 300 times that of carbon dioxide on a 100-y timescale, and is of major importance for stratospheric ozone depletion. The climate sensitivity of N2O emissions is poorly known, which makes it difficult to project how changing fertilizer use and climate will impact radiative forcing and the ozone layer. Analysis of 6 y of hourly N2O mixing ratios from a very tall tower within the US Corn Belt—one of the most intensive agricultural regions of the world—combined with inverse modeling, shows large interannual variability in N2O emissions (316 Gg N2O-N·y−1 to 585 Gg N2O-N·y−1). This implies that the regional emission factor is highly sensitive to climate. In the warmest year and spring (2012) of the observational period, the emission factor was 7.5%, nearly double that of previous reports. Indirect emissions associated with runoff and leaching dominated the interannual variability of total emissions. Under current trends in climate and anthropogenic N use, we project a strong positive feedback to warmer and wetter conditions and unabated growth of regional N2O emissions that will exceed 600 Gg N2O-N·y−1, on average, by 2050. This increasing emission trend in the US Corn Belt may represent a harbinger of intensifying N2O emissions from other agricultural regions. Such feedbacks will pose a major challenge to the Paris Agreement, which requires large N2O emission mitigation efforts to achieve its goals.*

Griffiths, N. A., Hanson, P. J., Ricciuto, D. M., Iversen, C. M., Jensen, A. M., Malhotra, A., . . . Weston, D. J. (2017). Temporal and spatial variation in peatland carbon cycling and implications for interpreting responses of an ecosystem-scale warming experiment. *Soil Science Society of America Journal, 81*(6), 1668-1688. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040638144&doi=10.2136%2fsssaj2016.12.0422&partnerID=40&md5=d17acee8e8a4b817036003e80db96eda. doi:10.2136/sssaj2016.12.0422
Research Tags: Soil, Emissions
Abstract: *We are conducting a large-scale, long-term climate change response experiment in an ombrotrophic peat bog in Minnesota to evaluate the effects of warming and elevated CO2 on ecosystem processes using empirical and modeling approaches. To better frame future assessments of peatland responses to climate change, we characterized and compared spatial vs. temporal variation in measured C cycle processes and their environmental drivers. We also conducted a sensitivity analysis of a peatland C model to identify how variation in ecosystem parameters contributes to model prediction uncertainty. High spatial variability in C cycle processes resulted in the inability to determine if the bog was a C source or sink, as the 95% confidence interval*

ranged from a source of 50 g C m–2 yr–1 to a sink of 67 g C m–2 yr–1. Model sensitivity analysis also identified that spatial variation in tree and shrub photosynthesis, allocation characteristics, and maintenance respiration all contributed to large variations in the pretreatment estimates of net C balance. Variation in ecosystem processes can be more thoroughly characterized if more measurements are collected for parameters that are highly variable over space and time, and especially if those measurements encompass environmental gradients that may be driving the spatial and temporal variation (e.g., hummock vs. hollow microtopographies, and wet vs. dry years). Together, the coupled modeling and empirical approaches indicate that variability in C cycle processes and their drivers must be taken into account when interpreting the significance of experimental warming and elevated CO2 treatments.

Grinde, A. R., Niemi, G. J., Sturtevant, B. R., Panci, H., Thogmartin, W., & Wolter, P. (2017). Importance of scale, land cover, and weather on the abundance of bird species in a managed forest. *Forest Ecology and Management, 405*, 295-308. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030181534&doi=10.1016%2fj.foreco.2017.09.057&partnerID=40&md5=15b8c455aa0fa737703cb58e1a6df4be. doi:10.1016/j.foreco.2017.09.057
Research Tags: Wildlife, Forestry
Abstract: *Climate change and habitat loss are projected to be the two greatest drivers of biodiversity loss over the coming century. While public lands have the potential to increase regional resilience of bird populations to these threats, long-term data are necessary to document species responses to changes in climate and habitat to better understand population vulnerabilities. We used generalized linear mixed models to determine the importance of stand-level characteristics, multi-scale land cover, and annual weather factors to the abundance of 61 bird species over a 20-year time frame in Chippewa National Forest, Minnesota, USA. Of the 61 species modeled, we were able to build final models with R-squared values that ranged from 26% to 69% for 37 species; the remaining 24 species models had issues with convergence or low explanatory power (R-squared < 20%). Models for the 37 species show that stand-level characteristics, land cover factors, and annual weather effects on species abundance were species-specific and varied within guilds. Forty-one percent of the final species models included stand-level characteristics, 92% included land cover variables at the 200 m scale, 51% included land cover variables at the 500 m scale, 46% included land cover variables at the 1000 m scale, and 38% included weather variables in best models. Three species models (8%) included significant weather and land cover interaction terms. Overall, models indicated that aboveground tree biomass and land cover variables drove changes in the majority of species. Of those species models including weather variables, more included annual variation in precipitation or drought than temperature. Annual weather variability was significantly more likely to impact abundance of species associated with deciduous forests and bird species that are considered climate sensitive. The long-term data and models we developed are particularly suited to informing science-based adaptive forest management plans that incorporate climate sensitivity, aim to conserve large areas of forest habitat, and maintain an historical mosaic of cover types for conserving a diverse and abundant avian assemblage.*

Groffman, P. M., Driscoll, C. T., Durán, J., Campbell, J. L., Christenson, L. M., Fahey, T. J., . . . Templer, P. H. (2018). Nitrogen oligotrophication in northern hardwood forests. *Biogeochemistry, 141*(3), 523-539. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046808039&doi=10.1007%2fs10533-018-0445-y&partnerID=40&md5=df47995b83bdab2b66bd211390bc5310. doi:10.1007/s10533-018-0445-y
Research Tags: Forestry
Abstract: *While much research over the past 30 years has focused on the deleterious effects of excess N on forests and associated aquatic ecosystems, recent declines in atmospheric N deposition and unexplained declines in N export from these ecosystems have raised new concerns about N oligotrophication, limitations of forest productivity, and the capacity for forests to respond dynamically to disturbance and environmental change. Here we show multiple data streams from long-term ecological research at the Hubbard Brook Experimental Forest in New Hampshire, USA suggesting that N oligotrophication in forest soils is driven by increased carbon flow from the atmosphere through soils that stimulates microbial immobilization of N and decreases available N for plants. Decreased available N in soils can result in increased N resorption by trees, which reduces litterfall N input to soils, further limiting available N supply and leading to further declines in soil N availability. Moreover, N oligotrophication has been likely exacerbated by changes in climate that*

increase the length of the growing season and decrease production of available N by mineralization during both winter and spring. These results suggest a need to re-evaluate the nature and extent of N cycling in temperate forests and assess how changing conditions will influence forest ecosystem response to multiple, dynamic stresses of global environmental change.

Grove, J. M., & Pickett, S. T. (2019). From transdisciplinary projects to platforms: expanding capacity and impact of land systems knowledge and decision making. *Current Opinion in Environmental Sustainability, 38*, 7-13. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065056407&doi=10.1016%2fj.cosust.2019.04.001&partnerID=40&md5=ac4c89e1f79ca2bd3ed7be8623eea4dd. doi:10.1016/j.cosust.2019.04.001

Research Tags: Research

Abstract: *Land system science can inform decision making to address societally important issues, including food, energy, and water security, livelihoods and lifestyles, biodiversity loss, and climate change. There is growing experience among scientists and practitioners with land systems as a transdisciplinary science. Most often, this experience has accumulated through short-term projects. However, there is a need for durable, long-term land system science platforms to address diverse types of complex, wicked problems, from immediate crises and emergencies over days and weeks; to sudden events over months and years; to extensive, pervasive, and subtle changes occurring over decades. In this paper, we offer a strategic framing of the issues and features for transdisciplinary land system science platforms that can be adapted and applied to local conditions.*

Gruber, A., Dorigo, W. A., Crow, W., & Wagner, W. (2017). Triple Collocation-Based Merging of Satellite Soil Moisture Retrievals. *IEEE Transactions on Geoscience and Remote Sensing, 55*(12), 6780-6792. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030651801&doi=10.1109%2fTGRS.2017.2734070&partnerID=40&md5=17fb62f85c5e39ea7b0c8e964bfc0389. doi:10.1109/TGRS.2017.2734070

Research Tags: Soil, Research

Abstract: *We propose a method for merging soil moisture retrievals from spaceborne active and passive microwave instruments based on weighted averaging taking into account the error characteristics of the individual data sets. The merging scheme is parameterized using error variance estimates obtained from using triple collocation analysis (TCA). In regions where TCA is deemed unreliable, we use correlation significance levels (p-values) as indicator for retrieval quality to decide whether to use active data only, passive data only, or an unweighted average. We apply the proposed merging scheme to active retrievals from advanced scatterometer and passive retrievals from the Advanced Microwave Scanning Radiometer-Earth Observing System using Global Land Data Assimilation System-Noah to complement the triplet required for TCA. The merged time series is evaluated against soil moisture estimates from ERA-Interim/Land and in situ measurements from the International Soil Moisture Network using the European Space Agency's (ESA's) current Climate Change Initiative-Soil Moisture (ESA CCI SM) product version v02.3 as benchmark merging scheme. Results show that the p-value classification provides a robust basis for decisions regarding using either active or passive data alone, or an unweighted average in cases where relative weights cannot be estimated reliably, and that the weights estimated from TCA in almost all cases outperform the ternary decision upon which the ESA CCI SM v02.3 is based. The proposed method forms the basis for the new ESA CCI SM product version v03.x and higher.*

Gu, H., & Bergman, R. (2017). Cradle-to-grave life cycle assessment of syngas electricity from woody biomass residues. *Wood and Fiber Science, 49*(2), 177-192. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029541184&partnerID=40&md5=dee7a198d3b2ce2107f5a7cde29e02a9.

Research Tags: Forestry, Energy, Emissions

Abstract: *Forest restoration and fire suppression activities in the western United States have resulted in large volumes of low-to-no value residues. An environmental assessment would enable greater use while maintaining environmental sustainability of these residues for energy products. One internationally accepted sustainable metric tool that can assess environmental impacts of new bioenergy conversion systems is the life cycle assessment (LCA). Using the LCA method, this study evaluated the synthesis gas (syngas) electricity produced via a distributed-scale biomass thermochemical conversion system called the Tucker renewable* *natural gas (RNG) system. This system converts woody biomass in a high-temperature and extremely low-oxygen environment to a medium-energy syngas that is burned to generate electricity. The system also produced biochar as a byproduct and tar as a waste. Results from the life cycle impact assessment included an estimate of the global warming (GW) from the cradle-to-grave production of syngas for electricity. When the carbon sequestration effect from the biochar by-product was included, GW impact value (0.330 kg CO2-eq/kWh) was notably lower compared with electricity generated from bituminous coal (1.079 kg CO2-eq/kWh) and conventional natural gas (0.720 kg CO2-eq/kWh). Other environmental impacts showed that syngas electricity ranged between the direct-biomass-burned electricity and fossil-fuel-combusted electricity for different impact categories. This occurred because, although the woody biomass feedstock was from a renewable resource with less environmental impact, propane was consumed during the thermochemical conversion. Specifically, the evaluation showed that the highest greenhouse gas (GHG) emissions contribution came from burning propane that was used to maintain the endothermic reaction in the Tucker RNG unit. If the tar waste from the system were converted into a low-energy syngas and used to supplement propane consumption, a further decrease of 41% in GHG emissions (ie fossil CO2) could be achieved in this cradle-to-grave assessment.*

Gu, X., Zhou, X., Bu, X., Xue, M., Jiang, L., Wang, S., . . . Clinton, P. W. (2019). Soil extractable organic C and N contents, methanotrophic activity under warming and degradation in a Tibetan alpine meadow. *Agriculture, Ecosystems and Environment, 278*, 6-14. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063385535&doi=10.1016%2fj.agee.2019.03.020&partnerID=40&md5=dca7259ec43c2aa4b79f07edd110e040. doi:10.1016/j.agee.2019.03.020

Research Tags: Soil, Grassland

Abstract: *The Tibetan alpine meadow ecosystem is an important part of the Eurasian grasslands and is experiencing intense warming at approximately three times the global warming rate and rapid degradation. However, little is known about the effect of warming and degradation and their interactions on ecosystem functions like soil carbon (C) and nitrogen (N) pools and methane (CH4) uptake in this region. Here, we selected a long-term simulated warming site in a Tibetan alpine meadow with different degradation levels. After 4 years of warming, we analyzed soil total C (TC) and total N (TN) contents, extractable organic C (EOC) and extractable organic N (EON) contents as well as methanotrophic activity, abundance and community structure. Soil EOC and EON contents were measured through hot water extraction, whereas methanotrophic activity was measured along a gradient of CH4 concentrations in laboratory incubations. Michaelis–Menten kinetics analysis [maximal rate of velocity (Vmax) and half-saturation constant (Km)] was used to quantify changes in methanotrophic activity among the treatments. Active methanotrophic communities in the natural soils were measured via DNA-based stable isotope probing (SIP). The results showed that warming significantly increased soil EON contents, whereas degradation significantly decreased soil TC and TN contents, and EOC and EON contents. Methanotrophic activity was significantly lower at different levels of degradation but no significant effects were observed under warming. Changes in soil methanotrophic abundance among the treatments followed the same trend, but warming and degradation had no interactive effects on methanotrophic activity and abundance. Active methanotrophic communities in the natural meadow soils were dominated by Methylosinus (a Type II methanotroph). In conclusion, our results indicate that soil C and N pools and CH4 oxidation capability were influenced more strongly by degradation than warming. However, warming may have an additional effect on the stability of these important ecosystem processes, regardless of degradation in this region.*

Guan, K., Wu, J., Kimball, J. S., Anderson, M. C., Frolking, S., Li, B., . . . Lobell, D. B. (2017). The shared and unique values of optical, fluorescence, thermal and microwave satellite data for estimating large-scale crop yields. *Remote Sensing of Environment, 199*, 333-349. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026512271&doi=10.1016%2fj.rse.2017.06.043&partnerID=40&md5=b63d47696ac08b4f0f0b00ade5b8736d. doi:10.1016/j.rse.2017.06.043

Research Tags: Crops, Research

Abstract: *Large-scale crop monitoring and yield estimation are important for both scientific research and practical applications. Satellite remote sensing provides an effective means for regional and global cropland monitoring, particularly in data-sparse regions that lack reliable ground observations and reporting. The*

conventional approach of using visible and near-infrared based vegetation index (VI) observations has prevailed for decades since the onset of the global satellite era. However, other satellite data encompass diverse spectral ranges that may contain complementary information on crop growth and yield, but have been largely understudied and underused. Here we conducted one of the first attempts at synergizing multiple satellite data spanning a diverse spectral range, including visible, near-infrared, thermal and microwave, into one framework to estimate crop yield for the U.S. Corn Belt, one of the world's most important food baskets. Specifically, we included MODIS Enhanced VI (EVI), estimated Gross Primary Production based on GOME-2 solar-induced fluorescence (SIF-GPP), thermal-based ALEXI Evapotranspiration (ET), QuikSCAT Ku-band radar backscatter, and AMSR-E X-band passive microwave Vegetation Optical Depth (VOD) in this study, benchmarked on USDA county-level crop yield statistics. We used Partial Least Square Regression (PLSR), an effective statistical model for dimension reduction, to distinguish commonly shared and unique individual information from the various satellite data and other ancillary climate information for crop yield estimation. In the PLSR model that includes all of the satellite data and climate variables from 2007 to 2009, we assessed the first two major PLSR components and found that the first component (an integrated proxy of crop aboveground biomass) explained 82% variability of modelled crop yield, and the second component (dominated by environmental stresses) explained 15% variability of modelled crop yield. We found that most of the satellite derived metrics (e.g. SIF-GPP, radar backscatter, EVI, VOD, ALEXI-ET) share common information related to aboveground crop biomass (i.e. the first component). For this shared information, the SIF-GPP and backscatter data contain almost the same amount of information as EVI at the county scale. When removing the above shared component from all of the satellite data, we found that EVI and SIF-GPP do not provide much extra information; instead, Ku-band backscatter, thermal-based ALEXI-ET, and X-band VOD provide unique information on environmental stresses that improves overall crop yield predictive skill. In particular, Ku-band backscatter and associated differences between morning and afternoon overpasses contribute unique information on crop growth and environmental stress. Overall, using satellite data from various spectral bands significantly improves regional crop yield predictions. The additional use of ancillary climate data (e.g. precipitation and temperature) further improves model skill, in part because the crop reproductive stage related to harvest index is highly sensitive to environmental stresses but they are not fully captured by the satellite data used in our study. We conclude that using satellite data across various spectral ranges can improve monitoring of large-scale crop growth and yield beyond what can be achieved from individual sensors. These results also inform the synergistic use and development of current and next generation satellite missions, including NASA ECOSTRESS, SMAP, and OCO-2, for agricultural applications.

Guan, Y., Zheng, F., Zhang, X., & Wang, B. (2017). Trends and variability of daily precipitation and extremes during 1960–2012 in the Yangtze River Basin, China. *International Journal of Climatology, 37*(3), 1282-1298. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84971301653&doi=10.1002%2fjoc.4776&partnerID=40&md5=6884c4abbb4a3fadc929bf82e218848e. doi:10.1002/joc.4776

Research Tags: Weather, Water

Abstract: *Trends and variability of extreme precipitation events are important for water-related disaster prevention and mitigation as well as water resource management. Using daily precipitation dataset from 143 meteorological stations in the Yangtze River Basin (YRB), a suite of heavy and extreme precipitation indices recommended by the Expert Team on Climate Change Detection and Indices, which has rarely been applied in this region, were analysed during 1960–2012. Results showed that simple daily intensity index, very wet day precipitation, extremely wet day precipitation, extremely heavy precipitation days, maximum 1-day precipitation, maximum 5-day precipitation and maximum consecutive dry days all increased significantly during 1960–2012. In contrast, ≥10 mm precipitation days and maximum consecutive wet days decreased significantly, implying that the precipitation processes in YRB were dominated by precipitation events with shorter durations. Geographically, a wetting tendency was observed in the eastern Tibet Plateau and the middle and lower YRB, while the other regions experienced precipitation deficits. The increasing precipitation was mainly due to the intensification of extreme precipitation events and the decreasing precipitation may be attributed to the decrease of ≥10 mm precipitation days or moderate precipitation events. In addition, the regional trends were of greater magnitudes in the middle and lower YRB, indicating more frequent extreme precipitation events in these sub-regions. Time series analysis revealed that most precipitation indices exhibited*

neither a stable nor a gradual pattern during 1960–2012, but a clearly upward trend, although non-monotonous, since the late-1980s was evident.

Guarin, J. R., Kassie, B., Mashaheet, A. M., Burkey, K., & Asseng, S. (2019). Modeling the effects of tropospheric ozone on wheat growth and yield. *European Journal of Agronomy, 105*, 13-23. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061384050&doi=10.1016%2fj.eja.2019.02.004&partnerID=40&md5=ef81b6b8fbc321288cf6a343eadc7e3f. doi:10.1016/j.eja.2019.02.004
Research Tags: Crops
Abstract: *Elevated tropospheric ozone (O3) concentrations can negatively impact wheat growth by reducing photosynthesis and accelerating leaf senescence. Future global O3 concentrations are expected to increase in many regions, which will further limit global wheat production. However, few crop models consider the effects of O3 stress on wheat. We incorporated the effects of O3 stress on photosynthesis and leaf senescence into the DSSAT-NWheat crop model and reproduced an observed experiment and reported yield declines from the literature. Simulated wheat yields decreased as daily O3 concentrations increased above 25 ppb, with yield losses ranging from 0.26% to 0.95% per ppb O3 increase, depending on the cultivar O3 sensitivity. The model reproduced known wheat physiological responses from the combination of O3 stress with water deficit and elevated atmospheric CO2 concentration. Increased water deficit stress and elevated atmospheric CO2 both reduce the negative impact of O3, but yield benefits from elevated CO2 can be lost due to elevated O3 concentrations. The O3-modified NWheat model simulates the effects of O3 stress on wheat growth and yield in interaction with other growth factors and can be used for studies on climate change and O3 impacts.*

Guarinello de Oliveira Portes, M. C., Safford, H., & Behling, H. (2018). Humans and climate as designers of the landscape in Serra da Bocaina National Park, southeastern Brazil, over the last seven centuries. *Anthropocene, 24*, 61-71. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056953940&doi=10.1016%2fj.ancene.2018.11.004&partnerID=40&md5=a703f274f61af039f474769449993d06. doi:10.1016/j.ancene.2018.11.004
Research Tags: Forestry
Abstract: *Campos de altitude and Araucaria forest are unique and highly diverse ecosystems and focus areas for conservation and restoration in southeastern Brazil. This paper reports a high-resolution paleoecological study of an approximately 700-year Late Holocene core, a period that includes the influence of two highly distinct civilizations and the transition between them: Amerindian/pre-Columbian and European/post-Columbian. Results highlight the interworkings of regional climate change and local human agency in "designing" the Late Holocene forest-grassland mosaic in the Serra da Bocaina. Amerindians maintained more open highland habitats probably through slash and burn agriculture. The depopulation of the study region after European arrival in the 1500s plus increasing precipitation led to a marked and rapid rebound in forest cover. After 1720 CE, establishment of permanent European communities and farming in the study area led to forest loss and a renewed expansion of grassland. Based on current knowledge about forest-grassland relationships, and in light of projections for warmer and wetter conditions in southeast Brazil, we provide suggestions for management strategies that might better maintain the mosaic of Araucaria forest and campos de altitude in the southeastern Brazilian highlands.*

Gugger, P. F., Liang, C. T., Sork, V. L., Hodgskiss, P., & Wright, J. W. (2018). Applying landscape genomic tools to forest management and restoration of Hawaiian koa (Acacia koa) in a changing environment. *Evolutionary Applications, 11*(2), 231-242. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028937731&doi=10.1111%2feva.12534&partnerID=40&md5=56b193d9bfa0be1210e0c9294ac41a43. doi:10.1111/eva.12534
Research Tags: Forestry
Abstract: *Identifying and quantifying the importance of environmental variables in structuring population genetic variation can help inform management decisions for conservation, restoration, or reforestation purposes, in both current and future environmental conditions. Landscape genomics offers a powerful approach for understanding the environmental factors that currently associate with genetic variation, and given those associations, where populations may be most vulnerable under future environmental change. Here, we applied genotyping by sequencing to generate over 11,000 single nucleotide polymorphisms from 311 trees and then*

used nonlinear, multivariate environmental association methods to examine spatial genetic structure and its association with environmental variation in an ecologically and economically important tree species endemic to Hawaii, Acacia koa. Admixture and principal components analyses showed that trees from different islands are genetically distinct in general, with the exception of some genotypes that match other islands, likely as the result of recent translocations. Gradient forest and generalized dissimilarity models both revealed a strong association between genetic structure and mean annual rainfall. Utilizing a model for projected future climate on the island of Hawaii, we show that predicted changes in rainfall patterns may result in genetic offset, such that trees no longer may be genetically matched to their environment. These findings indicate that knowledge of current and future rainfall gradients can provide valuable information for the conservation of existing populations and also help refine seed transfer guidelines for reforestation or replanting of koa throughout the state.

Guldin, J. M. (2019). Silvicultural options in forests of the southern United States under changing climatic conditions. *New Forests, 50*(1), 71-87. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049579333&doi=10.1007%2fs11056-018-9656-2&partnerID=40&md5=b56af3c7cfe718ba73656a9c8dda0271. doi:10.1007/s11056-018-9656-2

Research Tags: Forestry, Livestock

Abstract: *Changing climatic conditions add a measure of uncertainty to sustainable forest management in forest ecosystems of the southern United States. Increasing temperatures and decreasing patterns of precipitation especially in the Mid-South suggest that water stress, drought, and changing patterns of natural disturbance events will challenge managers in the twenty-first century. Efforts to manage southern forest stands in the face of changing climatic conditions will require a diversity of approaches including tactics to promote genetic diversity in natural and planted stands, encouragement of species diversity as new stands develop, and considering ways to promote diverse stand structures that encourage recruitment of new age cohorts within stands on a regular basis. With predicted changes in climatic conditions, forest ecosystems across the South will respond in different ways, depending upon whether or not they are currently being managed. Unmanaged stands will change in unpredictable ways that reflect the absence of management. But in managed stands, silvicultural treatments are available for foresters to apply to respond and adapt to maintain productive forests adapted to those changing conditions. Finally, one approach often advocated to deal with this uncertainty is a strategy for assisted migration, in which species are established in locations beyond their current range, where predicted climatic conditions are likely to occur at some point in the future within which those species will survive. This is basically an exercise in artificial regeneration, but will likely be more complicated than simply planting a few exotic seedlings and hoping for the best. The technical and practical challenges of planting species at the margins or beyond their natural range include a lack of research support especially for species not commonly planted in the region. Moreover, planting is costly, and because of that, intensive practices are more likely on institutional and government lands rather than family forests. In the end, all of these concepts fall within the practice of silviculture, and are tactics with which the profession is familiar.*

Gunn, K. M., Baule, W. J., Frankenberger, J. R., Gamble, D. L., Allred, B. J., Andresen, J. A., & Brown, L. C. (2018). Modeled climate change impacts on subirrigated maize relative yield in northwest Ohio. *Agricultural Water Management, 206*, 56-66. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046665140&doi=10.1016%2fj.agwat.2018.04.034&partnerID=40&md5=93d512f8ec95ce5fc2a1594db2e1f266. doi:10.1016/j.agwat.2018.04.034

Research Tags: Crops

Abstract: *Subirrigation is employed to supply water to crop root zones via subsurface drainage systems, which are typically installed for the purpose of excess soil water removal. Crop yield increases due to subirrigation have been demonstrated in numerous studies, but there is limited information regarding yield under future climate conditions when growing season conditions are expected to be drier in the U.S. Corn Belt. DRAINMOD was calibrated and validated for three locations with different soil series in northwest Ohio and used to investigate maize relative yield differences between subirrigation and free subsurface drainage for historic (1984–2013) and future (2041–2070) climate conditions. For historic conditions, the mean maize relative yield increased by 27% with subirrigation on the Nappanee loam soil, but had minimal effect on the Paulding clay*

and Hoytville silty clay soils. Maize relative yield under free subsurface drainage is predicted to decrease in the future, causing the relative yield difference between free subsurface drainage and subirrigation practices to nearly double from 9% to 16% between the historic and future periods. Consequently, the subirrigation practice can potentially mitigate adverse future climate change impacts on maize yield in northwest Ohio.

Gunn, K. M., Holly, M. A., Veith, T. L., Buda, A. R., Prasad, R., Alan Rotz, C., . . . Stoner, A. M. K. (2019). Projected heat stress challenges and abatement opportunities for U.S. Milk production. *PLoS ONE, 14*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063618673&doi=10.1371%2fjournal.pone.0214665&partnerID=40&md5=423997cf51941fda3f32cc372629701e. doi:10.1371/journal.pone.0214665

Research Tags: Livestock, Weather

Abstract: *Cost-effective heat mitigation strategies are imperative for maintaining milk production and dairy farm profitability in the U.S. with projected climate change. This study investigated the cost-effectiveness of four heat abatement strategies, including Minimal (open barn or shading), Moderate (forced ventilation), High (fans and misting), and Intense (air conditioning). Heat stress and subsequent impacts on milk production per cow were predicted across nine climatic regions in the U.S. for early (2015 to 2034), mid (2045 to 2064) and late (2081 to 2100) 21st century, using downscaled climate projections. Heat abatements were used to adjust predicted milk production losses and illustrate the potential to reduce milk production losses due to heat stress. Economic analysis included a cost-benefit ratio calculation associated with the implementation of each heat abatement. Results showed that milk production losses were expected to accelerate across the U.S. at a mean rate of 174±7 kg/cow/decade, with the fastest rate in the Southeast region. Relative to Minimal heat abatement, Moderate, High, and Intense heat abatements increased annual milk production per cow by 3%, 4%, and 6% during early-21st century, 3%, 6%, and 11% during mid-21st century, and 3%, 8%, and 21% during late-21st century, respectively. The cost effectiveness of different heat abatement strategies generally increased with subsequently stronger heat abatements. In mid- and late-21st century, mean annual net values of High and Intense heat stress abatement implementation approached -$30 to $190 /cow and -$20 to $590 /cow, respectively, with the largest net annual benefit in late-21st century under Intense abatement. Findings from the study demonstrate the value of using downscaled climate projections to shed light on local and regional strategies to abate heat stress on cattle and mitigate potential milk production losses due to climate change.*

Gunter, S. A., & Beck, M. R. (2018). Measuring the respiratory gas exchange by grazing cattle using an automated, open-circuit gas quantification system. *Translational Animal Science, 2*(1), 11-18. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050906689&doi=10.1093%2ftas%2ftxx009&partnerID=40&md5=cdc70901f9e11f6f7ff11ad32ab8e928. doi:10.1093/tas/txx009

Research Tags: Emissions, Livestock

Abstract: *Ruminants are a source of enteric CH4, which has been identified as an anthropogenic greenhouse gas that contributes to climate change. With interest in developing technologies to decrease enteric CH4 emissions, systems are currently being developed to measure CH4 emissions by cattle. An issue with grazing cattle is the ability to measure CH4 emissions in open-air environments. A scientific instrument for this task is an automated, open-circuit gas quantification system (GQS; C-Lock, Inc., Rapid City, SD). The GQS is a head chamber that grazing cattle occasionally visit (3 to 8 min/visit; 3 to 6 visits/d), and while the animal consumes a small portion of bait (0.5 to 1.0 kg/visit), the GQS captures the animal's breath cloud by exhausting air through the GQS. The breath cloud is then analyzed for CH4, CO2, and O2 concentrations. Data are hourly uploaded to a server where it is processed using algorithms to determine total daily fluxes. Several factors affect emission estimates generated by the GQS including the animal's visitation rate, length of sampling period, and airflow through the system. The location of the GQS is an important factor in determining the cattle's willingness to visit. Further, cattle need to be trained to use the GQS, which normally requires 4 to 8 wk. Several researchers have shown that 30 or more visits are required to obtain high-quality estimates of gas fluxes. Once cattle are trained to use the GQS, the bait delivery rate has little effect on the animal's willingness to use the system. Airflow through the GQS is an important factor, but as long as airflow is maintained above 26 L/s the breath-cloud capture seems nearly complete. There is great concern regarding circadian variation in the instantaneous production rates of CH4 because the GQS normally only spot-samples 2 to 4 times/d. Preliminary analysis has shown that variation in the instantaneous production rates of CH4 do not vary as*

greatly with grazing cattle compared with meal-fed cattle. It seems that increasing the visitation length decreases variation in estimated emissions, but there is a diminishing return to increasing visitation length. The GQS is a useful tool for researching the nutrition and emissions of grazing cattle, but great care must be taken to obtain the best quality data possible for use in this high-impact research.

Gunter, S. A., Bradford, J. A., & Moffet, C. A. (2017). Effects of mass airflow rate through an open-circuit gas quantification system when measuring carbon emissions. *Journal of Animal Science, 95*(1), 475-484. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017496822&doi=10.2527%2fJAS.2016.0933&partnerID=40&md5=a5e30fceb961b50577310381e12ccada. doi:10.2527/JAS.2016.0933

Research Tags: Emissions, Livestock

Abstract: *Methane (CH4) and carbon dioxide (CO2) represent 11 and 81%, respectively, of all anthropogenic greenhouse gas emissions. Agricultural CH4 emissions account for approximately 43% of all anthropogenic CH4 emissions. Most agricultural CH4 emissions are attributed to enteric fermentation within ruminant livestock; hence, the heightened interest in quantifying and mitigating this source. The automated, open-circuit gas quantification system (GQS; GreenFeed, C-Lock, Inc., Rapid City, SD) evaluated here can be placed in a pasture with grazing cattle and can measure their CH4 and CO2 emissions with spot sampling. However, improper management of the GQS can have an erroneous effect on emission estimates. One factor affecting the quality of emission estimates is the airflow rates through the GQS to ensure a complete capture of the breath cloud emitted by the animal. It is hypothesized that at lower airflow rates this cloud will be incompletely captured. To evaluate the effect of airflow rate through the GQS on emission estimates, a data set was evaluated with 758 CO2 and CH4 emission estimates with a range in airflows of 10.7 to 36.6 L/s. When airflow through the GQS was between 26.0 and 36.6 L/s, CO2 and CH4 emission estimates were not affected (P = 0.14 and 0.05, respectively). When airflow rates were less than 26.0 L/s, CO2 and CH4 emission estimates were lower and decreased as airflow rate decreased (P < 0.0001). We hypothesize that when airflow through the GQS decreases below 26 L/s, breath capture was incomplete and CO2 and CH4 emissions are underestimated. Maintaining mass airflow through a GQS at rates greater than 26 L/s is important for producing high quality CO2 and CH4 emission estimates.*

Guo, Q., Brockway, D. G., & Chen, X. (2017). Temperature-related sex allocation shifts in a recovering keystone species, Pinus palustris. *Plant Ecology and Diversity, 10*(4), 303-310. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038107206&doi=10.1080%2f17550874.2017.1402968&partnerID=40&md5=bbd38202207a6c860f6c2654c754b0c3. doi:10.1080/17550874.2017.1402968

Research Tags: Forestry

Abstract: *Background: The possible effects of climate change on sex allocation of a species have recently emerged as a topic of interest, relative to population sustainability via natural regeneration. Also, the universality of pollen limitation for reproduction and how climate may influence it in different taxonomic groups remain to be explored.*
Aims: The aim of this study was to examine how climate fluctuation may affect sex allocation in Pinus palustris.
Methods: We used a long-term observational data on P. palustris (1957–2014), including pollen, female conelets and cone production.
Results: We found that, unlike cone production with its ca. 3-year cycle, (1) pollen (male) and unfertilised conelet (female) production did not exhibit any temporal cycles, (2) pollen and unfertilised conelet production showed lower variation than cone production, (3) pollen and unfertilised conelet production were positively correlated to one another and to final cone production, (4) an optimal male-to-female sex allocation ratio exists for promoting cone production and (5) sex allocation ratio was positively correlated with temperature
Conclusions: Our findings shed new light on both the reproductive ecology and management of P. palustris ecosystems under changing climates (e.g., through alteration of pollen density and thus the resulting sex allocation).

Guo, Q., Brockway, D. G., Larson, D. L., Wang, D., & Ren, H. (2018). Improving Ecological Restoration to Curb Biotic Invasion - A Practical Guide. *Invasive Plant Science and Management, 11*(4), 163-174. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059631366&doi=10.1017%2finp.2018.29&partnerI

D=40&md5=f12af5b5a0e39a6db91562ae8978ae10. doi:10.1017/inp.2018.29
Research Tags: Grassland
Abstract: *Common practices for invasive species control and management include physical, chemical, and biological approaches. The first two approaches have clear limitations and may lead to unintended (negative) consequences, unless carefully planned and implemented. For example, physical removal rarely completely eradicates the targeted invasive species and can cause disturbances that facilitate new invasions by nonnative species from nearby habitats. Chemical treatments can harm native, and especially rare, species through unanticipated side effects. Biological methods may be classified as biocontrol and the ecological approach. Similar to physical and chemical methods, biocontrol also has limitations and sometimes leads to unintended consequences. Therefore, a relatively safer and more practical choice may be the ecological approach, which has two major components: (1) restoration of native species and (2) biomass manipulation of the restored community, such as selective grazing or prescribed burning (to achieve and maintain viable population sizes). Restoration requires well-planned and implemented planting designs that consider alpha-, beta-, and gamma-diversity and the abundance of native and invasive component species at local, landscape, and regional levels. Given the extensive destruction or degradation of natural habitats around the world, restoration could be most effective for enhancing ecosystem resilience and resistance to biotic invasions. At the same time, ecosystems in human-dominated landscapes, especially those newly restored, require close monitoring and careful intervention (e.g., through biomass manipulation), especially when successional trajectories are not moving as intended. Biomass management frequently uses prescribed burning, grazing, harvesting, and thinning to maintain overall ecosystem health and sustainability. Thus, the resulting optimal, balanced, and relatively stable ecological conditions could more effectively limit the spread and establishment of invasive species. Here we review the literature (especially within the last decade) on ecological approaches that involve biodiversity, biomass, and productivity, three key community/ecosystem variables that reciprocally influence one another. We focus on the common and most feasible ecological practices that can aid in resisting new invasions and/or suppressing the dominance of existing invasive species. We contend that, because of the strong influences from neighboring areas (i.e., as exotic species pools), local restoration and management efforts in the future need to consider the regional context and projected climate changes.*

Guo, Q., Chen, J., Zhang, X., Shen, M., Chen, H., & Guo, S. (2019). A new two-stage multivariate quantile mapping method for bias correcting climate model outputs. *Climate Dynamics*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064058016&doi=10.1007%2fs00382-019-04729-w&partnerID=40&md5=2dd1643198b40725e2a3ffcedd50c21f. doi:10.1007/s00382-019-04729-w
Research Tags: Research
Abstract: *Bias correction is an essential technique to correct climate model outputs for local or site-specific climate change impact studies. Most commonly used bias correction methods operate on a single variable, which ignores dependency among multiple variables. The misrepresentation of multivariable dependence may result in biased assessment of climate change impacts. To solve this problem, a new multivariate bias correction method referred to as two-stage quantile mapping (TSQM) is proposed by combining a single-variable bias correction method with a distribution-free shuffle approach. Specifically, a quantile mapping method is used to correct the marginal distribution of single variable and then a distribution-free shuffle approach to introduce proper multivariable correlations. The proposed method is compared with the other four state-of-the-art multivariate bias correction methods for correcting monthly precipitation, and maximum and minimum temperatures simulated by global climate models. The results show that the TSQM method is capable of both bias correcting univariate statistics and inducing proper inter-variable rank correlations. Especially, it outperforms all the other four methods in reproducing inter-variable rank correlations and in simulating mean temperature and potential evaporation for wet and dry months of the validation period. Overall, without complex algorithm and iterations, TSQM is fast, simple and easy to implement, and is proved a competitive bias correction technique to be widely applied in climate change impact studies.*

Guo, Q., Potter, K. M., Koch, F. H., & Riitters, K. H. (2019). Impacts of nonnative species on the Health of Natural and Planted Forests. *Forests, 10*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066819882&doi=10.3390%2ff10050366&partnerID=40&md5=23b851928d80370e24696c90acae4c76. doi:10.3390/f10050366

Research Tags: Forestry
Abstract: *Despite conservation efforts, most forest ecosystems worldwide are affected by biotic invasions; however, the specific impacts vary across different geographic regions and forest types. The relative contributions of the main drivers such as propagule pressure (e.g., due to human population, travel, and trade), climate, land use, and habitat invasibility remain uncertain. The special issue "Impacts of Nonnative Species on the Health of Natural and Planted Forests" was organized to facilitate timely communications among scientists and managers in different regions and to assist in attempts to improve forest health and maintain long-term sustainability. The special issue addresses broad issues related to forest invasions, including the impacts of nonnative species in various forest ecosystems (e.g., natural vs. urban) and the contributions of land use (e.g., fragmentation), human activity, and climate change to invasion. The new findings include identifying hotspots of potential invasion impacts and their causes, which can help inform policy makers as they develop effective strategies for prevention, early detection or eradication, and forest management.*

Guo, T., Mehan, S., Gitau, M. W., Wang, Q., Kuczek, T., & Flanagan, D. C. (2018). Impact of number of realizations on the suitability of simulated weather data for hydrologic and environmental applications. *Stochastic Environmental Research and Risk Assessment, 32*(8), 2405-2421. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037167004&doi=10.1007%2fs00477-017-1498-5&partnerID=40&md5=65ab58b34724c01a7f4bdb42bc4c7310. doi:10.1007/s00477-017-1498-5
Research Tags: Research, Weather
Abstract: *Stochastic weather generators are widely used in hydrological, environmental, and agricultural applications to simulate weather time series. However, such stochastic models produce random outputs hence the question on how representative the generated data are if obtained from only one simulation run (realization) as is common practice. In this study, the impact of different numbers of realizations (1, 25, 50, and 100) on the suitability of generated weather data was investigated. Specifically, 50 years of daily precipitation, and maximum and minimum temperatures were generated for three weather stations in the Western Lake Erie Basin (WLEB), using three widely used weather generators, CLIGEN, LARSWG and WeaGETS. Generated results were compared with 50 years of observed data. For all three generators, the analyses showed that one realization of data for 50 years of daily precipitation, and maximum and minimum temperatures may not be representative enough to capture essential statistical characteristics of the climate. Results from the three generators captured the essential statistical characteristics of the climate when the number of realizations was increased from 1 to 25, 50 or 100. Performance did not improve substantially when realizations were increased above 25. Results suggest the need for more than a single realization when generating weather data and subsequently utilizing in other models, to obtain suitable representations of climate.*

Guo, X., Zhou, X., Hale, L., Yuan, M., Ning, D., Feng, J., . . . Zhou, J. (2019). Climate warming accelerates temporal scaling of grassland soil microbial biodiversity. *Nature Ecology and Evolution, 3*(4), 612-619. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063490102&doi=10.1038%2fs41559-019-0848-8&partnerID=40&md5=698d7716c2af9ddb7ea4040756b1a21f. doi:10.1038/s41559-019-0848-8
Research Tags: Grassland, Soil
Abstract: *Determining the temporal scaling of biodiversity, typically described as species–time relationships (STRs), in the face of global climate change is a central issue in ecology because it is fundamental to biodiversity preservation and ecosystem management. However, whether and how climate change affects microbial STRs remains unclear, mainly due to the scarcity of long-term experimental data. Here, we examine the STRs and phylogenetic–time relationships (PTRs) of soil bacteria and fungi in a long-term multifactorial global change experiment with warming (+3 °C), half precipitation (−50%), double precipitation (+100%) and clipping (annual plant biomass removal). Soil bacteria and fungi all exhibited strong STRs and PTRs across the 12 experimental conditions. Strikingly, warming accelerated the bacterial and fungal STR and PTR exponents (that is, the w values), yielding significantly ($P < 0.001$) higher temporal scaling rates. While the STRs and PTRs were significantly shifted by altered precipitation, clipping and their combinations, warming played the predominant role. In addition, comparison with the previous literature revealed that soil bacteria and fungi had considerably higher overall temporal scaling rates ($w = 0.39$–0.64) than those of plants and animals ($w = 0.21$–0.38). Our results on warming-enhanced temporal scaling of microbial biodiversity suggest that the strategies of soil biodiversity preservation and ecosystem management may need to be adjusted in a warmer*

world.

Gustafson, E. J., De Bruijn, A., Lichti, N., Jacobs, D. F., Sturtevant, B. R., Foster, J., . . . Dalgleish, H. J. (2017). The implications of American chestnut reintroduction on landscape dynamics and carbon storage. *Ecosphere, 8*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018945254&doi=10.1002%2fecs2.1773&partnerID=40&md5=98d3ae2dd924d3bcb17d4e99ea0161cc. doi:10.1002/ecs2.1773
Research Tags: Forestry
Abstract: *In the eastern United States, American chestnut (Castanea dentata) was historically a major component of forest communities, but was functionally extirpated in the early 20th century by an introduced pathogen, chestnut blight (Cryphonectria parasitica). Because chestnut is fast-growing, long-lived, and resistant to decay, restoration of American chestnut using blight-resistant stock could have the potential to increase carbon sequestration or storage in forested landscapes. However, carbon dynamics are also affected by interspecific competition, succession, natural disturbance, and forest management activities, and it is unknown how chestnut restoration might interact with these other processes. We used the PnET-Succession extension of the LANDIS-II forest landscape model to study the implications of chestnut restoration on forest composition and carbon storage in the context of other disturbances, including timber harvest and insect pest outbreaks. Our results imply that it could take a millennium or more for chestnut to fully occupy landscapes without aggressive restoration efforts. When successful, chestnut restoration activities displaced other species approximately in proportion to their abundance on the landscape, rather than replacing a single species or genus (e.g., Quercus). Insect pests increased the rate of chestnut colonization by reducing the abundance of competitors, and also had a dominant effect on carbon dynamics. Although chestnut is fast-growing, moderately shade-tolerant, and decomposes very slowly, our results suggest that it can only modestly increase the carbon storage potential of eastern forests. However, our results also demonstrate that compositional changes in forest communities can have noticeable effects on biomass accumulation, even with the large uncertainties introduced by invasive pests.*

Gustafson, E. J., Kubiske, M. E., Miranda, B. R., Hoshika, Y., & Paoletti, E. (2018). Extrapolating plot-scale CO<inf>2</inf> and ozone enrichment experimental results to novel conditions and scales using mechanistic modeling. *Ecological Processes, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052800828&doi=10.1186%2fs13717-018-0142-8&partnerID=40&md5=d5fedbf36d3ed862f85329e72c12fe91. doi:10.1186/s13717-018-0142-8
Research Tags: Forestry
Abstract: *Introduction*
The Aspen-FACE experiment was an 11-year study of the effect of elevated CO2 and ozone (alone and in combination) on the growth of model aspen communities (pure aspen, aspen-birch, and aspen-maple) in the field in northern Wisconsin, USA. Uncertainty remains about how these short-term plot-level responses might play out over broader temporal and spatial scales where climate change, competition, succession, and disturbances interact with tree-level responses. In this study, we used a new physiology-based approach (PnET-Succession v3.1) within the forest landscape model LANDIS-II to extrapolate the FACE results to broader temporal scales (and ultimately to landscape scale) by mechanistically accounting for the globally changing drivers of temperature, precipitation, CO2, and ozone. We added novel algorithms to the model to mechanistically simulate the effects of ozone on photosynthesis through ozone-induced impairment of stomatal control (i.e., stomatal sluggishness) and damage of photosynthetic capacity at the chloroplast level.
Results
We calibrated the model to empirical observations of competitive interactions on the elevated CO2 and O3 plots of the Aspen-FACE experiment and successfully validated it on the combined factor plots. We used the validated model to extend the Aspen-FACE experiment for 80 years. When only aspen clones competed, we found that clone 271 always dominated, although the ozone-tolerant clone was co-dominant when ozone was present. Under all treatments, when aspen clone 216 and birch competed, birch was always dominant or co-dominant, and when clone 216 and maple competed, clone 216 was dominant, although maple was able to grow steadily because of its shade tolerance. We also predicted long-term competitive outcomes for novel assemblages of taxa under each treatment and discovered that future composition and dominant taxa depend

on treatment, and that short-term trends do not always persist in the long term.
Conclusions
We identified the strengths and weaknesses of PnET-Succession v3.1 and conclude that it can generate potentially robust predictions of the effects of elevated CO2 and ozone at landscape scales because of its mechanistically motivated algorithms. These capabilities can be used to project forest dynamics under anticipated future conditions that have no historical analog with which to parameterize less mechanistic models.

Gustafson, E. J., Miranda, B. R., De Bruijn, A. M. G., Sturtevant, B. R., & Kubiske, M. E. (2017). Do rising temperatures always increase forest productivity? Interacting effects of temperature, precipitation, cloudiness and soil texture on tree species growth and competition. *Environmental Modelling and Software, 97*, 171-183. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027977430&doi=10.1016%2fj.envsoft.2017.08.001&partnerID=40&md5=ab6610d1bbdff93c45d2bc721729416a. doi:10.1016/j.envsoft.2017.08.001
Research Tags: Weather, Soil, Forestry
Abstract: *Forest landscape models (FLM) are increasingly used to project the effects of climate change on forested landscapes, yet most use phenomenological approaches with untested assumptions about future forest dynamics. We used a FLM that relies on first principles to mechanistically simulate growth (LANDIS-II with PnET-Succession) to systematically explore how landscapes composed of tree species with various life history traits respond to individual climate and abiotic drivers. Moderate temperature rise (+3 °C) concurrent with rising CO2 concentration increased net photosynthesis of cohorts, but decreased biomass production because of increased maintenance respiration costs. However, an increase of 6 °C decreased both photosynthesis and biomass production, regardless of species optimal temperature. Increasing precipitation generally increased photosynthesis and biomass. Reduced cloudiness had a positive effect on photosynthesis and biomass, but much less than the other treatment factors. Our study informs expectations for the outcome of modeling studies that project forest futures under climate change.*

Gustafson, E. J., Miranda, B. R., & Sturtevant, B. R. (2018). Can future CO<inf>2</inf> concentrations mitigate the negative effects of high temperature and longer droughts on forest growth? *Forests, 9*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055730171&doi=10.3390%2ff9110664&partnerID=40&md5=2b1c3ac83922a5759276348ef5d359fa. doi:10.3390/f9110664
Research Tags: Weather, Forestry
Abstract: *Background: Climate change may subject forests to climate conditions to which they are not adapted. Elevated temperatures can potentially reduce net photosynthesis by increasing respiration rates and increasingly long droughts dramatically increase morbidity. While CO2 enrichment enhances productivity, it is not clear to what extent CO2 enrichment can offset the negative effects of elevated temperatures and longer droughts; (2) Methods: We used a mechanistic landscape model to conduct controlled simulation experiments manipulating CO2 concentration, temperature, drought length and soil water capacity; (3) Results: We found that elevated CO2 stimulates productivity such that it dwarfs the negative effect caused by elevated temperature. Energy reserves were not as strongly mitigated by elevated CO2, and the mortality of less competitive cohorts increased. Drought length had a surprisingly small effect on productivity measures, but longer droughts increased the risk of mortality; (4) Conclusions: Elevated CO2 compensated for the negative effect of longer droughts in terms of productivity measures, but not survival measures.*

Gustafson, E. J., Sturtevant, B. R., de Bruijn, A. M. G., Lichti, N., Jacobs, D. F., Kashian, D. M., . . . Townsend, P. A. (2018). Forecasting effects of tree species reintroduction strategies on carbon stocks in a future without historical analog. *Global Change Biology, 24*(11), 5500-5517. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052368036&doi=10.1111%2fgcb.14397&partnerID=40&md5=7ffe555eecf21f94216b3479c8c10507. doi:10.1111/gcb.14397
Research Tags: Forestry
Abstract: *American chestnut (Castanea dentata) was once an important component forests in the central Appalachians (USA), but it was functionally extirpated nearly a century ago. Attempts are underway to reintroduce blight-resistant chestnut to its former range, but it is uncertain how current forest composition,*

climate, and atmospheric changes and disturbance regimes will interact to determine future forest dynamics and ecosystem services. The combination of novel environmental conditions (e.g. climate change), a reintroduced tree species and new disturbance regimes (e.g. exotic insect pests, fire suppression) have no analog in the past that can be used to parameterize phenomenological models. We therefore used a mechanistic approach within the LANDIS-II forest landscape model that relies on physiological first principles to project forest dynamics as the outcome of competition of tree cohorts for light and water as a function of temperature, precipitation, CO2 concentration, and life history traits. We conducted a factorial landscape simulation experiment to evaluate specific hypotheses about future forest dynamics in two study sites in the center of the former range of chestnut. Our results supported the hypotheses that climate change would favor chestnut because of its optimal temperature range and relative drought resistance, and that chestnut would be less competitive in the more mesic Appalachian Plateau province because competitors will be less stressed. The hypothesis that chestnut will increase carbon stocks was supported, although the increase was modest. Our results confirm that aggressive restoration is needed regardless of climate and soils, and that increased aggressiveness of chestnut restoration increased biomass accumulation. The hypothesis that chestnut restoration will increase both compositional and structural richness was not supported because chestnut displaced some species and age cohorts. Although chestnut restoration did not markedly enhance carbon stocks, our findings provide hope that this formerly important species can be successfully reintroduced and associated ecosystem services recovered.

Gutierrez, A. P., Ponti, L., Cristofaro, M., Smith, L., & Pitcairn, M. J. (2017). Assessing the biological control of yellow starthistle (Centaurea solstitialis L): prospective analysis of the impact of the rosette weevil (Ceratapion basicorne (Illiger)). *Agricultural and Forest Entomology, 19*(3), 257-273. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009177525&doi=10.1111%2fafe.12205&partnerID=40&md5=e0f55694a56be8463038a57a5c8c78fd. doi:10.1111/afe.12205

Research Tags: Grassland

Abstract: *Yellow starthistle (Centaurea solstitialis L) (YST) is an invasive weed native to the Mediterranean region with a geographical centre of diversity in Turkey. It is widely established in Chile, Australia, and western North America. It arrived in California as a contaminant in alfalfa seed in 1859 and, by 2002, had infested >7.7 million hectares in the U.S.A.*

Biological control of YST using capitula feeding weevils, picture wing flies and a foliar rust pathogen has been ongoing in the western U.S.A. for more than three decades with limited success. Modelling and field research suggest natural enemies that kill whole plants and/or reduce seed production of survivors are good candidates for successful biological control. A candidate species with some of these attributes is the rosette weevil Ceratapion basicorne (Illiger).

In the present study, a model of the rosette weevil is added to an extant system model of YST and its capitula feeding natural enemies and, in a GIS context, is used to assess YST control in the Palearctic region and the weevil's potential impact on YST in western U.S.A.

The results obtained suggest densities of mature YST plants in western U.S.A. would be reduced by 70–80% in many areas.

Guyer, A., Hibbard, B. E., Holzkämper, A., Erb, M., & Robert, C. A. M. (2018). Influence of drought on plant performance through changes in belowground tritrophic interactions. *Ecology and Evolution, 8*(13), 6756-6765. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050189898&doi=10.1002%2fece3.4183&partnerID=40&md5=465298676878316c5df44db06dc88d04. doi:10.1002/ece3.4183

Research Tags: Crops, Weather

Abstract: *Climate change is predicted to increase the risk of drought in many temperate agroecosystems. While the impact of drought on aboveground plant-herbivore-natural enemy interactions has been studied, little is known about its effects on belowground tritrophic interactions and root defense chemistry. We investigated the effects of low soil moisture on the interaction between maize, the western corn rootworm (WCR, Diabrotica virgifera), and soil-borne natural enemies of WCR. In a manipulative field experiment, reduced soil moisture and WCR attack reduced plant performance and increased benzoxazinoid levels. The negative effects of WCR on cob dry weight and silk emergence were strongest at low moisture levels.*

Inoculation with entomopathogenic nematodes (EPNs, Heterorhabditis bacteriophora) was ineffective in controlling WCR, and the EPNs died rapidly in the warm and dry soil. However, ants of the species Solenopsis molesta invaded the experiment, were more abundant in WCR-infested pots and predated WCR independently of soil moisture. Ant presence increased root and shoot biomass and was associated with attenuated moisture-dependent effects of WCR on maize cob weight. Our study suggests that apart from directly reducing plant performance, drought can also increase the negative effects of root herbivores such as WCR. It furthermore identifies S. molesta as a natural enemy of WCR that can protect maize plants from the negative impact of herbivory under drought stress. Robust herbivore natural enemies may play an important role in buffering the impact of climate change on plant-herbivore interactions.

Guyette, R., Stambaugh, M. C., Dey, D., & Muzika, R. M. (2017). The theory, direction, and magnitude of ecosystem fire probability as constrained by precipitation and temperature. *PLoS ONE, 12*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85024399596&doi=10.1371%2fjournal.pone.0180956&partnerID=40&md5=6c599905b58ac63090d23c06c385fe56. doi:10.1371/journal.pone.0180956

Research Tags: Forestry, Weather

Abstract: *The effects of climate on wildland fire confronts society across a range of different ecosystems. Water and temperature affect the combustion dynamics, irrespective of whether those are associated with carbon fueled motors or ecosystems, but through different chemical, physical, and biological processes. We use an ecosystem combustion equation developed with the physical chemistry of atmospheric variables to estimate and simulate fire probability and mean fire interval (MFI). The calibration of ecosystem fire probability with basic combustion chemistry and physics offers a quantitative method to address wildland fire in addition to the well-studied forcing factors such as topography, ignition, and vegetation. We develop a graphic analysis tool for estimating climate forced fire probability with temperature and precipitation based on an empirical assessment of combustion theory and fire prediction in ecosystems. Climate-affected fire probability for any period, past or future, is estimated with given temperature and precipitation. A graphic analyses of wildland fire dynamics driven by climate supports a dialectic in hydrologic processes that affect ecosystem combustion: 1) the water needed by plants to produce carbon bonds (fuel) and 2) the inhibition of successful reactant collisions by water molecules (humidity and fuel moisture). These two postulates enable a classification scheme for ecosystems into three or more climate categories using their position relative to change points defined by precipitation in combustion dynamics equations. Three classifications of combustion dynamics in ecosystems fire probability include: 1) precipitation insensitive, 2) precipitation unstable, and 3) precipitation sensitive. All three classifications interact in different ways with variable levels of temperature.*

Hain, E. F., Kennen, J. G., Caldwell, P. V., Nelson, S. A. C., Sun, G., & McNulty, S. G. (2018). Using regional scale flow–ecology modeling to identify catchments where fish assemblages are most vulnerable to changes in water availability. *Freshwater Biology, 63*(8), 928-945. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034116620&doi=10.1111%2ffwb.13048&partnerID=40&md5=36f7455b06eb3ab1abe5208303802574. doi:10.1111/fwb.13048

Research Tags: Water, Wildlife

Abstract: *Streamflow is essential for maintaining healthy aquatic ecosystems and for supporting human water supply needs. Changes in climate, land use and water use practices may alter water availability. Understanding the potential effect of these changes on aquatic ecosystems is critical for long-term water management to maintain a balance between water for human consumption and ecosystem needs.*

Fish species data and streamflow estimates from a rainfall-runoff and flow routing model were used to develop boosted regression tree models to predict the relationship between streamflow and fish species richness (FSR) under plausible scenarios of (1) water withdrawal, (2) climate change and (3) increases in impervious surfaces in the Piedmont ecoregion of North Carolina, U.S.A. Maximum monthly flow, the fraction of total flow originating from impervious surface runoff, coefficient of monthly streamflow variability, and the specific river basin accounted for 50% of the variability in FSR. This model was used to predict FSR values for all twelve-digit Hydrological Unit Code catchments (HUC-12s) in the North Carolina Piedmont under current flow conditions and under water withdrawal, climate change and impervious surface scenarios.

Flow–ecology modeling results indicate that predicted FSR declined significantly with increased water withdrawals. However, the magnitude of decline varied geographically. A "hot-spot" analysis was conducted *based on predicted changes in FSR under each scenario to understand which HUC-12s were most likely to be affected by changes in water withdrawals, climate and impervious surfaces. Under the 20% withdrawal increase scenario, 413 of 886 (47%) HUC-12s in the study area were predicted to lose one or more species. HUC-12s in the Broad, Catawba, Yadkin and Cape Fear river basins were most susceptible to species loss.*

These findings may help decision making efforts by identifying catchments most vulnerable to changing water availability. Additionally, FSR-discharge modeling results can assist resource agencies, water managers and stakeholders in assessing the effect of water withdrawals in catchments to better support the protection and long-term conservation of species.

Hakamada, R., Hubbard, R. M., Ferraz, S., Stape, J. L., & Lemos, C. (2017). Biomass production and potential water stress increase with planting density in four highly productive clonal Eucalyptus genotypes§. *Southern Forests, 79*(3), 251-257. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012873027&doi=10.2989%2f20702620.2016.1256041&partnerID=40&md5=72099fff7f6f2ef2bf87edfefbb81a82. doi:10.2989/20702620.2016.1256041

Research Tags: Forestry

Abstract: *The choice of planting density and tree genotype are basic decisions when establishing a forest stand. Understanding the interaction between planting density and genotype, and their relationship with biomass production and potential water stress, is crucial as forest managers are faced with a changing climate. However, few studies have investigated this relationship, especially in areas with highly productive forests. This study aimed to determine the interaction between biomass production and leaf water potential, as a surrogate of potential water stress, in different clonal Eucalyptus genotypes across a range of planting densities. Four clones (two clones of E. urophylla × E. grandis, one clone of E. urophylla, and one clone of E. grandis × E. camaldulensis) and four planting densities (ranging from 591 to 2 949 trees ha−1) were evaluated in an experimental stand in south-eastern Brazil. Biomass production was estimated 2.5 years after planting and predawn (ψpd) and midday (ψmd) leaf water potential were measured 2 and 2.5 years after planting, in February (wet season) and August (dry season) in 2014. For all clones, total stand stemwood biomass production increased and leaf water potential decreased with planting density, and their interaction was significant. Thus, wood biomass at tighter spacings was higher but exhibited lower leaf water potentials, resulting in a trade-off between productivity and potential water stress. These are preliminary findings and still need to be supported by more experimental evidence and repetitions. However, in light of the increased frequency of extreme climate events, silvicultural practices that are tailored to the potential productivity of each region and that result in low potential water stress should be considered.*

Hale, L., Feng, W., Yin, H., Guo, X., Zhou, X., Bracho, R., . . . Zhou, J. (2019). Tundra microbial community taxa and traits predict decomposition parameters of stable, old soil organic carbon. *ISME Journal*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070230491&doi=10.1038%2fs41396-019-0485-x&partnerID=40&md5=ca9622c2bb7ef03fc046c8fb1720a37a. doi:10.1038/s41396-019-0485-x

Research Tags: Grassland, Soil

Abstract: *The susceptibility of soil organic carbon (SOC) in tundra to microbial decomposition under warmer climate scenarios potentially threatens a massive positive feedback to climate change, but the underlying mechanisms of stable SOC decomposition remain elusive. Herein, Alaskan tundra soils from three depths (a fibric O horizon with litter and course roots, an O horizon with decomposing litter and roots, and a mineral-organic mix, laying just above the permafrost) were incubated. Resulting respiration data were assimilated into a 3-pool model to derive decomposition kinetic parameters for fast, slow, and passive SOC pools. Bacterial, archaeal, and fungal taxa and microbial functional genes were profiled throughout the 3-year incubation. Correlation analyses and a Random Forest approach revealed associations between model parameters and microbial community profiles, taxa, and traits. There were more associations between the microbial community data and the SOC decomposition parameters of slow and passive SOC pools than those of the fast SOC pool. Also, microbial community profiles were better predictors of model parameters in deeper soils, which had higher mineral contents and relatively greater quantities of old SOC than in surface soils. Overall, our analyses revealed the functional potential of microbial communities to decompose tundra SOC through a suite of specialized genes and taxa. These results portray divergent strategies by which microbial communities access SOC pools across varying depths, lending mechanistic insights into the vulnerability of* *what is considered stable SOC in tundra regions.*

Hales, K. E., & Cole, N. A. (2017). Hourly methane production in finishing steers fed at different levels of dry matter intake. *Journal of Animal Science, 95*(5), 2089-2096. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019467328&doi=10.2527%2fjas2016.1023&partnerID=40&md5=6bb9b15d5a94d8679a905e1b8562a3cc. doi:10.2527/jas2016.1023

Research Tags: Livestock, Emissions

Abstract: *Methane (CH) loss from finishing cattle is important as it represents an energy loss that could be used for maintenance and growth, and CH is a greenhouse gas with a global warming potential 21 to 25 times that of CO. Our objectives were to determine hourly CH production from growing cattle fed diets differing in corn processing method (dry rolling or steam flaking) and wet distillers grains with solubles (WDGS) inclusion rate. Eight steers (195 kg ± 2.3 in Exp. 1 and 322 kg ± 3.7 in Exp. 2) were fed the following diets: 1) steam-flaked corn (SFC)-based diet with 0% WDGS (SFC-0); 2) SFC-based diet with 15% WDGS (SFC-15); 3) SFC-based diet with 30% WDGS (SFC-30); 4) SFC-based diet with 45% WDGS (SFC-45); 5) Dry-rolled corn DRC)-based diet with 0% WDGS (DRC-0); and 6) DRC-based diet with 30% WDGS (DRC-30). All hourly CH data were analyzed using the MIXED procedure of SAS. Individual animal was the experimental unit. The model included the fixed effect of h, diet, and the h × diet interaction. Hourly differences in CH were analyzed using repeated measures. There were numerous h × diet interactions and thus simple-effect means are presented. In steers fed DRC-0 or DRC-30 at 2-times maintenance, the greatest hourly CH emissions occur 6 h after feeding (< 0.01) with a secondary peak between 10 and 11 h after feeding (< 0.01). For cattle fed SFC-0, SFC-15, SFC-30, and SFC-45 at 2-times maintenance, all diets had peak CH emissions 5 and 6 h after feeding (< 0.01), with a secondary CH peak for SFC-45 nine to 11 h after feeding (< 0.01). Cattle fed all diets at a maintenance level of intake exhibited 1 peak in hourly CH production between 3 and 6 h after feeding (< 0.01). All steers fed SFC-30 and SFC-45 had sustained CH production over several hours, irrespective of intake level. Steers fed SFC-45 produced more CH beginning 4 h after feeding (< 0.01) and produced a greater amount of CH than any other treatment (< 0.01). Methane production generally peaked 6 h after feeding irrespective of intake level or diet type. Additionally, when fed above a maintenance level of intake, a secondary peak in CH production was observed 9 to 11 h after feeding, and steers fed at a maintenance level of intake had only 1 peak in CH production in a 23-h period.*

Hallema, D. W., Robinne, F. N., & Bladon, K. D. (2018). Reframing the Challenge of Global Wildfire Threats to Water Supplies. *Earth's Future, 6*(6), 772-776. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049563925&doi=10.1029%2f2018EF000867&partnerID=40&md5=ce5271e8f838af3bc4a3a5985eb7fb7f. doi:10.1029/2018EF000867

Research Tags: Water, Weather, Forestry

Abstract: *The timing, extent, and severity of forest wildfires have increased in many parts of the world in recent decades. These wildfires can have substantial and devastating impacts on water supply, ecohydrological systems, and sociohydrosystems. Existing frameworks to assess the magnitude and spatial extent of these effects generally focus on local processes or services and are not readily transferable to other regions. However, there is a growing need for regional, continental, and global scale indices to assess the potential effect of wildfires on freshwater availability and water supply resilience. Such indices must consider both the individual and compound effects of wildfires. In so doing, this will enable comprehensive insights on the water security paradigm and the value of hydrological services in fire-affected areas around the globe.*

Hallema, D. W., Sun, G., Bladon, K. D., Norman, S. P., Caldwell, P. V., Liu, Y., & McNulty, S. G. (2017). Regional patterns of postwildfire streamflow response in the Western United States: The importance of scale-specific connectivity. *Hydrological Processes, 31*(14), 2582-2598. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020110873&doi=10.1002%2fhyp.11208&partnerID=40&md5=bbeda2e39aa4cb8ece6ed2fb86006e57. doi:10.1002/hyp.11208

Research Tags: Water, Weather, Forestry

Abstract: *Wildfires can impact streamflow by modifying net precipitation, infiltration, evapotranspiration, snowmelt, and hillslope run-off pathways. Regional differences in fire trends and postwildfire streamflow responses across the conterminous United States have spurred concerns about the impact on streamflow in*

forests that serve as water resource areas. This is notably the case for the Western United States, where fire activity and burn severity have increased in conjunction with climate change and increased forest density due to human fire suppression. In this review, we discuss the effects of wildfire on hydrological processes with a special focus on regional differences in postwildfire streamflow responses in forests. Postwildfire peak flows and annual water yields are generally higher in regions with a Mediterranean or semi-arid climate (Southern California and the Southwest) compared to the highlands (Rocky Mountains and the Pacific Northwest), where fire-induced changes in hydraulic connectivity along the hillslope results in the delivery of more water, more rapidly to streams. No clear streamflow response patterns have been identified in the humid subtropical Southeastern United States, where most fires are prescribed fires with a low burn severity, and more research is needed in that region. Improved assessment of postwildfire streamflow relies on quantitative spatial knowledge of landscape variables such as prestorm soil moisture, burn severity and correlations with soil surface sealing, water repellency, and ash deposition. The latest studies furthermore emphasize that understanding the effects of hydrological processes on postwildfire dynamic hydraulic connectivity, notably at the hillslope and watershed scales, and the relationship between overlapping disturbances including those other than wildfire is necessary for the development of risk assessment tools.

Hallema, D. W., Sun, G., Caldwell, P. V., Norman, S. P., Cohen, E. C., Liu, Y., . . . McNulty, S. G. (2018). Burned forests impact water supplies. *Nature Communications, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045268847&doi=10.1038%2fs41467-018-03735-6&partnerID=40&md5=9553b05c72df409f11cb30e11cd2a355. doi:10.1038/s41467-018-03735-6

Research Tags: Water, Weather, Forestry

Abstract: *Wildland fire impacts on surface freshwater resources have not previously been measured, nor factored into regional water management strategies. But, large wildland fires are increasing and raise concerns about fire impacts on potable water. Here we synthesize long-term records of wildland fire, climate, and river flow for 168 locations across the United States. We show that annual river flow changed in 32 locations, where more than 19% of the basin area was burned. Wildland fires enhanced annual river flow in the western regions with a warm temperate or humid continental climate. Wildland fires increased annual river flow most in the semi-arid Lower Colorado region, in spite of frequent droughts in this region. In contrast, prescribed burns in the subtropical Southeast did not significantly alter river flow. These extremely variable outcomes offer new insights into the potential role of wildfire and prescribed fire in regional water resource management, under a changing climate.*

Hallema, D. W., Sun, G., Caldwell, P. V., Norman, S. P., Cohen, E. C., Liu, Y., . . . McNulty, S. G. (2017). Assessment of wildland fire impacts on watershed annual water yield: Analytical framework and case studies in the United States. *Ecohydrology, 10*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006272099&doi=10.1002%2feco.1794&partnerID=40&md5=3db149b7b6eb4eb11881bf5e80fe9089. doi:10.1002/eco.1794

Research Tags: Water, Weather, Forestry

Abstract: *More than 50% of water supplies in the conterminous United States originate on forestland or rangeland and are potentially under increasing stress as a result of larger and more severe wildfires. Little is known, however, about the long-term impacts of fire on annual water yield and the role of climate variability within this context. We here propose a framework for evaluating wildland fire impacts on streamflow that combines double-mass analysis with new methods (change point analysis, climate elasticity modeling, and process-based modeling) to distinguish between multiyear fire and climate impacts. The framework captures a wide range of fire types, watersheds characteristics, and climate conditions using streamflow data, as opposed to other approaches requiring paired watersheds. The process is illustrated with three case studies. A watershed in Arizona experienced a +266% increase in annual water yield in the 5 years after a wildfire, where +219% was attributed to wildfire and +24% to precipitation trends. In contrast, a California watershed had a lower (−64%) post-fire net water yield, comprised of enhanced flow (+38%) attributed to wildfire offset (−102%) by lower precipitation in the post-fire period. Changes in streamflow within a watershed in South Carolina had no apparent link to periods of prescribed burning but matched a very wet winter and reports of storm damage. The presented framework is unique in its ability to detect and quantify fire or other disturbances, even if the date or nature of the disturbance event is uncertain, and regardless of precipitation trends.*

Halofsky, J. E., Andrews-Key, S. A., Edwards, J. E., Johnston, M. H., Nelson, H. W., Peterson, D. L., . . . Williamson, T. B. (2018). Adapting forest management to climate change: The state of science and applications in Canada and the United States. *Forest Ecology and Management, 421*, 84-97. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044103981&doi=10.1016%2fj.foreco.2018.02.037&partnerID=40&md5=b3d495f32a597d597306511cfb2e31fb. doi:10.1016/j.foreco.2018.02.037

Research Tags: Forestry, Research

Abstract: *Over the last decade, considerable progress has been made in developing vulnerability assessment tools and in applying these methodologies to identify and implement climate change adaptation approaches for forest ecosystems and forest management organizations in Canada and the United States. However, given that adaptation processes are in early stages, evaluation of approaches across agency, organizational, and geographic boundaries is critical. Thus, we conducted a qualitative comparison of three conceptual frameworks for climate change vulnerability assessment and adaptation efforts in the Canadian and United States forestry agency contexts. We focus our comparison on components of the conceptual frameworks, development process, intended users, similarities and differences in institutional contexts (geographic and organizational), and implementation. Finally, we present case studies to illustrate how the frameworks have been implemented on the ground and in different contexts. Despite different trajectories of development, the Canadian and US forest agencies have developed similar conceptual frameworks for vulnerability assessment and adaptation. We found that key components of the conceptual frameworks included: establishing a science-management partnership; evaluating current forest conditions and management objectives; conducting detailed science-based vulnerability assessments; developing adaptation approaches and on-the-ground tactics; implementing adaptation tactics; and monitoring outcomes and adjusting as needed. However, the contexts in which these frameworks are implemented vary considerably within and between countries, mostly because of differences in land ownership, management norms, and organizational cultures. On-the-ground applications, although slow to develop, are beginning to proliferate, providing examples that can be emulated by others. A strategy for accelerating implementation of adaptation in Canada and the United States is suggested, building on successes by federal agencies and extending to public, private, and crown lands.*

Halofsky, J. E., Hoglund-Wyatt, K., Dello, K., Peterson, D. L., & Stevenson, J. (2018). Assessing and adapting to climate change in the Blue Mountains, Oregon (USA): Overview, biogeography, and climate. *10*, 1-8. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045831875&doi=10.1016%2fj.cliser.2018.03.002&partnerID=40&md5=d89fceddf537483d8ea12cfa658464f3. doi:10.1016/j.cliser.2018.03.002

Research Tags: Forestry, Water

Abstract: *The Blue Mountains Adaptation Partnership (BMAP) was established to increase climate change awareness, assess vulnerability to climate change, and develop science-based adaptation strategies for national forest lands in the Blue Mountains region of northeast Oregon and southeast Washington (USA). The BMAP process included (1) development of a science-management partnership, (2) a vulnerability assessment of the effects of climate change on natural resources and infrastructure, (3) development of adaptation options that will help reduce negative effects of climate change and assist the transition of biological systems and management to a changing climate, and (4) ongoing dialogue and activities related to climate change in the Blue Mountains region. This special issue of Climate Services describes social context and climate change vulnerability assessments for water use and infrastructure, vegetation, and riparian ecosystems of the Blue Mountains region, as well as adaptation options for natural resource management. This manuscript introduces the special issue, describing the management, biogeographic, and climatic context for the Blue Mountains region; the climate change vulnerability assessment and adaptation process used in BMAP; and the potential applications of the information described in the special issue. Although the institutional focus of information in the special issue is U.S. Forest Service lands (Malheur, Umatilla, and Wallowa-Whitman National Forests), the broader social context and adaptation options should be applicable to other lands throughout this region and the Pacific Northwest.*

Halofsky, J. E., Peterson, D. L., Karen Dante-Wood, S., & Hoang, L. (2018) Toward Climate-Smart Resource Management in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 221-228).

Research Tags: Forestry, Water, Research

Abstract: *The Northern Rockies Adaptation Partnership facilitated the largest climate change adaptation effort on public lands to date, including participants from federal agencies and stakeholder organizations interested in a broad range of resource issues. It achieved specific goals of national climate change strategies for the U.S. Forest Service and National Park Service, providing a scientific foundation for resource management and planning in the Northern Rockies. The large number of adaptation strategies and tactics, many of which are a component of current management practice, provide a pathway for slowing the rate of deleterious change in resource conditions. Rapid implementation of adaptation—in land management plans, National Environmental Policy Act documents, project plans, and restoration—will help maintain functionality of terrestrial and aquatic ecosystems in the Northern Rockies, as well as build the organizational capacity of federal agencies to incorporate climate change in their mission of sustainable resource management. Long-term monitoring will help detect potential climate change effects on natural resources, and evaluate the effectiveness of adaptation options that have been implemented.*

Halofsky, J. E., Peterson, D. L., & Prendeville, H. R. (2018). Assessing vulnerabilities and adapting to climate change in northwestern U.S. forests. *Climatic Change, 146*(1-2), 89-102. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018796474&doi=10.1007%2fs10584-017-1972-6&partnerID=40&md5=4166a89a6d44d7099cfb11b2a8f6ab74. doi:10.1007/s10584-017-1972-6
Research Tags: Forestry
Abstract: *Multiple climate change vulnerability assessments in the Pacific Northwest region of the USA provide the scientific information needed to begin adaptation in forested landscapes. Adaptation options developed by resource managers in conjunction with these assessments, newly summarized in the Climate Change Adaptation Library of the Western United States, provide an extensive choice of peer-reviewed climate-smart management strategies and tactics. More adaptation options are available for vegetation than for any other resource category, allowing vegetation management to be applied across a range of spatial and temporal scales. Good progress has been made in strategic development and planning for climate change adaptation in the Northwest, although on-the-ground implementation is in the early stages. However, recent regulatory mandates plus the increasing occurrence of extreme events (drought, wildfires, insect outbreaks) provide motivation to accelerate the adaptation process in planning and management on federal lands and beyond. Timely implementation of adaptation and collaboration across boundaries will help ensure the functionality of Northwest forests at broad spatial scales in a warmer climate.*

Halofsky, J. E., Warziniack, T. W., Peterson, D. L., & Ho, J. J. (2017). Understanding and Managing the Effects of Climate Change on Ecosystem Services in the Rocky Mountains. *Mountain Research and Development, 37*(3), 340-352. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030090621&doi=10.1659%2fMRD-JOURNAL-D-16-00087.1&partnerID=40&md5=fb2f4baece092930b3537286f9ac2712. doi:10.1659/MRD-JOURNAL-D-16-00087.1
Research Tags: Forestry, Water, Research
Abstract: *Public lands in the US Rocky Mountains provide critical ecosystem services, especially to rural communities that rely on these lands for fuel, food, water, and recreation. Climate change will likely affect the ability of these lands to provide ecosystem services. We describe 2 efforts to assess climate change vulnerabilities and develop adaptation options on federal lands in the Rocky Mountains. We specifically focus on aspects that affect community economic security and livelihood security, including water quality and quantity, timber, livestock grazing, and recreation. Headwaters of the Rocky Mountains serve as the primary source of water for large populations, and these headwaters are located primarily on public land. Thus, federal agencies will play a key role in helping to protect water quantity and quality by promoting watershed function and water conservation. Although increased temperatures and atmospheric concentration of CO2 have the potential to increase timber and forage production in the Rocky Mountains, those gains may be offset by wildfires, droughts, insect outbreaks, non-native species, and altered species composition. Our assessment identified ways in which federal land managers can help sustain forest and range productivity, primarily by increasing ecosystem resilience and minimizing current stressors, such as invasive species. Climate change will likely increase recreation participation. However, recreation managers will need more flexibility to adjust practices, provide recreation opportunities, and sustain economic benefits to communities. Federal agencies are*

now transitioning from the planning phase of climate change adaptation to implementation to ensure that ecosystem services will continue to be provided from federal lands in a changing climate.

Halofsky, J. S., Conklin, D. R., Donato, D. C., Halofsky, J. E., & Kim, J. B. (2018). Climate change, wildfire, and vegetation shifts in a high-inertia forest landscape: Western Washington, U.S.A. *PLoS ONE, 13*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058791416&doi=10.1371%2fjournal.pone.0209490&partnerID=40&md5=abef954f59349f3d97fba2174c50dc36. doi:10.1371/journal.pone.0209490

Research Tags: Forestry

Abstract: *Future vegetation shifts under changing climate are uncertain for forests with infrequent stand-replacing disturbance regimes. These high-inertia forests may have long persistence even with climate change because disturbance-free periods can span centuries, broad-scale regeneration opportunities are fewer relative to frequent-fire systems, and mature tree species are long-lived with relatively high tolerance for sub-optimal growing conditions. Here, we used a combination of empirical and process-based modeling approaches to examine vegetation projections across high-inertia forests of Washington State, USA, under different climate and wildfire futures. We ran our models without forest management (to assess inherent system behavior/potential) and also with wildfire suppression. Projections suggested relatively stable mid-elevation forests through the end of the century despite anticipated increases in wildfire. The largest changes were projected at the lowest and uppermost forest boundaries, with upward expansion of the driest low-elevation forests and contraction of cold, high-elevation subalpine parklands. While forests were overall relatively stable in simulations, increases in early-seral conditions and decreases in late-seral conditions occurred as wildfire became more frequent. With partial fire suppression, projected changes were dampened or delayed, suggesting a potential tool to forestall change in some (but not all) high-inertia forests, especially since extending fire-free periods does little to alter overall fire regimes in these systems. Model projections also illustrated the importance of fire regime context and projection limitations; the time horizon over which disturbances will eventually allow the system to shift are so long that the prevailing climatic conditions under which many of those shifts will occur are beyond what most climate models can predict with any certainty. This will present a fundamental challenge to setting expectations and managing for long-term change in these systems.*

Halofsky, J. S., Donato, D. C., Franklin, J. F., Halofsky, J. E., Peterson, D. L., & Harvey, B. J. (2018). The nature of the beast: Examining climate adaptation options in forests with stand-replacing fire regimes. *Ecosphere, 9*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044180314&doi=10.1002%2fecs2.2140&partnerID=40&md5=1de9ac5faf0affda446deb2318f62425. doi:10.1002/ecs2.2140

Research Tags: Forestry, Weather

Abstract: *Building resilience to natural disturbances is a key to managing forests for adaptation to climate change. To date, most climate adaptation guidance has focused on recommendations for frequent-fire forests, leaving few published guidelines for forests that naturally experience infrequent, stand-replacing wildfires. Because most such forests are inherently resilient to stand-replacing disturbances, and burn severity mosaics are largely indifferent to manipulations of stand structure (i.e., weather-driven, rather than fuel-driven fire regimes), we posit that pre-fire climate adaptation options are generally fewer in these regimes relative to others. Outside of areas of high human value, stand-scale fuel treatments commonly emphasized for other forest types would undermine many of the functions, ecosystem services, and other values for which these forests are known. For stand-replacing disturbance regimes, we propose that (1) managed wildfire use (e.g., allowing natural fires to burn under moderate conditions) can be a useful strategy as in other forest types, but likely confers fewer benefits to long-term forest resilience and climate adaptation, while carrying greater socio-ecological risks; (2) reasoned fire exclusion (i.e., the suppression component of a managed wildfire program) can be an appropriate strategy to maintain certain ecosystem conditions and services in the face of change, being more ecologically justifiable in long-interval fire regimes and producing fewer of the negative consequences than in frequent-fire regimes; (3) low-risk pre-disturbance adaptation options are few, but the most promising approaches emphasize fundamental conservation biology principles to create a safe operating space for the system to respond to change (e.g., maintaining heterogeneity across scales and minimizing stressors); and (4) post-disturbance conditions are the primary opportunity to implement adaptation strategies*

(such as protecting live tree legacies and testing new regeneration methods), providing crucial learning opportunities. This approach will provide greater context and understanding of these systems for ecologists and resource managers, stimulate future development of adaptation strategies, and illustrate why public expectations for climate adaptation in these forests will differ from those for frequent-fire forests.

Halofsky, J. S., Halofsky, J. E., Hemstrom, M. A., Morzillo, A. T., Zhou, X., & Donato, D. C. (2017). Divergent trends in ecosystem services under different climate-management futures in a fire-prone forest landscape. *Climatic Change, 142*(1-2), 83-95. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014058165&doi=10.1007%2fs10584-017-1925-0&partnerID=40&md5=94b308184ed33e489536aeed9c5fd24e. doi:10.1007/s10584-017-1925-0
Research Tags: Forestry, Weather
Abstract: *While ecosystem services and climate change are often examined independently, quantitative assessments integrating these fields are needed to inform future land management decisions. Using climate-informed state-and-transition simulations, we examined projected trends and tradeoffs for a suite of ecosystem services under four climate change scenarios and two management scenarios (active management emphasizing fuel treatments and no management other than fire suppression) in a fire-prone landscape of dry and moist mixed-conifer forests in central Oregon, USA. Focal ecosystem services included fire potential (regulating service), timber volume (provisioning service), and potential wildlife habitat (supporting service). Projections without climate change suggested active management in dry mixed-conifer forests would create more open forest structures, reduce crown fire potential, and maintain timber stocks, while in moist mixed-conifer forests, active management would reduce crown fire potential but at the expense of timber stocks. When climate change was considered, however, trends in most ecosystem services changed substantially, with large increases in wildfire area predominating broad-scale trends in outputs, regardless of management approach (e.g., strong declines in timber stocks and habitat for closed-forest wildlife species). Active management still had an influence under a changing climate, but as a moderator of the strong climate-driven trends rather than being a principal driver of ecosystem service outputs. These results suggest projections of future ecosystem services that do not consider climate change may result in unrealistic expectations of benefits.*

Hamilton, J. A., Royauté, R., Wright, J. W., Hodgskiss, P., & Ledig, F. T. (2017). Genetic conservation and management of the California endemic, Torrey pine (Pinus torreyana Parry): Implications of genetic rescue in a genetically depauperate species. *Ecology and Evolution, 7*(18), 7370-7381. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021733976&doi=10.1002%2fece3.3306&partnerID=40&md5=cb3ec097cdb794b3431b96f86380895b. doi:10.1002/ece3.3306
Research Tags: Forestry
Abstract: *Rare species present a challenge under changing environmental conditions as the genetic consequences of rarity may limit species ability to adapt to environmental change. To evaluate the evolutionary potential of a rare species, we assessed variation in traits important to plant fitness using multigenerational common garden experiments. Torrey pine, Pinus torreyana Parry, is one of the rarest pines in the world, restricted to one mainland and one island population. Morphological differentiation between island and mainland populations suggests adaptation to local environments may have contributed to trait variation. The distribution of phenotypic variances within the common garden suggests distinct population-specific growth trajectories underlay genetic differences, with the island population exhibiting substantially reduced genetic variance for growth relative to the mainland population. Furthermore, F1 hybrids, representing a cross between mainland and island trees, exhibit increased height accumulation and fecundity relative to mainland and island parents. This may indicate genetic rescue via intraspecific hybridization could provide the necessary genetic variation to persist in environments modified as a result of climate change. Long-term common garden experiments, such as these, provide invaluable resources to assess the distribution of genetic variance that may inform conservation strategies to preserve evolutionary potential of rare species, including genetic rescue.*

Han, M., Zhang, H., Chávez, J. L., Ma, L., Trout, T. J., & DeJonge, K. C. (2018). Improved soil water deficit estimation through the integration of canopy temperature measurements into a soil water balance model. *Irrigation Science, 36*(3), 187-201. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044938284&doi=10.1007%2fs00271-018-0574-z&partnerID=40&md5=1774b41631b789a5e170fd9cb1a5255d. doi:10.1007/s00271-018-0574-z

Research Tags: Soil, Water, Forestry, Research

Abstract: *The total available water in the soil root zone (TAWr), which regulates the plant transpiration, is a critical parameter for irrigation management and hydrologic modeling studies. However, the TAWr was not well-investigated in current hydrologic or agricultural research for two reasons: (1) there is no direct measurement method of this parameter; and (2) there is, in general, a large spatial and temporal variability of TAWr. In this study, we propose a framework to improve TAWr estimation by incorporating the crop water stress index (CWSI) from canopy temperature into the Food and Agriculture Organization of the United Nations (FAO) paper 56 water balance model. Field experiments of irrigation management were conducted for maize during the 2012, 2013 and 2015 growing seasons near Greeley, Colorado, USA. The performance of the FAO water balance model with CWSI-determined TAWr was validated using measured soil water deficit. The statistical analyses between modeled and observed soil water deficit indicated that the CWSI-determined TAWr significantly improved the performance of the soil water balance model, with reduction of the mean absolute error (MAE) and root mean squared error (RMSE) by 17 and 20%, respectively, compared with the standard FAO model (with experience estimated TAWr). The proposed procedure may not work under well-watered conditions, because TAWr may not influence the crop transpiration or crop water stress in both daily and seasonal scales under such conditions. The proposed procedure potentially could be applied in other ecosystems and with other crop water stress related measurements, such as surface evapotranspiration from remote sensing methodology.*

Hanberry, B. B., & Fraser, J. S. (2019). Visualizing current and future climate boundaries of the conterminous United States: Implications for forests. *Forests, 10*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063865739&doi=10.3390%2ff10030280&partnerID=40&md5=0572ac91b918058c86f4b0a62332c872. doi:10.3390/f10030280

Research Tags: Forestry

Abstract: *Many potential geographic information system (GIS) applications remain unrealized or not yet extended to diverse spatial and temporal scales due to the relative recency of conversion from paper maps to digitized images. Here, we applied GIS to visualize changes in the ecological boundaries of plant hardiness zones and the Köppen-Trewartha classification system between current climate (1981–2010) and future climate (2070–2099), as well as changing climate within stationary state boundaries of the conterminous United States, which provide context for the future of forests. Three climate models at Representative Concentration Pathway (RCP) 8.5 were variable in climate projections. The greatest departure from the current climate in plant hardiness zones, which represent the coldest days, occurred where temperatures were coldest, whereas temperatures in the southeastern United States remained relatively stable. Most (85% to 99%) of the conterminous US increased by at least one plant hardiness zone (5.6 °C). The areal extent of subtropical climate types approximately doubled, expanding into current regions of hot temperate climate types, which shifted into regions of warm temperate climate types. The northernmost tier of states may generally develop the hottest months of the southernmost tier of states; Montana's hottest month may become hotter than Arizona's current hottest month. We applied these results to demonstrate the large magnitude of potential shifts in forested ecosystems at the end of the century. Shifts in ecological boundaries and climate within administrative boundaries may result in mismatches between climate and ecosystems and coupled human–environment systems.*

Hand, M. S., Eichman, H., Jack Triepke, F., & Jaworski, D. (2018). Socioeconomic vulnerability to ecological changes to national forests and grasslands in the Southwest. *USDA Forest Service - General Technical Report RMRS-GTR, 2018*(383). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065796713&partnerID=40&md5=fc2588ee528443b4ae2355be9768c5cc.

Research Tags: Forestry, Economics

Abstract: *The flow of ecosystem services derived from forests and grasslands in the Southwestern United States may change in the future. People and communities may be vulnerable if they are exposed, are sensitive, and have limited ability to adapt to ecological changes. Geospatial descriptions of ecosystem services, projected* *climate-related ecological changes, and socioeconomic conditions are used to assess socioeconomic vulnerability to changes in the provision of ecosystem services by national forests and grasslands in the Southwest. Vulnerability is uneven in the Southwest due to varying projected effects of climate on forest ecosystem services, and different levels of exposure, sensitivity, and adaptive capacity of people in the region*

Hand, M. S., & Lawson, M. (2018) Effects of Climate Change on Recreation in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 169-188).
Research Tags: Economics
Abstract: *Outdoor recreation is an important benefit provided by Federally managed and other public lands throughout the Rocky Mountains. National forests in the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and Greater Yellowstone Area (a region hereafter called the Northern Rockies region) have an estimated 13.3 million visits per year; Yellowstone, Grand Teton, and Glacier National Parks account for another 8 million visits per year. National forests and national parks provide recreation opportunities at sites that offer a wide variety of characteristics. Recreation on public lands in the Northern Rockies region is inseparable from ecosystems and natural features. Whether visitors ski, hike, hunt, or camp, explore developed sites or the backcountry, or simply drive through a park or forest, natural and ecological conditions in large part determine their overall recreation experience.*

Hao, L., Huang, X., Qin, M., Liu, Y., Li, W., & Sun, G. (2018). Ecohydrological Processes Explain Urban Dry Island Effects in a Wet Region, Southern China. *Water Resources Research, 54*(9), 6757-6771. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053675889&doi=10.1029%2f2018WR023002&partnerID=40&md5=49464acfd917f4cc20d5d9ef0158dbf7. doi:10.1029/2018WR023002
Research Tags: Emissions
Abstract: *Conversion of agricultural lands to urban uses affects regional and global climate not only through the release of greenhouse gases but also through altering land surface physical processes such as energy and water balances. Most existing studies on the meteorological impacts of urbanization focus on urban heat island effects with little attention on its impacts of atmospheric humidity, a key variable in hydrometeorology and climate science. We define the influences of urbanization on reducing atmospheric humidity and elevating vapor pressure deficit as urban dry island (UDI) effects. We conduct a case study in the Yangtze River Delta, a typical humid area in southern China that is under rapid urbanization. We examine spatiotemporal characteristics of UDI and identify potential drivers during 2001–2014. Relationships and interactions between variations of air temperature, atmospheric humidity, evapotranspiration, and leaf area index of different land cover were determined using correlation and attribution analyses at both station and regional levels. We show that atmospheric humidity decreased dramatically and vapor pressure deficit increased sharply in the urban core, resulting in enhanced UDI. In addition to global warming and localized urban heat island, UDI is closely related to the loss of vegetation cover (i.e., natural wetlands and paddies). Reduction of evapotranspiration or latent heat is another important factor contributing to UDI effects. We conclude that the role of vegetated land cover and associated ecohydrological processes in moderating UDI and maintaining a stable climate and environment should be considered in massive urban planning and global change impact assessment in southern China.*

Hao, L., Pan, C., Fang, D., Zhang, X., Zhou, D., Liu, P., . . . Sun, G. (2018). Quantifying the effects of overgrazing on mountainous watershed vegetation dynamics under a changing climate. *Science of the Total Environment, 639*, 1408-1420. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047494225&doi=10.1016%2fj.scitotenv.2018.05.224&partnerID=40&md5=18f8a2696f410ad0f6a985ca647dadf6. doi:10.1016/j.scitotenv.2018.05.224
Research Tags: Livestock, Grassland
Abstract: *Grazing is a major ecosystem disturbance in arid regions that are increasingly threatened by climate change. Understanding the long-term impacts of grazing on rangeland vegetation dynamics in a complex terrain in mountainous regions is important for quantifying dry land ecosystem services for integrated watershed management and climate change adaptation. However, data on the detailed long-term spatial distribution of grazing activities are rare, which prevents trend detection and environmental impact assessments of grazing. This study quantified the impacts of grazing on vegetation dynamics for the period of*

1983–2010 in the Upper Heihe River basin, a complex multiple-use watershed in northwestern China. We also examined the relative contributions of grazing and climate to vegetation change using a dynamic grazing pressure method. Spatial grazing patterns and temporal dynamics were mapped at a 1 km × 1 km pixel scale using satellite-derived leaf area index (LAI) data. We found that overgrazing was a dominant driver for LAI reduction in alpine grasslands and shrubs, especially for the periods of 1985–1991 and 1997–2004. Although the recent decade-long active grazing management contributed to the improvement of LAI and partially offset the negative effects of increased livestock, overgrazing has posed significant challenges to shrub-grassland ecosystem recovery in the eastern part of the study basin. We conclude that the positive effects of a warming and wetting climate on vegetation could be underestimated if the negative long-term grazing effects are not considered. Findings from the present case study show that assessing long-term climate change impacts on watersheds must include the influences of human activities. Our study provides important guidance for ecological restoration efforts in locating vulnerable areas and designing effective management practices in the study watershed. Such information is essential for natural resource management that aims at meeting multiple demands of watershed ecosystem services in arid and semiarid rangelands.

Hao, Y., Zhang, H., Biederman, J. A., Li, L., Cui, X., Xue, K., . . . Wang, Y. (2018). Seasonal timing regulates extreme drought impacts on CO<inf>2</inf> and H<inf>2</inf>O exchanges over semiarid steppes in Inner Mongolia, China. *Agriculture, Ecosystems and Environment, 266*, 153-166. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051503467&doi=10.1016%2fj.agee.2018.06.010&partnerID=40&md5=4cbec4771fd393ef5fbdd0dabeb3dc2a. doi:10.1016/j.agee.2018.06.010
Research Tags: Grassland, Weather
Abstract: *Climate models predict a substantial increase in the frequency of extreme drought, suggesting subsequent impacts on the carbon (C) and water cycles. Although many studies have investigated the impacts of extreme drought on ecosystem functioning, it remains unknown how the timing of extreme drought within a growing season may affect carbon and water cycling. Here we conducted a 3-year field experiment to investigate the influence of seasonal drought timing on ecosystem carbon and water exchange by excluding rainfall (for consecutive 30 days) during three periods of the growing season (May–June, July–August and August–September) in fenced and grazed sites of a semiarid temperate steppe in Inner Mongolia, China. In the fenced steppe, extreme drought reduced growing-season net CO2 uptake regardless of drought timing, while in the grazed steppe, early-growing season drought caused relatively larger reductions to net CO2 uptake than drought imposed later in the season. The effect of extreme drought on evapotranspiration (ET) was similar to that of CO2 exchange at the fenced site, with consistent reductions of seasonally-integrated ET for all treatments compared with the ambient condition. In contrast, at the grazed site, the response of ET to extreme drought was more variable, possibly due to the absence of litter and greater bare ground. Surprisingly, both gross and net carbon uptake declined with increasing ET at the grazed site, while the fenced site showed the positive water-carbon linkage typically seen in semiarid ecosystems. The different responses of CO2 and water exchanges for the fenced and grazed sites were regulated predominately by soil temperature and soil water content. Together, our results show that drought timing within the growing season can significantly alter drought impacts on ecosystem water and CO2 exchanges, and that grazing management may further mediate the response.*

Hardegree, S. P., Abatzoglou, J. T., Brunson, M. W., Germino, M. J., Hegewisch, K. C., Moffet, C. A., . . . Meredith, G. R. (2018). Weather-Centric Rangeland Revegetation Planning. *Rangeland Ecology and Management, 71*(1), 1-11. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037825925&doi=10.1016%2fj.rama.2017.07.003&partnerID=40&md5=bc963ace2cc8fb7df1d190ff47a2ee31. doi:10.1016/j.rama.2017.07.003
Research Tags: Grassland
Abstract: *Invasive annual weeds negatively impact ecosystem services and pose a major conservation threat on semiarid rangelands throughout the western United States. Rehabilitation of these rangelands is challenging due to interannual climate and subseasonal weather variability that impacts seed germination, seedling survival and establishment, annual weed dynamics, wildfire frequency, and soil stability. Rehabilitation and restoration outcomes could be improved by adopting a weather-centric approach that uses the full spectrum of available site-specific weather information from historical observations, seasonal climate forecasts, and*

climate-change projections. Climate data can be used retrospectively to interpret success or failure of past seedings by describing seasonal and longer-term patterns of environmental variability subsequent to planting. A more detailed evaluation of weather impacts on site conditions may yield more flexible adaptive-management strategies for rangeland restoration and rehabilitation, as well as provide estimates of transition probabilities between desirable and undesirable vegetation states. Skillful seasonal climate forecasts could greatly improve the cost efficiency of management treatments by limiting revegetation activities to time periods where forecasts suggest higher probabilities of successful seedling establishment. Climate-change projections are key to the application of current environmental models for development of mitigation and adaptation strategies and for management practices that require a multidecadal planning horizon. Adoption of new weather technology will require collaboration between land managers and revegetation specialists and modifications to the way we currently plan and conduct rangeland rehabilitation and restoration in the Intermountain West.

Harden, J. W., Hugelius, G., Ahlström, A., Blankinship, J. C., Bond-Lamberty, B., Lawrence, C. R., . . . Nave, L. E. (2018). Networking our science to characterize the state, vulnerabilities, and management opportunities of soil organic matter. *Global Change Biology, 24*(2), e705-e718. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030627756&doi=10.1111%2fgcb.13896&partnerID=40&md5=f8ffa7a2779de4db6b2379417f1b586c. doi:10.1111/gcb.13896

Research Tags: Soil

Abstract: *Soil organic matter (SOM) supports the Earth's ability to sustain terrestrial ecosystems, provide food and fiber, and retains the largest pool of actively cycling carbon. Over 75% of the soil organic carbon (SOC) in the top meter of soil is directly affected by human land use. Large land areas have lost SOC as a result of land use practices, yet there are compensatory opportunities to enhance productivity and SOC storage in degraded lands through improved management practices. Large areas with and without intentional management are also being subjected to rapid changes in climate, making many SOC stocks vulnerable to losses by decomposition or disturbance. In order to quantify potential SOC losses or sequestration at field, regional, and global scales, measurements for detecting changes in SOC are needed. Such measurements and soil-management best practices should be based on well established and emerging scientific understanding of processes of C stabilization and destabilization over various timescales, soil types, and spatial scales. As newly engaged members of the International Soil Carbon Network, we have identified gaps in data, modeling, and communication that underscore the need for an open, shared network to frame and guide the study of SOM and SOC and their management for sustained production and climate regulation.*

Harris, L. B., Scholl, A. E., Young, A. B., Estes, B. L., & Taylor, A. H. (2019). Spatial and temporal dynamics of 20th century carbon storage and emissions after wildfire in an old-growth forest landscape. *Forest Ecology and Management, 449*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069660744&doi=10.1016%2fj.foreco.2019.117461&partnerID=40&md5=8f758218514546ec2b51cded0183c412. doi:10.1016/j.foreco.2019.117461

Research Tags: Forestry, Weather

Abstract: *Both fire exclusion and subsequent wildfires have strongly affected carbon storage in fire-prone dry forests, with implications for how carbon storage will change in the future. Using a reconstruction of forest structure in 1899 and pre- and post-fire field data, we quantified changes in carbon stocks in a 2125-ha old-growth mixed conifer forest landscape over a century of fire exclusion and emissions due to a 2013 wildfire. From 1899 to 2002 aboveground carbon storage in live trees increased 2.5-fold from 97 Mg/ha to 263 Mg/ha. Despite burning in an uncharacteristically severe wildfire, the forest still contained 169 Mg/ha of live aboveground tree carbon in 2014. Direct fire emissions were 72 Mg/ha and did not vary with canopy cover loss because emissions were largely driven by consumption of accumulated surface fuels. Areas that burned at low, moderate and high severity in the wildfire contained similar amounts of carbon in 1899, when the forest was still experiencing frequent low severity fire. By 2002 the low severity areas contained 80 and 86 Mg/ha more aboveground live tree carbon than moderate and high severity areas respectively. The wildfire reinforced and amplified these differences in carbon storage that arose during fire exclusion, such that carbon storage following the wildfire was more variable across the landscape. Additionally, the proportion of carbon stored in shade-intolerant, more fire-sensitive species increased. These changes in where and in what tree species carbon*

is stored, due to the combination of fire exclusion and wildfire, have implications for the potential future stability of these carbon stocks.

Hasegawa, T., Li, T., Yin, X., Zhu, Y., Boote, K., Baker, J., . . . Zhu, J. (2017). Causes of variation among rice models in yield response to CO<inf>2</inf> examined with Free-Air CO<inf>2</inf> Enrichment and growth chamber experiments. *Scientific Reports, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032788274&doi=10.1038%2fs41598-017-13582-y&partnerID=40&md5=6d99c18083b8295374eca006e3f01197. doi:10.1038/s41598-017-13582-y

Research Tags: Crops, Research

Abstract: *The CO2 fertilization effect is a major source of uncertainty in crop models for future yield forecasts, but coordinated efforts to determine the mechanisms of this uncertainty have been lacking. Here, we studied causes of uncertainty among 16 crop models in predicting rice yield in response to elevated [CO2] (E-[CO2]) by comparison to free-air CO2 enrichment (FACE) and chamber experiments. The model ensemble reproduced the experimental results well. However, yield prediction in response to E-[CO2] varied significantly among the rice models. The variation was not random: models that overestimated at one experiment simulated greater yield enhancements at the others. The variation was not associated with model structure or magnitude of photosynthetic response to E-[CO2] but was significantly associated with the predictions of leaf area. This suggests that modelled secondary effects of E-[CO2] on morphological development, primarily leaf area, are the sources of model uncertainty. Rice morphological development is conservative to carbon acquisition. Uncertainty will be reduced by incorporating this conservative nature of the morphological response to E-[CO2] into the models. Nitrogen levels, particularly under limited situations, make the prediction more uncertain. Improving models to account for [CO2] × N interactions is necessary to better evaluate management practices under climate change.*

Hastings, J. M., Potter, K. M., Koch, F. H., Megalos, M., & Jetton, R. M. (2017). Prioritizing conservation seed banking locations for imperiled hemlock species using multi-attribute frontier mapping. *New Forests, 48*(2), 301-316. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014104554&doi=10.1007%2fs11056-017-9575-7&partnerID=40&md5=9bbfa69469bd673bec6ce9d395ca069f. doi:10.1007/s11056-017-9575-7

Research Tags: Forestry, Wildlife

Abstract: *Hemlock woolly adelgid (Adelges tsugae Annand) (HWA) is an invasive forest insect sweeping across the native range of eastern (Tsuga canadensis [L.] Carr.) and Carolina (Tsuga caroliniana Engelm.) hemlocks, threatening to severely reduce eastern hemlock extent and to push Carolina hemlock to extirpation. HWA poses a significant threat to these eastern US natives, now infesting hemlocks across 19 states and more than 400 counties. For the long-term preservation of the species, ex situ genetic resource conservation efforts such as seed collection, storage, and adelgid-resistant hemlock breeding may all be necessary. To ensure the efficient and effective application of these efforts, it will be necessary to prioritize locations within the native ranges, because it is logistically impossible to apply these efforts to all populations. To build upon 12 years of seed banking for eastern and Carolina hemlock, we applied a novel approach for incorporating multiple dissimilar data sets into a geographic prioritization of areas for the most effective and efficient conservation of genetic diversity. The approach involves integration of geographic information systems with the multi-attribute frontier mapping technique to identify locations across the ranges of these two imperiled species most in need of conservation actions. Specifically, our assessment incorporated four genetic diversity parameters, a climate component, a measure of population disjunctiveness, a measure of local hemlock abundance, and seed collection density to prioritize areas of eastern and Carolina hemlock occurrence for ex situ gene conservation. For each species, the result was a mapped index of locations prioritized by the combined significance of these factors. For eastern hemlock, this assessment assigned the highest priority to disjunct populations and to some areas within the main-body range. With Carolina hemlock, disjunct northern populations and central main-body locations received the highest prioritization. Our prioritization approach could be applied similarly to other species facing pressure from invasive pests or other environmental threats.*

Hatfield, J. (2017). Turfgrass and climate change. *Agronomy Journal, 109*(4), 1708-1718. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023773082&doi=10.2134%2fagronj2016.10.0626&

partnerID=40&md5=947bf78d76660a4879bef796b2e07104. doi:10.2134/agronj2016.10.0626
Research Tags: Grassland
Abstract: *Climate change is occurring and is impacting biological systems through increased temperatures, more variable precipitation, and increased CO2 in the atmosphere. These effects have been documented for agricultural species, primarily grain crops, pasture and rangeland species. The extension of these relationships to turfgrass has been limited; however, these plants are an important part of our ecosystems and preservation of these plantings adds to social value and ecosystem services. Turfgrasses can be divided into cool-season and warm-season species and the projected changes in maximum air temperatures, along with increased root zone temperatures may promote a Northward migration of warm-season turfgrasses. Increased spring precipitation and more variable summer precipitation coupled with more intense precipitation events are projected to occur requiring enhanced management of soil water. Turfgrass management to ensure adequate root zone soil water, and the selection of varieties or species with greater drought tolerance in the warmer regions will be necessary to preserve turfgrass plantings. Increases in CO2 benefits turfgrass growth and positively affects water use efficiency, which decreases the potential effects of a more variable precipitation regime because of impacts on soil water use. Genotypic variation in response to soil water deficits provides a foundation for screening turfgrass species to adapt to climatic stresses. Changes in temperature and precipitation variation will increase the potential for abiotic and biotic stresses on turfgrasses. Turfgrass management will require increased attention to increased abiotic and biotic stresses.*

Hatfield, J. L., Antle, J., Garrett, K. A., Izaurralde, R. C., Mader, T., Marshall, E., . . . Ziska, L. (2018). Indicators of climate change in agricultural systems. *Climatic Change*, 1-14. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048032842&doi=10.1007%2fs10584-018-2222-2&partnerID=40&md5=b53922981c690dc1fd4febc04a36304d. doi:10.1007/s10584-018-2222-2
Research Tags: Crops, Weather, Soil
Abstract: *Climate change affects all segments of the agricultural enterprise, and there is mounting evidence that the continuing warming trend with shifting seasonality and intensity in precipitation will increase the vulnerability of agricultural systems. Agricultural is a complex system within the USA encompassing a large number of crops and livestock systems, and development of indicators to provide a signal of the impact of climate change on these different systems would be beneficial to the development of strategies for effective adaptation practices. A series of indicators were assembled to determine their potential for assessing agricultural response to climate change in the near term and long term and those with immediate capability of being implemented and those requiring more development. The available literature reveals indicators on livestock related to heat stress, soil erosion related to changes in precipitation, soil carbon changes in response to increasing carbon dioxide and soil management practices, economic response to climate change in agricultural production, and crop progress and productivity. Crop progress and productivity changes are readily observed data with a historical record for some crops extending back to the mid-1800s. This length of historical record coupled with the county-level observations from each state where a crop is grown and emerging pest populations provides a detailed set of observations to assess the impact of a changing climate on agriculture. Continued refinement of tools to assess climate impacts on agriculture will provide guidance on strategies to adapt to climate change.*

Hatfield, J. L., & Dold, C. (2018). Agroclimatology and wheat production: Coping with climate change. *Frontiers in Plant Science, 9*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043302218&doi=10.3389%2ffpls.2018.00224&partnerID=40&md5=20126abfbd1cf1df2695883922735ebe. doi:10.3389/fpls.2018.00224
Research Tags: Crops, Weather
Abstract: *Cereal production around the world is critical to the food supply for the human population. Crop productivity is primarily determined by a combination of temperature and precipitation because temperatures have to be in the range for plant growth and precipitation has to supply crop water requirements for a given environment. The question is often asked about the changes in productivity and what we can expect in the future and we evaluated the causes for variation in historical annual statewide wheat grain yields in Oklahoma, Kansas, and North Dakota across the Great Plains of United States. Wheat (Triticum aestivum L.) is adapted to this area and we focused on production in these states from 1950 to 2016. This analysis used a framework for*

annual yields using yield gaps between attainable and actual yields and found the primary cause of the variation among years were attributable to inadequate precipitation during the grain-filling period. In Oklahoma, wheat yields were reduced when April and May precipitation was limited ($r2 = 0.70$), while in Kansas, May precipitation was the dominant factor ($r2 = 0.78$), and in North Dakota June–July precipitation was the factor explaining yield variation ($r2 = 0.65$). Temperature varied among seasons and at the statewide level did not explain a significant portion of the yield variation. The pattern of increased variation in precipitation will cause further variation in wheat production across the Great Plains. Reducing yield variation among years will require adaptation practices that increase water availability to the crop coupled with the positive impact derived from other management practices, e.g., cultivars, fertilizer management, etc.

Hatfield, J. L., & Dold, C. (2019). Water-use efficiency: Advances and challenges in a changing climate. *Frontiers in Plant Science*, *10*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064209235&doi=10.3389%2ffpls.2019.00103&partnerID=40&md5=231c14939d07159689e220c97e7f8b51. doi:10.3389/fpls.2019.00103

Research Tags: Water, Crops

Abstract: *Water use efficiency (WUE) is defined as the amount of carbon assimilated as biomass or grain produced per unit of water used by the crop. One of the primary questions being asked is how plants will respond to a changing climate with changes in temperature, precipitation, and carbon dioxide (CO_2) that affect their WUE At the leaf level, increasing CO_2 increases WUE until the leaf is exposed to temperatures exceeded the optimum for growth (i.e., heat stress) and then WUE begins to decline. Leaves subjected to water deficits (i.e., drought stress) show varying responses in WUE. The response of WUE at the leaf level is directly related to the physiological processes controlling the gradients of CO_2 and H_2O, e.g., leaf:air vapor pressure deficits, between the leaf and air surrounding the leaf. There a variety of methods available to screen genetic material for enhanced WUE under scenarios of climate change. When we extend from the leaf to the canopy, then the dynamics of crop water use and biomass accumulation have to consider soil water evaporation rate, transpiration from the leaves, and the growth pattern of the crop. Enhancing WUE at the canopy level can be achieved by adopting practices that reduce the soil water evaporation component and divert more water into transpiration which can be through crop residue management, mulching, row spacing, and irrigation. Climate change will affect plant growth, but we have opportunities to enhance WUE through crop selection and cultural practices to offset the impact of a changing climate.*

Hatfield, J. L., Sauer, T. J., & Cruse, R. M. (2017) Soil: The Forgotten Piece of the Water, Food, Energy Nexus. In*: Vol. 143. Advances in Agronomy* (pp. 1-46).

Research Tags: Soil, Water, Crops

Abstract: *The water, food, energy nexus has prompted sustainability concerns as interactions between these interdependent human needs are degrading natural resources required for a secure future world. Discussions about the future needs for food, water, and energy to support the increasing world population have ignored our soil resource that is the cornerstone or our capacity to produce food, capture water, and generate energy from biological systems. Soil scientists often recognize soils as a critical component of food, energy, or water security; however, the translation of that awareness into action strategies to either enhance public recognition of soil resource importance or improve soil management is lacking. Food, water, and energy security represents the current and future challenge of sustaining humankind while protecting the environment. These interactions are recognized by scientists, but the linkage to policy decisions or implementation of strategies to create positive outcomes for food, energy, or water enhancement is lacking. If we consider that soil is responsible for 99% of the world's food production, then the importance of soil in the food, energy, water nexus becomes apparent. If we further consider that soil erosion is the major factor, affecting soil degradation and declines in productivity are directly related to degradation of the soil resource, then the implications of soil in the context of increasing food, energy, and water security becomes more evident. However, if the attitude is one that technology will provide answers to these problems, then the soil degradation rate will continue to increase and we will reach a tipping point in which technological advances will not be able to overcome the impacts of a reduced topsoil depth coupled with a more variable climate. Soil is the forgotten piece of the food, energy, water nexus; however, the oversight extends beyond this nexus to include many of the ecological services required by humankind.*

Haugo, R. D., Kellogg, B. S., Cansler, C. A., Kolden, C. A., Kemp, K. B., Robertson, J. C., . . . Restaino, C. M. (2019). The missing fire: quantifying human exclusion of wildfire in Pacific Northwest forests, USA. *Ecosphere, 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065045317&doi=10.1002%2fecs2.2702&partnerID=40&md5=dc51840c97b660f942a92b9bd514b6f5. doi:10.1002/ecs2.2702

Research Tags: Forestry, Weather

Abstract: *Western U.S. wildfire area burned has increased dramatically over the last half-century. How contemporary extent and severity of wildfires compare to the pre-settlement patterns to which ecosystems are adapted is debated. We compared large wildfires in Pacific Northwest forests from 1984 to 2015 to modeled historic fire regimes. Despite late twentieth-century increases in area burned, we show that Pacific Northwest forests have experienced an order of magnitude less fire over 32 yr than expected under historic fire regimes. Within fires that have burned, severity distributions are disconnected from historical references. From 1984 to 2015, 1.6 M ha burned; this is 13.3–18.9 M ha less than expected. Deficits were greatest in dry forest ecosystems adapted to frequent, low-severity fire, where 7.2–10.3 M ha of low-severity fire was missing, compared to a 0.2–1.1 M ha deficit of high-severity fire. When these dry forests do burn, we observed that 36% burned with high-severity compared to 6–9% historically. We found smaller fire deficits, 0.3–0.6 M ha, within forest ecosystems adapted to infrequent, high-severity fire. However, we also acknowledge inherent limitations in evaluating contemporary fire regimes in ecosystems which historically burned infrequently and for which fires were highly episodic. The magnitude of contemporary fire deficits and disconnect in burn severity compared to historic fire regimes have important implications for climate change adaptation. Within forests characterized by low- and mixed-severity historic fire regimes, simply increasing wildfire extent while maintaining current trends in burn severity threatens ecosystem resilience and will potentially drive undesirable ecosystem transformations. Restoring natural fire regimes requires management that facilitates much more low- and moderate-severity fire.*

Havens, S., Marks, D., FitzGerald, K., Masarik, M., Flores, A. N., Kormos, P., & Hedrick, A. (2019). Approximating input data to a snowmelt model using weather research and forecasting model outputs in lieu of meteorological measurements. *Journal of Hydrometeorology, 20*(5), 847-862. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066256222&doi=10.1175%2fJHM-D-18-0146.1&partnerID=40&md5=985d9b002a95c9fd4db945deb8398bec. doi:10.1175/JHM-D-18-0146.1

Research Tags: Water

Abstract: *Forecasting the timing and magnitude of snowmelt and runoff is critical to managing mountain water resources. Warming temperatures are increasing the rain–snow transition elevation and are limiting the forecasting skill of statistical models relating historical snow water equivalent to streamflow. While physically based methods are available, they require accurate estimations of the spatial and temporal distribution of meteorological variables in complex terrain. Across many mountainous areas, measurements of precipitation and other meteorological variables are limited to a few reference stations and are not adequate to resolve the complex interactions between topography and atmospheric flow. In this paper, we evaluate the ability of the Weather Research and Forecasting (WRF) Model to approximate the inputs required for a physics-based snow model, iSnobal, instead of using meteorological measurements, for the Boise River Basin (BRB) in Idaho, United States. An iSnobal simulation using station data from 40 locations in and around the BRB resulted in an average root-mean-square error (RMSE) of 4.5 mm compared with 12 SNOTEL measurements. Applying WRF forcings alone was associated with an RMSE of 10.5 mm, while including a simple bias correction to the WRF outputs of temperature and precipitation reduced the RMSE to 6.5 mm. The results highlight the utility of using WRF outputs as input to snowmelt models, as all required input variables are spatiotemporally complete. This will have important benefits in areas with sparse measurement networks and will aid snowmelt and runoff forecasting in mountainous basins.*

Havens, S., Marks, D., Kormos, P., & Hedrick, A. (2017). Spatial Modeling for Resources Framework (SMRF): A modular framework for developing spatial forcing data for snow modeling in mountain basins. *Computers and Geosciences, 109*, 295-304. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032664951&doi=10.1016%2fj.cageo.2017.08.016&

partnerID=40&md5=5a5dcdd90866ef28cda3bf4dee027797. doi:10.1016/j.cageo.2017.08.016
Research Tags: Water
Abstract: *In the Western US and many mountainous regions of the world, critical water resources and climate conditions are difficult to monitor because the observation network is generally very sparse. The critical resource from the mountain snowpack is water flowing into streams and reservoirs that will provide for irrigation, flood control, power generation, and ecosystem services. Water supply forecasting in a rapidly changing climate has become increasingly difficult because of non-stationary conditions. In response, operational water supply managers have begun to move from statistical techniques towards the use of physically based models. As we begin to transition physically based models from research to operational use, we must address the most difficult and time-consuming aspect of model initiation: the need for robust methods to develop and distribute the input forcing data. In this paper, we present a new open source framework, the Spatial Modeling for Resources Framework (SMRF), which automates and simplifies the common forcing data distribution methods. It is computationally efficient and can be implemented for both research and operational applications. We present an example of how SMRF is able to generate all of the forcing data required to a run physically based snow model at 50–100 m resolution over regions of 1000–7000 km2. The approach has been successfully applied in real time and historical applications for both the Boise River Basin in Idaho, USA and the Tuolumne River Basin in California, USA. These applications use meteorological station measurements and numerical weather prediction model outputs as input. SMRF has significantly streamlined the modeling workflow, decreased model set up time from weeks to days, and made near real-time application of a physically based snow model possible.*

Havstad, K. M., Brown, J. R., Estell, R., Elias, E., Rango, A., & Steele, C. (2018). Vulnerabilities of Southwestern U.S. Rangeland-based animal agriculture to climate change. *Climatic Change, 148*(3), 371-386. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84994477400&doi=10.1007%2fs10584-016-1834-7&partnerID=40&md5=5496e8c36f94c13ff8a2fde44dd17729. doi:10.1007/s10584-016-1834-7
Research Tags: Livestock, Grassland
Abstract: *The Southwestern US is a five-state region that has supported animal agriculture since the late 16th Century when European settlers crossed the Rio Grande into present day west Texas and southern New Mexico with herds of cattle, sheep, goats and horses. For the past 400 years the rangeland livestock industry, in its many forms and manifestations, has developed management strategies and conservation practices that impart resilience to the climatic extremes, especially prolonged droughts, that are common and extensive across this region. Livestock production from rangelands in the southwest (SW) is adapted to low rainfall and high ambient temperatures, but will have to continue to adapt management strategies, such as reduced stocking rates, proper grazing management practices, employing animal genetics suited to arid environments with less herbaceous production, erosion control conservation practices, and alternative forage supplies, in an increasingly arid and variable climatic environment. Even though the aging demographics of western ranchers could be a deterrent to implementing various adaptations, there are examples of creative management coalitions to cope with climatic change that are emerging in the SW that can serve as instructive examples. More importantly, there are additional opportunities for incorporation of transformative practices and technologies that can sustain animal agriculture in the SW in a warmer environment. Animal agriculture in the SW is inherently resilient, and has the capacity to adapt and transform as needed to the climatic changes that are now occurring and will continue to occur across this region. However, producers and land managers will need to thoroughly understand the vulnerabilities and sensitivities that face them as well as the ecological characteristics of their specific landscapes in order to cope with the emerging climatic changes across the SW region.*

Hayes, M. A., & Piaggio, A. J. (2018). Assessing the potential impacts of a changing climate on the distribution of a rabies virus vector. *PLoS ONE, 13*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042299828&doi=10.1371%2fjournal.pone.0192887&partnerID=40&md5=aa1e6ba1ce543036fcca599a6a088422. doi:10.1371/journal.pone.0192887
Research Tags: Wildlife
Abstract: *Common vampire bats (Desmodus rotundus) occur throughout much of South America to northern México. Vampire bats have not been documented in recent history in the United States, but have been*

documented within about 50 km of the U.S. state of Texas. Vampire bats feed regularly on the blood of mammals and can transmit rabies virus to native species and livestock, causing impacts on the health of prey. Thus cattle producers, wildlife management agencies, and other stakeholders have expressed concerns about whether vampire bats might spread into the southern United States. On the other hand, concerns about vampire-borne rabies can also result in wanton destruction at bat roosts in areas occupied by vampire bats, but also in areas not known to be occupied by this species. This can in turn negatively affect some bat roosts, populations, and species that are of conservation concern, including vampire bats. To better understand the current and possible future distribution of vampire bats in North America and help mitigate future cattle management problems, we used 7,094 vampire bat occurrence records from North America and species distribution modeling (SDM) to map the potential distribution of vampire bats in North America under current and future climate change scenarios. We analysed and mapped the potential distribution of this species using 5 approaches to species distribution modeling: logistic regression, multivariate adaptive regression splines, boosted regression trees, random forest, and maximum entropy. We then projected these models into 17 "worst-case" future climate scenarios for year 2070 to generate hypotheses about how the vampire bat distribution in North America might change in the future. Of the variables used in this analysis, minimum temperature of the coldest month had the highest variable importance using all 5 SDM approaches. These results suggest two potential near-future routes of vampire bat dispersal into the U.S., one via southern Texas, and a second into southern Florida. Some of our SDM models support the hypothesis that suitable habitat for vampire bats may currently exist in parts of the México–U.S. borderlands, including extreme southern portions of Texas, as well as in southern Florida. However, this analysis also suggests that extensive expansion into the south-eastern and south-western U.S. over the coming ~60 years appears unlikely.

Haynes, K. M., Kane, E. S., Potvin, L., Lilleskov, E. A., Kolka, R. K., & Mitchell, C. P. J. (2017). Gaseous mercury fluxes in peatlands and the potential influence of climate change. *Atmospheric Environment, 154*, 247-259. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011880130&doi=10.1016%2fj.atmosenv.2017.01.049&partnerID=40&md5=d284c9003dbc03d4a91cad8be32e8cb9. doi:10.1016/j.atmosenv.2017.01.049

Research Tags: Emissions, Soil

Abstract: *Climate change has the potential to significantly impact the stability of large stocks of mercury (Hg) stored in peatland systems due to increasing temperatures, altered water table regimes and subsequent shifts in vascular plant communities. However, the Hg exchange dynamics between the atmosphere and peatlands are not well understood. At the PEATcosm Mesocosm Facility in Houghton, Michigan, total gaseous Hg (TGM) fluxes were monitored in a subset of 1-m3 peat monoliths with altered water table positions (high and low) and vascular plant functional groups (sedge only, Ericaceae only or unmanipulated control) above the Sphagnum moss layer. At the SPRUCE bog in north-central Minnesota, TGM fluxes were measured from plots subjected to deep peat soil warming (up to +9 °C above ambient at a depth of 2 m). At PEATcosm, the strongest depositional trend was observed with the Low WT – sedge only treatment mesocosms with a mean TGM flux of −73.7 ± 6.3 ng m−2 d−1, likely due to shuttling of Hg to the peat at depth by aerenchymous tissues. The highest total leaf surface and tissue Hg concentrations were observed with the Ericaceae shrubs. A negative correlation between TGM flux and Ericaceae total leaf surface area suggests an influence of shrubs in controlling Hg exchange through stomatal uptake, surface sorption and potentially, peat shading. Surface peat total Hg concentrations are highest in treatments with greatest deposition suggesting deposition controls Hg accumulation in surface peat. Fluxes in the SPRUCE plots ranged from −45.9 ± 93.8 ng m−2 d−1 prior to the implementation of the deep warming treatments to −1.41 ± 27.1 ng m−2 d−1 once warming targets were achieved at depth and +10.2 ± 44.6 ng m−2 d−1 following prolonged deep soil warming. While these intervals did not differ significantly, a significant positive increase in the slope of the regression between flux and surface temperature was observed across the pre-treatment and warming periods. Shifts in vascular vegetation cover and peat warming as a result of climate change may significantly affect the dynamics of TGM fluxes between peatlands and the atmosphere.*

Haynes, K. M., Kane, E. S., Potvin, L., Lilleskov, E. A., Kolka, R. K., & Mitchell, C. P. J. (2017). Mobility and transport of mercury and methylmercury in peat as a function of changes in water table regime and plant functional groups. *Global Biogeochemical Cycles, 31*(2), 233-244. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011634524&doi=10.1002%2f2016GB005471&partnerID=40&md5=f8aed094649ce51649fcc4077cbc84b3. doi:10.1002/2016GB005471
Research Tags: Soil, Emissions
Abstract: *Climate change is likely to significantly affect the hydrology, ecology, and ecosystem function of peatlands, with potentially important but unclear impacts on mercury mobility within and transport from peatlands. Using a full-factorial mesocosm approach, we investigated the potential impacts on mercury mobility of water table regime changes (high and low) and vegetation community shifts (sedge-dominated, Ericaceae-dominated, or unmanipulated control) in peat monoliths at the PEATcosm mesocosm facility in Houghton, Michigan. Lower and more variable water table regimes and the loss of Ericaceae shrubs act significantly and independently to increase both total Hg and methylmercury concentrations in peat pore water and in spring snowmelt runoff. These differences are related to enhanced peat decomposition and internal regeneration of electron acceptors which are more strongly related to water table regime than to plant community changes. Loss of Ericaceae shrubs and an increase in sedge cover may also affect Hg concentrations and mobility via oxygen shuttling and/or the provision of labile root exudates. Altered hydrological regimes and shifting vegetation communities, as a result of global climate change, are likely to enhance Hg transport from peatlands to downstream aquatic ecosystems.*

Haynes, K. M., Kane, E. S., Potvin, L., Lilleskov, E. A., Kolka, R. K., & Mitchell, C. P. J. (2019). Impacts of experimental alteration of water table regime and vascular plant community composition on peat mercury profiles and methylmercury production. *Science of the Total Environment, 682*, 611-622. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065913322&doi=10.1016%2fj.scitotenv.2019.05.072&partnerID=40&md5=e8e70e7e9f9bff3c589db6551897b7f1. doi:10.1016/j.scitotenv.2019.05.072
Research Tags: Water, Soil
Abstract: *Climate change is expected to alter the hydrology and vascular plant communities in peatland ecosystems. These changes may have as yet unexplored impacts on peat mercury (Hg) concentrations and net methylmercury (MeHg) production. In this study, peat was collected from PEATcosm, an outdoor, controlled mesocosm experiment where peatland water table regimes and vascular plant functional groups were manipulated over several years to simulate potential climate change effects. Potential Hg(II) methylation and MeHg demethylation rate constants were assessed using enriched stable isotope incubations at the end of the study in 2015, and ambient peat total Hg (THg) and MeHg concentration depth profiles were tracked annually from 2011 to 2014. Peat THg and MeHg concentrations and the proportion of THg methylated (%MeHg) increased significantly within the zone of water table fluctuation when water tables were lowered, but potential Hg(II) methylation rate constants were similar regardless of water table treatment. When sedges dominate over ericaceous shrubs, MeHg concentrations and %MeHg became significantly elevated within the sedge rooting zone. Increased desorption of Hg(II) and MeHg from the solid phase peat into pore water occurred with a lowered water table and predominant sedge cover, likely due to greater aerobic peat decomposition. Deeper, more variable water tables and a transition to sedge-dominated communities coincided with increased MeHg accumulation within the zone of water table fluctuation. Sustained high water tables promoted the net downward migration of Hg(II) and MeHg. The simultaneous decrease in Hg(II) and MeHg concentrations in the near-surface peat and accumulation deeper in the peat profile, combined with the trends in Hg(II) and MeHg partitioning to mobile pore waters, suggest that changes to peatland hydrology and vascular plant functional groups redistribute peat Hg(II) and MeHg via vertical hydrochemical transport mechanisms.*

He, H. S., Gustafson, E. J., & Lischke, H. (2017). Modeling forest landscapes in a changing climate: theory and application. *Landscape Ecology, 32*(7), 1299-1305. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019660907&doi=10.1007%2fs10980-017-0529-4&partnerID=40&md5=610e2e90f3c992210babb91004c25ebc. doi:10.1007/s10980-017-0529-4
Research Tags: Forestry, Research
No Abstract

He, T., Liang, S., Wang, D., Cao, Y., Gao, F., Yu, Y., & Feng, M. (2018). Evaluating land surface albedo estimation from Landsat MSS, TM, ETM +, and OLI data based on the unified direct estimation approach. *Remote Sensing of Environment, 204*, 181-196. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032730160&doi=10.1016%2fj.rse.2017.10.031&partnerID=40&md5=27c5bceaeb4dd57d4b27590fb6be2597. doi:10.1016/j.rse.2017.10.031
Research Tags: Research
Abstract: *Surface albedo is widely used in climate and environment applications as an important parameter for controlling the surface energy budget. There is an increasing need for albedo data to be available for use in applications that require a fine spatial resolution and for validating coarse-resolution datasets; however, such products with long-term global coverage are not available thus far. Existing algorithms for Landsat albedo estimation all require surface reflectance from explicit and reliable atmospheric correction, which may sometimes be unavailable or carry uncertainties due to saturated visible bands or a lack of dense vegetation. In addition, most of the existing algorithms require concurrent clear-sky observations from the Moderate Resolution Imaging Spectroradiometer (MODIS) for bidirectional reflectance distribution function (BRDF) correction, which limited the data availability for Landsat albedo estimation. To overcome these problems, in this study, we adopt the direct estimation approach previously used with coarser resolution data, such as MODIS and Visible Infrared Imaging Radiometer Suite (VIIRS), and apply it to multiple Landsat data obtained by Multispectral Scanner (MSS), Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM +), and Operational Land Imager (OLI). By incorporating Landsat spectral response functions and a database of bidirectional reflectance distribution function (BRDF) into radiative transfer simulations, a unified algorithm is developed to estimate surface albedo directly from the Landsat top-of-atmospheric reflectance data obtained by MSS, TM, ETM +, and OLI with few ancillary inputs. To overcome the saturation problems in the visible bands of TM and ETM + over very bright surfaces, a refined approach is employed by using only non-saturated bands. The validation results against ground measurements over various land cover types and climate regions show that our algorithm is effective for both snow-free and snow-covered surfaces and can achieve root-mean-square errors (RMSEs) of not more than 0.034. In addition, we show the high potential of the earlier MSS data for producing consistent surface albedo estimations based on inter-comparison with TM-based results with RMSEs of 0.011–0.017 and R2 of 0.858–0.963. This long-term, 30-m resolution surface albedo estimation can date back to the early 1980s, which allows for improved understanding of long-term climate change and land cover change effects.*

Hedges, S. B., Cohen, W. B., Timyan, J., & Yang, Z. (2018). Haiti's biodiversity threatened by nearly complete loss of primary forest. *Proceedings of the National Academy of Sciences of the United States of America, 115*(46), 11850-11855. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056535558&doi=10.1073%2fpnas.1809753115&partnerID=40&md5=69862ce26e14f51a9505b09326a3a4c1. doi:10.1073/pnas.1809753115
Research Tags: Forestry
Abstract: *Tropical forests hold most of Earth's biodiversity. Their continued loss through deforestation and agriculture is the main threat to species globally, more than disease, invasive species, and climate change. However, not all tropical forests have the same ability to sustain biodiversity. Those that have been disturbed by humans, including forests previously cleared and regrown (secondary growth), have lower levels of species richness compared with undisturbed (primary) forests. The difference is even greater considering extinctions that will later emanate from the disturbance (extinction debt). Here, we find that Haiti has less than 1% of its original primary forest and is therefore among the most deforested countries. Primary forest has declined over three decades inside national parks, and 42 of the 50 highest and largest mountains have lost all primary forest. Our surveys of vertebrate diversity (especially amphibians and reptiles) on mountaintops indicates that endemic species have been lost along with the loss of forest. At the current rate, Haiti will lose essentially all of its primary forest during the next two decades and is already undergoing a mass extinction of its biodiversity because of deforestation. These findings point to the need, in general, for better reporting of forest cover data of relevance to biodiversity, instead of "total forest" as defined by the United Nation's Food and Agricultural Organization. Expanded detection and monitoring of primary forest globally will improve the efficiency of conservation measures, inside and outside of protected areas.*

Heinemeyer, K., Squires, J., Hebblewhite, M., O'Keefe, J. J., Holbrook, J. D., & Copeland, J. (2019). Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation. *Ecosphere, 10*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062696840&doi=10.1002%2fecs2.2611&partnerID

=40&md5=5d328f58ba6e9f6768edf9aa64a2122f. doi:10.1002/ecs2.2611
Research Tags: Wildlife
Abstract: *Outdoor recreation is increasingly recognized to impact nature and wildlife, yet few studies have examined recreation within large natural landscapes that are critical habitat to some of our most rare and potentially disturbance-sensitive species. Over six winters (2010–2015) and four study areas (>1.1 million ha) in Idaho, Wyoming, and Montana, we studied the responses of wolverines (Gulo gulo) to backcountry winter recreation. We fit Global Positioning System (GPS) collars to 24 individual wolverines and acquired >54,000 GPS locations over 39 animal-years during winter (January–April). Simultaneously, we monitored winter recreation, collecting ~6000 GPS tracks (~200,000 km) from backcountry recreationists. We combined the GPS tracks with trail use counts and aerial recreation surveys to map the extent and relative intensity of motorized and non-motorized recreation. We integrated our wolverine and backcountry recreation data to (1) assess patterns of wolverine habitat selection and (2) evaluate the effect of backcountry recreation on wolverine habitat relationships. We used resource selection functions to model habitat selection of male and female wolverines within their home ranges. We first modeled habitat selection for environmental covariates to understand male and female habitat use then incorporated winter recreation covariates. We assessed the potential for indirect habitat loss from winter recreation and tested for functional responses of wolverines to differing levels and types of recreation. Motorized recreation occurred at higher intensity across a larger footprint than non-motorized recreation in most wolverine home ranges. Wolverines avoided areas of both motorized and non-motorized winter recreation with off-road recreation eliciting a stronger response than road-based recreation. Female wolverines exhibited stronger avoidance of off-road motorized recreation and experienced higher indirect habitat loss than male wolverines. Wolverines showed negative functional responses to the level of recreation exposure within the home range, with female wolverines showing the strongest functional response to motorized winter recreation. We suggest indirect habitat loss, particularly to females, could be of concern in areas with higher recreation levels. We speculate that the potential for backcountry winter recreation to affect wolverines may increase under climate change if reduced snow pack concentrates winter recreationists and wolverines in the remaining areas of persistent snow cover.*

Helmer, E. H., Gerson, E. A., Scott Baggett, L., Bird, B. J., Ruzycki, T. S., & Voggesser, S. M. (2019). Neotropical cloud forests and páramo to contract and dry from declines in cloud immersion and frost. *PLoS ONE, 14*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064432518&doi=10.1371%2fjournal.pone.0213155&partnerID=40&md5=33378ef66f2fd4847c959bedc89dd1f4. doi: 10.1371/journal.pone.0213155
Research Tags: Forestry, Emissions
Abstract: *Clouds persistently engulf many tropical mountains at elevations cool enough for clouds to form, creating isolated areas with frequent fog and mist. Under these isolated conditions, thousands of unique species have evolved in what are known as tropical montane cloud forests (TMCF) and páramo. Páramo comprises a set of alpine ecosystems that occur above TMCF from about 11° N to 9° S along the Americas continental divide. TMCF occur on all continents and island chains with tropical climates and mountains and are increasingly threatened by climate and land-use change. Climate change could impact a primary feature distinguishing these ecosystems, cloud immersion. But where and in what direction cloud immersion of TMCF and páramo will change with climate are fundamental unknowns. Prior studies at a few TMCF sites suggest that cloud immersion will increase in some places while declining in others. Other unknowns include the extent of deforestation in protected and unprotected cloud forest climatic zones, and deforestation extent compared with projected climate change. Here we use a new empirical approach combining relative humidity, frost, and novel application of maximum watershed elevation to project change in TMCF and páramo for Representative greenhouse gas emissions Concentration Pathways (RCPs) 4.5 and 8.5. Results suggest that in <25–45 yr, 70–86% of páramo will dry or be subject to tree invasion, and cloud immersion declines will shrink or dry 57–80% of Neotropical TMCF, including 100% of TMCF across Mexico, Central America, the Caribbean, much of Northern South America, and parts of Southeast Brazil. These estimates rise to 86% of Neotropical TMCF and 98% of páramo in <45–65 yr if greenhouse gas emissions continue rising throughout the 21st century. We also find that TMCF zones are largely forested, but some of the most deforested areas will undergo the least climate change. We project that cloud immersion will increase for only about 1% of all TMCF and in only a few places. Declines in cloud immersion dominate TMCF change across the Neotropics.*

Herbst, D. B., Cooper, S. D., Medhurst, R. B., Wiseman, S. W., & Hunsaker, C. T. (2019). Drought ecohydrology alters the structure and function of benthic invertebrate communities in mountain streams. *Freshwater Biology, 64*(5), 886-902. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062799916&doi=10.1111%2ffwb.13270&partnerID=40&md5=5d04c156ce9f263925e1324d8999f088. doi:10.1111/fwb.13270

Research Tags: Wildlife

Abstract: *We studied benthic macroinvertebrate communities in 12 mid-elevation mountain streams in the Sierra Nevada, California. Data were collected at nine times (seven springs and two autumns) over a 14-year period of variable hydrological conditions, including years of flood and extreme unprecedented drought.*

The taxonomic and trait structures of communities were similar during wet and average springs but became increasingly different as drought continued and smaller streams became intermittent.

The density of total invertebrates, primarily chironomids, increased during the drought years, but the richness and abundance of mayfly, stonefly, and caddisfly (EPT) taxa declined during the late drought. During the late drought, the proportions of rheophilic, semivoltine taxa with clinger or swimmer behavioural habits decreased, whereas small, stress-tolerant taxa with burrower and climber habits increased. Collector–gatherers dominated in all periods, but during the severe drought the relative abundance of micropredators increased and filterers, shredders, and grazers decreased.

We also found greater changes in community structure between spring runoff and autumn base flow conditions in an average than a wet year. However, spring to autumn population growth rates were much greater during the wet than average year.

Invertebrate richness and EPT abundance decreased and community structure showed large changes when stream discharge fell below 1–10 L/s, but remained relatively constant across a range of higher flows. During the severe drought, there were significant declines in the densities of 40% of the common EPT taxa compared to average and wet years, but chironomid, mite, and other invertebrate taxa showed variable responses.

Invertebrate diversity, community structure, and ecosystem functions in small, headwater streams are especially vulnerable to drought conditions, which are expected to increase in frequency and intensity with climate change in the Sierra Nevada and other mountainous regions.

Herman, M. R., Nejadhashemi, A. P., Abouali, M., Hernandez-Suarez, J. S., Daneshvar, F., Zhang, Z., . . . Sharifi, A. (2018). Evaluating the role of evapotranspiration remote sensing data in improving hydrological modeling predictability. *Journal of Hydrology, 556*, 39-49. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034060918&doi=10.1016%2fj.jhydrol.2017.11.009&partnerID=40&md5=dec38c9dfcc90bf28be56ba49b3f6817. doi:10.1016/j.jhydrol.2017.11.009

Research Tags: Water, Research

Abstract: *As the global demands for the use of freshwater resources continues to rise, it has become increasingly important to insure the sustainability of this resources. This is accomplished through the use of management strategies that often utilize monitoring and the use of hydrological models. However, monitoring at large scales is not feasible and therefore model applications are becoming challenging, especially when spatially distributed datasets, such as evapotranspiration, are needed to understand the model performances. Due to these limitations, most of the hydrological models are only calibrated for data obtained from site/point observations, such as streamflow. Therefore, the main focus of this paper is to examine whether the incorporation of remotely sensed and spatially distributed datasets can improve the overall performance of the model. In this study, actual evapotranspiration (ETa) data was obtained from the two different sets of satellite based remote sensing data. One dataset estimates ETa based on the Simplified Surface Energy Balance (SSEBop) model while the other one estimates ETa based on the Atmosphere-Land Exchange Inverse (ALEXI) model. The hydrological model used in this study is the Soil and Water Assessment Tool (SWAT), which was calibrated against spatially distributed ETa and single point streamflow records for the Honeyoey Creek-Pine Creek Watershed, located in Michigan, USA. Two different techniques, multi-variable and genetic algorithm, were used to calibrate the SWAT model. Using the aforementioned datasets, the performance of the hydrological model in estimating ETa was improved using both calibration techniques by achieving Nash-Sutcliffe efficiency (NSE) values >0.5 (0.73–0.85), percent bias (PBIAS) values within ±25% (±21.73%), and root mean squared error – observations standard deviation ratio (RSR) values <0.7 (0.39–0.52). However, the*

genetic algorithm technique was more effective with the ETa calibration while significantly reducing the model performance for estimating the streamflow (NSE: 0.32–0.52, PBIAS: ±32.73%, and RSR: 0.63–0.82). Meanwhile, using the multi-variable technique, the model performance for estimating the streamflow was maintained with a high level of accuracy (NSE: 0.59–0.61, PBIAS: ±13.70%, and RSR: 0.63–0.64) while the evapotranspiration estimations were improved. Results from this assessment shows that incorporation of remotely sensed and spatially distributed data can improve the hydrological model performance if it is coupled with a right calibration technique.

Hernandez, A. J., Healey, S. P., Huang, H., & Ramsey, R. D. (2018). Improved prediction of stream flow based on updating land cover maps with remotely sensed forest change detection. *Forests, 9*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048203311&doi=10.3390%2ff9060317&partnerID=40&md5=56b18ed93d1859ffedb8f24a9fb0153a. doi:10.3390/f9060317
Research Tags: Water
Abstract: *The water balance in a watershed can be disrupted by forest disturbances such as harvests and fires. Techniques to accurately and efficiently map forest cover changes due to disturbance are evolving quickly, and it is of interest to ask how useful maps of different types of disturbances over time can be in the prediction of water yield. We assessed the benefits of using land cover maps produced at annual vs. five-year intervals in the prediction of monthly streamflows across 10 watersheds contained entirely within the US National Forest System. We found that annually updating land cover maps with forest disturbance data significantly improved water yield predictions using the Soil and Water Assessment Tool (SWAT; p < 0.01 improvement for both the Nash–Sutcliffe efficiency measure and the ratio of the root mean square error to the standard deviation of the measured data). Improvement related to using annually updated land cover maps was directly related to the amount of disturbance observed in a watershed. Our results lay a foundation to apply new high-resolution disturbance datasets in the field of hydrologic modeling to monitor ungauged watersheds and to explore potential water yield changes in watersheds if climate conditions or management practices were to change forest disturbance processes.*

Herndon, E. M., Kinsman-Costello, L., Duroe, K. A., Mills, J., Kane, E. S., Sebestyen, S. D., . . . Wullschleger, S. D. (2019). Iron (Oxyhydr)Oxides Serve as Phosphate Traps in Tundra and Boreal Peat Soils. *Journal of Geophysical Research: Biogeosciences, 124*(2), 227-246. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061253288&doi=10.1029%2f2018JG004776&partnerID=40&md5=f879407276b98e3081fb77acd4ed1e49. doi:10.1029/2018JG004776
Research Tags: Soil, Grassland
Abstract: *The ability of plants to derive nutrients from the soil influences their capacity to photosynthesize and draw carbon out of the atmosphere. Plants compete for nutrients such as phosphate with soil microorganisms and with soil minerals. Iron oxides, in particular, effectively bind phosphate and keep it sequestered from plants. We demonstrate that iron oxides bind high quantities of phosphate in arctic and boreal systems where minerals are often assumed to have negligible influence on biological processes. Although plant biomass is likely to increase in a climate that is warmer and enriched in carbon dioxide, iron oxides may increasingly limit phosphate availability to plants and constrain ecosystem productivity.*

Herold, M., Carter, S., Avitabile, V., Espejo, A. B., Jonckheere, I., Lucas, R., . . . De Sy, V. (2019). The Role and Need for Space-Based Forest Biomass-Related Measurements in Environmental Management and Policy. *Surveys in Geophysics, 40*(4), 757-778. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061374917&doi=10.1007%2fs10712-019-09510-6&partnerID=40&md5=04cb405621e5c6468ee95d498f09fd1c. doi:10.1007/s10712-019-09510-6
Research Tags: Forestry
Abstract: *The achievement of international goals and national commitments related to forest conservation and management, climate change, and sustainable development requires credible, accurate, and reliable monitoring of stocks and changes in forest biomass and carbon. Most prominently, the Paris Agreement on Climate Change and the United Nations' Sustainable Development Goals in particular require data on biomass to monitor progress. Unprecedented opportunities to provide forest biomass data are created by a series of upcoming space-based missions, many of which provide open data targeted at large areas and better spatial*

resolution biomass monitoring than has previously been achieved. We assess various policy needs for biomass data and recommend a long-term collaborative effort among forest biomass data producers and users to meet these needs. A gap remains, however, between what can be achieved in the research domain and what is required to support policy making and meet reporting requirements. There is no single biomass dataset that serves all users in terms of definition and type of biomass measurement, geographic area, and uncertainty requirements, and whether there is need for the most recent up-to-date biomass estimate or a long-term biomass trend. The research and user communities should embrace the potential strength of the multitude of upcoming missions in combination to provide for these varying needs and to ensure continuity for long-term data provision which one-off research missions cannot provide. International coordination bodies such as Global Forest Observations Initiative (GFOI), Committee on Earth Observation Satellites (CEOS), and Global Observation of Forest Cover and Land Dynamics (GOFC-GOLD) will be integral in addressing these issues in a way that fulfils these needs in a timely fashion. Further coordination work should particularly look into how space-based data can be better linked with field reference data sources such as forest plot networks, and there is also a need to ensure that reference data cover a range of forest types, management regimes, and disturbance regimes worldwide.

Herrick, J. E., Shaver, P., Pyke, D. A., Pellant, M., Toledo, D., & Lepak, N. (2019). A strategy for defining the reference for land health and degradation assessments. *Ecological indicators, 97*, 225-230. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054922678&doi=10.1016%2fj.ecolind.2018.06.065&partnerID=40&md5=c253da921b210fe11cac97790079eb6a. doi:10.1016/j.ecolind.2018.06.065

Research Tags: Research

Abstract: *Much of the confusion about the definition of reference conditions for land health and degradation assessments is due to differences in policy and management objectives. Selection of a historic reference where it is not necessary, such as in the definition of future land degradation neutrality, can add significant cost and uncertainty to land management projects that require some knowledge of the current status of the land relative to its potential. This paper (1) provides a review of conditions under which historic reference information is and is not required to meet management and policy objectives, (2) summarizes current approaches to defining the reference for land health and degradation assessments, and (3) presents a protocol, "Describing Indicators of Rangeland Health" (DIRH) for collecting and organizing data that can be used to define a historic reference. This protocol builds on the framework and indicators presented in the "Interpreting Indicators of Rangeland Health" (IIRH). IIRH uses a combination of scientific and local knowledge to generate soil- and climate-specific assessments of three attributes of land health. It is used in a number of countries. In the United States, data are aggregated over 30,000 locations to provide national assessments.*

Higuera, P. E., Metcalf, A. L., Miller, C., Buma, B., McWethy, D. B., Metcalf, E. C., . . . Virapongse, A. (2019). Integrating subjective and objective dimensions of resilience in fire-prone landscapes. *BioScience, 69*(5), 379-388. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067650312&doi=10.1093%2fbiosci%2fbiz030&partnerID=40&md5=27e8cbc9f63801dd8495d66e115ca21b. doi:10.1093/biosci/biz030

Research Tags: Forestry, Weather

Abstract: *Resilience has become a common goal for science-based natural resource management, particularly in the context of changing climate and disturbance regimes. Integrating varying perspectives and definitions of resilience is a complex and often unrecognized challenge to applying resilience concepts to social–ecological systems (SESs) management. Using wildfire as an example, we develop a framework to expose and separate two important dimensions of resilience: the inherent properties that maintain structure, function, or states of an SES and the human perceptions of desirable or valued components of an SES. In doing so, the framework distinguishes between value-free and human-derived, value-explicit dimensions of resilience. Four archetypal scenarios highlight that ecological resilience and human values do not always align and that recognizing and anticipating potential misalignment is critical for developing effective management goals. Our framework clarifies existing resilience theory, connects literature across disciplines, and facilitates use of the resilience concept in research and land-management applications.*

Hines, J., Pabst, S., Mueller, K. E., Blumenthal, D. M., Cesarz, S., & Eisenhauer, N. (2017). Soil-mediated effects of global

change on plant communities depend on plant growth form. *Ecosphere, 8*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035310914&doi=10.1002%2fecs2.1996&partnerID=40&md5=98603491655ab961fa30d55767c761da. doi:10.1002/ecs2.1996
Research Tags: Weather
Abstract: *Understanding why species respond to climate change is critical for forecasting invasions, diversity, and productivity of communities. Although researchers often predict species' distributions and productivity based on direct physiological responses to environments, theory suggests that striking shifts in community composition could arise if global change alters indirect feedbacks mediated by resources, mutualists, or antagonists. To test whether global change influences plant communities via soil-mediated feedbacks, we grew model communities in soils collected from a seven-year field manipulation of CO2, warming, and invasion. We evaluated mechanisms underlying variation in the model communities by comparing species' growth in equivalent soil histories with, and without, experimentally reduced soil biota (via sterilization) and nutrient limitation (via fertilization). We show that grasses performed consistently across all soil history scenarios and that soil biota limited grasses more than nutrients. In contrast, forbs were differentially sensitive to soil history scenarios, with the magnitude and direction of responses to soil biota and nutrients dependent upon plant species and global change scenario. The asymmetry in importance of soil history for grasses and forbs is likely explained by differences in life history strategy. We conclude that accounting for species' growth strategies will improve predictions of species sensitivity to altered soil feedbacks in future climates.*

Hitaj, C., Rehkamp, S., Canning, P., & Peters, C. J. (2019). Greenhouse Gas Emissions in the United States Food System: Current and Healthy Diet Scenarios. *Environmental Science and Technology, 53*(9), 5493-5503. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065586038&doi=10.1021%2facs.est.8b06828&partnerID=40&md5=5e20d1a05f710e4ac27d2f9498c88134. doi:10.1021/acs.est.8b06828
Research Tags: Emissions, Crops, Livestock
Abstract: *We estimate the impact on greenhouse gas emissions (GHGE) of shifting from the current average United States diet to four alternative diets that meet the 2010 Dietary Guidelines for Americans (DGA). In contrast to prior studies, which rely on process-based life-cycle-analysis GHGE estimates from the literature for particular food items, we combine a diet model, an environmentally extended input–output model of energy use in the U.S. food system, and a biophysical model of land use for crops and livestock to estimate food system GHGE from the combustion of fossil fuels and from biogenic sources, including enteric fermentation, manure management, and soil management. We find that an omnivore diet that meets the DGA while constraining cost leaves food system GHGE essentially unchanged relative to the current baseline diet (985 000 000 tons of CO2 eq or 3191 kilograms of CO2 eq per capita per year), while a DGA-compliant vegetarian and a DGA-compliant omnivore diet that minimizes energy consumption in the food system reduce GHGE by 32% and 22%, respectively. These emission reductions were achieved mainly through quantity and composition changes in the meat, poultry, fish; dairy; and caloric sweeteners categories. Shifting from current to healthy diets as defined by the DGA does not necessarily reduce GHGE in the U.S. food system, although there are diets, including two presented here and by inference many others, which can achieve a reduction in GHGE.*

Hobbie, J. E., Shaver, G. R., Rastetter, E. B., Cherry, J. E., Goetz, S. J., Guay, K. C., . . . Kling, G. W. (2017). Ecosystem responses to climate change at a Low Arctic and a High Arctic long-term research site. *Ambio, 46*, 160-173. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85010408606&doi=10.1007%2fs13280-016-0870-x&partnerID=40&md5=7097c3b07ca736f2fdf8bf9dbf309168. doi:10.1007/s13280-016-0870-x
Research Tags: Grassland, Weather
Abstract: *Long-term measurements of ecological effects of warming are often not statistically significant because of annual variability or signal noise. These are reduced in indicators that filter or reduce the noise around the signal and allow effects of climate warming to emerge. In this way, certain indicators act as medium pass filters integrating the signal over years-to-decades. In the Alaskan Arctic, the 25-year record of warming of air temperature revealed no significant trend, yet environmental and ecological changes prove that warming is affecting the ecosystem. The useful indicators are deep permafrost temperatures, vegetation and shrub biomass, satellite measures of canopy reflectance (NDVI), and chemical measures of soil weathering. In contrast, the 18-year record in the Greenland Arctic revealed an extremely high summer air-warming of 1.3*

°C/decade; the cover of some plant species increased while the cover of others decreased. Useful indicators of change are NDVI and the active layer thickness.

Hoberg, E. P., Cook, J. A., Agosta, S. J., Boeger, W., Galbreath, K. E., Laaksonen, S., . . . Brooks, D. R. (2017). Arctic systems in the Quaternary: Ecological collision, faunal mosaics and the consequences of a wobbling climate. *Journal of Helminthology, 91*(4), 409-421. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017449987&doi=10.1017%2fS0022149X17000347&partnerID=40&md5=464e8f531956ec09c2b92024e3a5dd7b. doi:10.1017/S0022149X17000347
Research Tags: Grassland, Wildlife
Abstract: *Climate oscillations and episodic processes interact with evolution, ecology and biogeography to determine the structure and complex mosaic that is the biosphere. Parasites and parasite–host assemblages are key components in a general explanatory paradigm for global biodiversity. We explore faunal assembly in the context of Quaternary time frames of the past 2.6 million years, a period dominated by episodic shifts in climate. Climate drivers cross a continuum from geological to contemporary timescales and serve to determine the structure and distribution of complex biotas. Cycles within cycles are apparent, with drivers that are layered, multifactorial and complex. These cycles influence the dynamics and duration of shifts in environmental structure on varying temporal and spatial scales. An understanding of the dynamics of high-latitude systems, the history of the Beringian nexus (the intermittent land connection linking Eurasia and North America) and downstream patterns of diversity depend on teasing apart the complexity of biotic assembly and persistence. Although climate oscillations have dominated the Quaternary, contemporary dynamics are driven by tipping points and shifting balances emerging from anthropogenic forces that are disrupting ecological structure. Climate change driven by anthropogenic forcing has supplanted a history of episodic variation and is eliminating ecological barriers and constraints on development and distribution for pathogen transmission. A framework to explore interactions of episodic processes on faunal structure and assembly is the Stockholm Paradigm, which appropriately shifts the focus from cospeciation to complexity and contingency in explanations of diversity.*

Holden, Z. A., Swanson, A., Luce, C. H., Jolly, W. M., Maneta, M., Oyler, J. W., . . . Affleck, D. (2018). Decreasing fire season precipitation increased recent western US forest wildfire activity. *Proceedings of the National Academy of Sciences of the United States of America, 115*(36), E8349-E8357. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052741731&doi=10.1073%2fpnas.1802316115&partnerID=40&md5=f910e30383b5d91ea60b837bb2e46868. doi:10.1073/pnas.1802316115
Research Tags: Forestry, Weather
Abstract: *Western United States wildfire increases have been generally attributed to warming temperatures, either through effects on winter snowpack or summer evaporation. However, near-surface air temperature and evaporative demand are strongly influenced by moisture availability and these interactions and their role in regulating fire activity have never been fully explored. Here we show that previously unnoted declines in summer precipitation from 1979 to 2016 across 31–45% of the forested areas in the western United States are strongly associated with burned area variations. The number of wetting rain days (WRD; days with precipitation ≥2.54 mm) during the fire season partially regulated the temperature and subsequent vapor pressure deficit (VPD) previously implicated as a primary driver of annual wildfire area burned. We use path analysis to decompose the relative influence of declining snowpack, rising temperatures, and declining precipitation on observed fire activity increases. After accounting for interactions, the net effect of WRD anomalies on wildfire area burned was more than 2.5 times greater than the net effect of VPD, and both the WRD and VPD effects were substantially greater than the influence of winter snowpack. These results suggest that precipitation during the fire season exerts the strongest control on burned area either directly through its wetting effects or indirectly through feedbacks to VPD. If these trends persist, decreases in summer precipitation and the associated summertime aridity increases would lead to more burned area across the western United States with far-reaching ecological and socioeconomic impacts.*

Holder, A. L., Gullett, B. K., Urbanski, S. P., Elleman, R., O'Neill, S., Tabor, D., . . . Baker, K. R. (2017). Emissions from prescribed burning of agricultural fields in the Pacific Northwest. *Atmospheric Environment, 166*, 22-33. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022320401&doi=10.1016%2fj.atmosenv.2017.06.043&partnerID=40&md5=5c2a432d38c5a3042eecbdc280bf4d06. doi:10.1016/j.atmosenv.2017.06.043
Research Tags: Emissions, Crops
Abstract: *Prescribed burns of winter wheat stubble and Kentucky bluegrass fields in northern Idaho and eastern Washington states (U.S.A.) were sampled using ground-, aerostat-, airplane-, and laboratory-based measurement platforms to determine emission factors, compare methods, and provide a current and comprehensive set of emissions data for air quality models, climate models, and emission inventories. Batch measurements of PM2.5, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated dibenzodioxins/dibenzofurans (PCDDs/PCDFs), and continuous measurements of black carbon (BC), particle mass by size, CO, CO2, CH4, and aerosol characteristics were taken at ground level, on an aerostat-lofted instrument package, and from an airplane. Biomass samples gathered from the field were burned in a laboratory combustion facility for comparison with these ground and aerial field measurements. Emission factors for PM2.5, organic carbon (OC), CH4, and CO measured in the field study platforms were typically higher than those measured in the laboratory combustion facility. Field data for Kentucky bluegrass suggest that biomass residue loading is directly proportional to the PM2.5 emission factor; no such relationship was found with the limited wheat data. CO2 and BC emissions were higher in laboratory burn tests than in the field, reflecting greater carbon oxidation and flaming combustion conditions. These distinctions between field and laboratory results can be explained by measurements of the modified combustion efficiency (MCE). Higher MCEs were recorded in the laboratory burns than from the airplane platform. These MCE/emission factor trends are supported by 1–2 min grab samples from the ground and aerostat platforms. Emission factors measured here are similar to other studies measuring comparable fuels, pollutants, and combustion conditions. The size distribution of refractory BC (rBC) was single modal with a log-normal shape, which was consistent among fuel types when normalized by total rBC mass. The field and laboratory measurements of the Angstrom exponent (α) and single scattering albedo (ω) exhibit a strong decreasing trend with increasing MCEs in the range of 0.9–0.99. Field measurements of α and ω were consistently higher than laboratory burns, which is likely due to less complete combustion. When VOC emissions are compared with MCE, the results are consistent for both fuel types: emission factors increase as MCE decreases.*

Holtz, B., Browne, G. T., Doll, D., Culumber, M., Yaghmour, M. A., Jahanzad, E., . . . Gaudin, A. (2018) Whole almond orchard recycling and the effect on second generation tree growth, yield, light interception, and soil fertility. In*: Vol. 1219*. *Acta horticulturae* (pp. 265-271).
Research Tags: Forestry, Crops
Abstract: *The grinding and incorporating into soil of whole almond trees, during orchard removal, could provide a sustainable practice that enhances both air and soil quality. We hypothesize that wood debris incorporated into soils could increase organic matter, enhance carbon sequestration, and improve soil quality and tree yield. The objective of this project was to compare on-site grinding up and soil incorporation of whole trees with on-site burning and ash incorporation as a means of orchard removal. In 2008, each treatment was applied to seven replicate plots of an old stone fruit orchard in a randomized block design. An "Iron Wolf," a 45,454 kg rock-crusher, was used to grind up and incorporate the standing tree rows of the old orchard to a soil depth of up to 30 cm. The grinding incorporated an estimated 67,000 kg of woody biomass ha-1. For the burn treatment, trees were pushed into a pile, burned, and the ash was spread evenly throughout the plot. All replicate plots were re-planted with "bare-root" almond trees in 2009. Significantly greater increase in tree circumference was observed in the grind treatment from 2014-2016 when compared to the burn. Also, in 2016, significantly greater photosynthetically active light interception was observed in the grind treatment. Yields were determined from 2011-2017 and the grind treatment cumulative yield was greater by 1,778.49 kg ha-1 in the 'Butte' cultivar. Yields were also determined in 'Nonpareil' in 2014, 2016, and 2017 and the grind treatment cumulative yield was 1,120 kg ha-1 greater than the burn yield. Significantly more soil nutrients (calcium, manganese, iron, magnesium, boron, nitrate, potassium, copper), higher electrical conductivity, organic matter, total and organic carbon were measured in the grind treatment soils when compared to the burn treatment. Soil pH was significantly lower in the grind treatment plots. Leaf petiole analysis also revealed higher nutrients (nitrogen, potassium, phosphorus, manganese, and iron) and less sodium and magnesium levels in trees growing in the grind treatment. Bud failure severity was lower on the 'Carmel' trees in the grind treatment when compared to the burn treatment. This project demonstrated whole orchard recycling as an alternative to*

burning in the field or in a co-generation facility. We estimate that over 8,000 ha in California have been ground and incorporated in the last three years.

Holtz, C. T., & Schoettle, A. W. (2018). Is resistance to mountain pine beetle associated with genetic resistance to white pine blister rust in Limber Pine? *Forests, 9*(10). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053846754&doi=10.3390%2ff9100595&partnerID=40&md5=3a3283fa68b6a46b694461320911c4a4. doi:10.3390/f9100595
Research Tags: Forestry, Wildlife
Abstract: *Limber pine (Pinus flexilis James) co-evolved with the mountain pine beetle (Dendroctonus ponderosae Hopkins; MPB) and is now also challenged by the non-native pathogen Cronartium ribicola (J.C. Fisch.) that causes the lethal disease white pine blister rust (WPBR). Previous research suggests that trees infected with WPBR can be preferred hosts for MPB. Using resin duct traits associated with MPB resistance, we tested for a relationship between resistance to MPB and WPBR in limber pine, in the absence of either biological agent. These analyses will help evaluate if MPB historically may have contributed to natural selection for WPBR resistance in advance of WPBR invasion, and could help explain the unusually high frequency of the dominant Cr4 allele for complete resistance to WPBR in limber pine populations of the Southern Rocky Mountains. Resin duct production, density and relative duct area did not differ between healthy trees previously inferred to carry the dominant Cr4 allele and trees that lack it at 22 sites, though some duct traits varied with elevation. MPB resistance does not appear to have played an evolutionary role in contributing to the high frequency of Cr4 in naïve populations, however, MPB may affect the future evolution of resistance to WPBR in the pines where the two pests coincide and WPBR will affect forest recovery after MPB epidemics. MPB-WPBR interactions in a changing climate will affect the future trajectory of limber pine.*

Holzworth, D. P., Snow, V., Janssen, S., Athanasiadis, I. N., Donatelli, M., Hoogenboom, G., . . . Thorburn, P. (2017). Agricultural production systems modelling and software: Current status and future prospects. *Environmental Modelling and Software, 72*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84912065139&doi=10.1016%2fj.envsoft.2014.12.013&partnerID=40&md5=f672a0a6076a342d9f0fd8ff77534e6d. doi:10.1016/j.envsoft.2014.12.013
Research Tags: Research, Crops
Abstract: *During the past decade, the application of agricultural production systems modelling has rapidly expanded while there has been less emphasis on model improvement. Cropping systems modelling has become agricultural modelling, incorporating new capabilities enabling analyses in the domains of greenhouse gas emissions, soil carbon changes, ecosystem services, environmental performance, food security, pests and disease losses, livestock and pasture production, and climate change mitigation and adaptation. New science has been added to the models to support this broadening application domain, and new consortia of modellers have been formed that span the multiple disciplines.*
There has not, however, been a significant and sustained focus on software platforms to increase efficiency in agricultural production systems research in the interaction between the software industry and the agricultural modelling community. This paper describes the changing agricultural modelling landscape since 2002, largely from a software perspective, and makes a case for a focussed effort on the software implementations of the major models.

Hoover, C. M., & Smith, J. E. (2017). Equivalence among three alternative approaches to estimating live tree carbon stocks in the eastern United States. *Forest Ecology and Management, 400*, 100-109. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020288055&doi=10.1016%2fj.foreco.2017.05.052&partnerID=40&md5=f4662082e9651cb40a63a77224296544. doi:10.1016/j.foreco.2017.05.052
Research Tags: Research, Forestry
Abstract: *Assessments of forest carbon are available via multiple alternate tools or applications and are in use to address various regulatory and reporting requirements. The various approaches to making such estimates may or may not be entirely comparable. Knowing how the estimates produced by some commonly used approaches vary across forest types and regions allows users of carbon stock estimates to make informed comparisons. Here, we focus on equivalence of alternate estimates of aboveground live tree carbon in eastern U.S. forests derived from the carbon reports output by the Fire and Fuels Extension (FFE) to the Forest*

Vegetation Simulator (FVS). Three approaches to estimating individual-tree carbon are compared by FVS variant and forest type. There are two approaches available in the FVS Fire and Fuels Extension (labeled FFE and Jenkins) and a third based on the U.S. Forest Service's forest inventory (component ratio method, labeled CRM).
We found that the two volume-based approaches, CRM and FFE, are most often identified as equivalent within forest type group or whole-variant relative to the other two pairs of approaches. Equivalence is common in the Northeast and Southern variants, but relatively infrequent in the Central States and Lake States variants. The underlying volume equations of the FFE and CRM approaches influence the carbon equivalence patterns as indicated by differences in volume estimates between FVS and the U.S. Forest Service's forest inventory. Aggregation, or expanding forest estimates to include increasingly larger areas, tends to reduce apparent differences between approaches – that is, they become more equivalent. This result is most evident with the CRM-FFE pair or in softwood forest type groups.

Hoover, C. M., & Smith, J. E. (2017). Equivalence of live tree carbon stocks produced by three estimation approaches for forests of the western United States. *Forest Ecology and Management, 385*, 236-253. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85003945019&doi=10.1016%2fj.foreco.2016.11.041&partnerID=40&md5=3b1ccec69e4670f6da83340f359c0645. doi:10.1016/j.foreco.2016.11.041
Research Tags: Forestry
Abstract: *The focus on forest carbon estimation accompanying the implementation of increased regulatory and reporting requirements is fostering the development of numerous tools and methods to facilitate carbon estimation. One such well-established mechanism is via the Forest Vegetation Simulator (FVS), a growth and yield modeling system used by public and private land managers and researchers, which provides two alternate approaches to quantifying carbon in live trees on forest land – these are known as the Jenkins and Fire and Fuels Extension (FFE) equations. A necessary consideration in developing forest carbon estimates is to address alternate, potentially different, estimates that are likely available from more than one source. A key to using such information is some understanding of where alternate estimates are expected to produce equivalent results. We address this here by focusing on potential equivalence among three commonly employed approaches to estimating individual-tree carbon, which are all applicable to inventory sampling or inventory simulation applications. Specifically, the two approaches available in FVS – Jenkins and FFE – and the third, the component ratio method (CRM) used in the U.S. Forest Service's, Forest Inventory and Analysis national DataBase (FIADB).*
A key finding of this study is that the Jenkins, FFE, and CRM methods are not universally equivalent, and that equivalence varies across regions, forest types, and levels of data aggregation. No consistent alignment of approaches was identified. In general, equivalence was identified in a greater proportion of cases when forests were summarized at more aggregate levels such as all softwood type groups or entire variants. Most frequently, the FIA inventory-based CRM and FFE were determined to be equivalent.

Hoover, D. L., Wilcox, K. R., & Young, K. E. (2018). Experimental droughts with rainout shelters: A methodological review. *Ecosphere, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041196187&doi=10.1002%2fecs2.2088&partnerID=40&md5=09821a5b0d4fb352078a1584e4c5bffd. doi:10.1002/ecs2.2088
Research Tags: Weather
Abstract: *Forecast increases in the frequency, intensity, and duration of droughts with climate change may have extreme and extensive ecological consequences. There are currently hundreds of published, ongoing, and new drought experiments worldwide aimed to assess ecological sensitivity to drought and identify the mechanisms governing resistance and resilience. To date, the results from these experiments have varied widely, and thus, patterns of drought sensitivities and the underlying mechanisms have been difficult to discern. Here we examined 89 published drought experiments, along with their associated historical precipitation records to (1) identify where and how drought experiments have been imposed, (2) determine the extremity of drought treatments in the context of historical climate, and (3) assess the influence of ambient precipitation variability on the magnitude of drought experiments. In general, drought experiments were most common in water-limited ecosystems, such as grasslands, and were often short-term, as 80% were 1–4 yr in duration. When placed in a historical context, the majority of drought experiments imposed extreme drought, with 61%*

below the 5th, and 43% below the 1st percentile of the 50-yr annual precipitation distribution. We also determined that interannual precipitation variability had a large and potentially underappreciated effect on the magnitude of drought treatments due to the co-varying nature of control and drought precipitation inputs. Thus, detecting significant ecological effects in drought experiments is strongly influenced by the interaction between experimental drought magnitude, precipitation variability, and key ecological thresholds. The patterns that emerged from this study have important implications for the design and interpretation of drought experiments and also highlight critical gaps in our understanding of the ecological effects of drought.

Hou, C., Chu, M. L., Guzman, J. A., Acero Triana, J. S., Moriasi, D. N., & Steiner, J. L. (2019). Field scale nitrogen load in surface runoff: Impacts of management practices and changing climate. *Journal of Environmental Management, 249*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070222107&doi=10.1016%2fj.jenvman.2019.109327&partnerID=40&md5=5dbd9b12e32c3934e4d4f6ab7d81e757. doi:10.1016/j.jenvman.2019.109327
Research Tags: Water, Crops
Abstract: *The use of Nitrogen (N) fertilizer boosted crop production to accommodate 7 billion people on Earth in the 20th century but with the consequence of exacerbating N losses from agricultural landscapes. Land management practices that can prevent high N load are constantly being sought for mitigation and conservation purposes. This study was aimed at evaluating the impacts of different land management practices under projected climate scenarios on surface runoff linked N load at the field scale level. A framework to analyze changes in N load at a high spatiotemporal resolution under high greenhouse emission climate projections was developed using the Pesticide Root Zone Model (PRZM) for the Willow Creek Watershed in the Fort Cobb Experimental Watershed in Oklahoma. Specifically, 12 combinations of land management and climate scenarios were evaluated based on their N load via surface runoff from 2020 to 2070. Results showed that crop rotation practices lowered both the N load and the probability of high N load events. Spring application reduced the negative effects in summer and fall from other land management practices but at the risk of increased probability of generating high N load in April and May. The fertilizer application rate was found to be the most critical factor that affected the amount and the probability of high N load events. By adopting a target application management approach, the monthly maximum N can be decreased by 13% while the annual mean N load by 6%. The model framework and analysis method developed in this research can be used to analyze tradeoffs between environmental welfare and economic benefits of N fertilizer at the field scale level.*

Hou, R., Ouyang, Z., Han, D., & Wilson, G. V. (2018). Effects of field experimental warming on wheat root distribution under conventional tillage and no-tillage systems. *Ecology and Evolution, 8*(5), 2418-2427. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041111532&doi=10.1002%2fece3.3864&partnerID=40&md5=acec2b46aca89507c5c7f97e235b2483. doi:10.1002/ece3.3864
Research Tags: Crops, Weather
Abstract: *Despite the obvious importance of roots to agro-ecosystem functioning, few studies have attempted to examine the effects of warming on root biomass and distribution, especially under different tillage systems. In this study, we performed a field warming experiment using infrared heaters on winter wheat, in long-term conventional tillage and no-tillage plots, to determine the responses of root biomass and distribution to warming. Soil monoliths were collected from three soil depths (0–10, 10–20, and 20–30 cm). Results showed that root biomass was noticeably increased under both till and no-till tillage systems (12.1% and 12.9% in 2011, and 9.9% and 14.5% in 2013, in the two tillage systems, respectively) in the 0–30 cm depth, associated with a similar increase in shoot biomass. However, warming-induced root biomass increases occurred in the deeper soil layers (i.e., 10–20 and 20–30 cm) in till, while the increase in no-till was focused in the surface layer (0–10 cm). Differences in the warming-induced increases in root biomass between till and no-till were positively correlated with the differences in soil total nitrogen (R2 = .863, p < .001) and soil bulk density (R2 = .853, p < .001). Knowledge of the distribution of wheat root in response to warming should help manage nutrient application and cycling of soil C-N pools under anticipated climate change conditions.*

Houle, G. P., Kane, E. S., Kasischke, E. S., Gibson, C. M., & Turetsky, M. R. (2018). Recovery of carbon pools a decade after wildfire in black spruce forests of interior Alaska: Effects of soil texture and landscape position.

Canadian Journal of Forest Research, 48(1), 1-10. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040013199&doi=10.1139%2fcjfr-2017-0236&partnerID=40&md5=1f82e33616eeabea1b59cb374292f680. doi:10.1139/cjfr-2017-0236
Research Tags: Forestry
Abstract: *We measured organic-layer (OL) recovery and carbon stocks in dead woody debris a decade after wildfire in black spruce (Picea mariana (Mill.) B.S.P.) forests of interior Alaska. Previous study at these research plots has shown the strong role that landscape position plays in governing the proportion of OL consumed during fire and revegetation after fire. Here, we show that landscape position likely influences fire dynamics in these stands through changes in mineral soil texture. The content of fine-textured materials in underlying mineral soils was positively related to OL depths measured 1 and 10 years after fire, and there was an interaction between soil texture and elevation in governing OL consumption and OL recovery a decade following fire. OL depths 10 years after fire were 2 cm greater than 1 year after fire, with a range of 19 cm of accumulation to 9 cm of subsidence. Subsidence was inversely related to the percentage of fine textures within the parent material. The most influential factor determining the accumulation of OL carbon stocks a decade following wildfire was the interaction between landscape position and the presence of fine-textured soil. As such, parent material texture interacted with biological processes to govern the recovery of soil organic layers.*

Howell, P. J. (2018). Changes in native bull trout and non-native brook trout distributions in the upper Powder River basin after 20 years, relationships to water temperature and implications of climate change. *Ecology of Freshwater Fish, 27*(3), 710-719. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039158946&doi=10.1111%2feff.12386&partnerID=40&md5=7d2493c4cdfd3a490e29c7fd44a8c552. doi:10.1111/eff.12386
Research Tags: Water, Wildlife
Abstract: *Many bull trout populations have declined from non-native brook trout introductions, habitat changes (e.g. water temperature) and other factors. We systematically sampled the distribution of bull trout and brook trout in the upper Powder River basin in Oregon in the 1990s and resampled it in 2013–2015, examined temperature differences in the habitats of the two species and analysed trends in temperatures in the light of possible increases associated with climate change. The species' distributions are currently similar to those in the 1990s, except in one stream where bull trout declined. However, bull trout consisting of resident forms remain restricted to a few kilometres of habitat at the upper end of fish distribution. In streams where both species occur, the typical pattern was an intermediate zone of mixed bull trout, brook trout, and hybrids downstream of allopatric bull trout and allopatric brook trout extending farther downstream. Temperature differences between where bull trout and most brook trout occurred were small (0.5–1.0°C August mean). There were no statistical increases in water temperatures in nearby streams since the 1990s and no warming trends in air temperatures for the past 25–60 years. However, peak summer water temperatures are occurring about 3 weeks earlier than 25 years ago. Future effects of climate change, including possible increases in temperature, changes in timing and other factors (e.g. snowpack, flow and extreme events) remain a concern for the persistence of these populations. However, it is difficult to precisely predict where those changes will occur and what they will be.*

Hoylman, Z. H., Jencso, K. G., Hu, J., Martin, J. T., Holden, Z. A., Seielstad, C. A., & Rowell, E. M. (2018). Hillslope Topography Mediates Spatial Patterns of Ecosystem Sensitivity to Climate. *Journal of Geophysical Research: Biogeosciences, 123*(2), 353-371. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042135763&doi=10.1002%2f2017JG004108&partnerID=40&md5=3e25f2c9c8d95e857340996b74b6e9e7. doi:10.1002/2017JG004108
Research Tags:
Abstract: *Understanding how hillslope topography modulates ecosystem dynamics across topoclimatic gradients is critical for predicting future climate change impacts on vegetation function. We examined the influence of hillslope topography on ecosystem productivity, structure, and photosynthetic activity across a range of water and energy availability using three independent methods in a forested watershed (Montana, USA): 308 tree cores; light detection and ranging quantification of stem density, basal area, foliar biomass, and total biomass; and the enhanced vegetation index (EVI; 1984–2012). Multiple linear regression analysis across three conifer species revealed significant increases in measured basal area increment growth rates (from 56 to*

2,058 mm2/yr) with increasing values of the topographic wetness index and decreases in the climatic water deficit. At the watershed scale, we observed strong gradients in total biomass (e.g., 52 to 75 Mg/ha), which increased from ridgelines to convergent hollows. The most predominant topographic organization of forest biomass occurred along locations of climatically driven water limitations. Similarly, an analysis of growing season EVI indicated enhanced photosynthetic activity and a prolonged growing season in convergent hillslope positions. Collectively, these analyses confirm that within water-limited landscapes, meter-scale differences in topographic position can mediate the effects of the local energy balance and contribute to large differences in local hydrometeorological processes that are a necessary consideration for quantifying spatial patterns of ecosystem productivity. Further, they suggest that local topography and its topology with regional climate may become increasingly important for understanding spatial patterns of ecosystem productivity, mortality, and resilience as regional climates become more arid.

Hristov, A. N., Degaetano, A. T., Rotz, C. A., Hoberg, E., Skinner, R. H., Felix, T., . . . Hollinger, D. Y. (2018). Climate change effects on livestock in the Northeast US and strategies for adaptation. *Climatic Change, 146*(1-2), 33-45. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85024495887&doi=10.1007%2fs10584-017-2023-z&partnerID=40&md5=9b3f7186e0aa8a6c4affaaaca78d95f2. doi:10.1007/s10584-017-2023-z

Research Tags: Livestock

Abstract: *The livestock industries are a major contributor to the economy of the northeastern United States. Climate models predict increased average maximum temperatures, days with temperatures exceeding 25 °C, and higher annual precipitation in the Northeast. These environmental changes combined with increased atmospheric CO2 concentration are expected to either increase or decrease forage productivity depending on the crop, and may decrease protein content and forage digestibility. Winter damage to sensitive forage species may also increase. Predicted temperature increases are expected to reduce fertility in dairy cattle and heat stress-induced inflammation may limit energy available for productive functions. Additional loss in milk production due to decreased feed intake is estimated to be up to 1% of the projected annual milk production through 2100. The effects of climate change on the beef industry in the Northeast are expected to be minimal. Broiler production in the region may benefit from warmer winter and summer temperatures, but future housing will require greater insulation and ventilation fan capacity. Providing adequate housing and ventilation to offset climate changes will also be important for the layer industry and will likely increase the price of eggs. Climate change is expected to have an economic impact on the horse industry in the region through additional management of land and forage resources, building of shelters, and heat abatement at equine events. Increased temperatures and more intense storms will increase nutrient losses and gaseous emissions from animal manure. Uncertainties about how host animals, pathogens, and disease vectors will respond to climate change highlight the need for continued animal health monitoring.*

Hu, T., Sun, L., Hu, H., Weise, D. R., & Guo, F. (2017). Soil Respiration of the Dahurian Larch (Larix gmelinii) Forest and the Response to Fire Disturbance in Da Xing'an Mountains, China. *Scientific Reports, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020469315&doi=10.1038%2fs41598-017-03325-4&partnerID=40&md5=56d6d40cc03490da3c0cb496d5699cd6. doi:10.1038/s41598-017-03325-4

Research Tags: Soil, Weather, Forestry

Abstract: *Despite the high frequency of wildfire disturbances in boreal forests in China, the effects of wildfires on soil respiration are not yet well understood. We examined the effects of fire severity on the soil respiration rate (Rs) and its component change in a Dahurian Larch (Larix gmelinii) in Northeast China. The results showed that Rs decreased with fire burning severity. Compared with the control plots, Rs in the low burning severity plots decreased by 19%, while it decreased by 28% in the high burning severity plots. The Rs decrease was mainly due to a decreased autotrophic respiration rate (Ra). The temperature sensitivity (Q 10) of Rs increased after the low severity fire disturbances, but it decreased after the high severity fire disturbance. The Rs were triggered by the soil temperature, which may explain most of the Rs variability in this area. Our study, for the first time, provides the data-based foundation to demonstrate the importance of assessing CO2 fluxes considering both fire severity and environmental factors post-fire in boreal forests of China.*

Huang, M., Mheni, N., Brown-Guedira, G., McKendry, A., Griffey, C., Van Sanford, D., . . . Sneller, C. (2018). Genetic analysis of heading date in winter and spring wheat. *Euphytica, 214*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049570710&doi=10.1007%2fs10681-018-2199-y&partnerID=40&md5=1fe53412b1a68fc2114923c35aaa7501. doi:10.1007/s10681-018-2199-y

Research Tags: Crops

Abstract: *Climate change will have severe effects on wheat production, but crop phenology can be an important component of wheat adaptation. In this study, elite soft winter wheat and hard spring wheat (HSW) populations were phenotyped for heading date (HD) in North America and Tanzania (HSW only). All lines were genotyped with common single nucleotide polymorphism markers to compare the genetics and prediction accuracy of genomic selection (GS) for HD in winter and spring wheat. Lines were tested under diverse environments and the HSW germplasm was assessed for their early maturity performance in Africa. Two clusters of environments were formed for each population. One cluster consisted of southern environments and the other consisted of northern environments. The latter produced a more narrow range of HD than the southern cluster. Thirteen highly significant (p < 0.0005) quantitative trait loci (QTLs) for HD were detected in two populations. Within each population, the QTL effects were consistent between clusters of environments. Within each population, GS model developed using data from one cluster of environments could predict HD in the other cluster. The prediction accuracy of GS between two populations was minimal. Similarly, only a few minor effects QTL were in common between the two populations. Additionally, we identified 15 spring wheat genotypes with HD earlier than commercial Tanzanian wheat varieties. These genotypes could be used as a resource for creating early HD wheat varieties for Tanzania.*

Huang, W., Swatantran, A., Duncanson, L., Johnson, K., Watkinson, D., Dolan, K., . . . Dubayah, R. (2017). County-scale biomass map comparison: a case study for Sonoma, California. *Carbon Management, 8*(5-6), 417-434. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035102630&doi=10.1080%2f17583004.2017.1396840&partnerID=40&md5=356f326f1763f8869c3804f11c72dc3b. doi:10.1080/17583004.2017.1396840

Research Tags: Forestry

Abstract: *The amount of carbon stored in forests affects a wide range of regional- to global-scale climate change processes. However, current maps often show large differences in carbon accounting. In this study, we present a framework to evaluate and compare multiple recent biomass maps at the county scale (4119 km2). We first compare the differences in the forest and non-forest areas at the pixel and county levels from multiple maps. Map-based estimates of county-level mean and total biomass are compared to the United States Forest Service (USFS) sample-based estimates. Comparison of raster-based biomass products shows differences in mean and total biomass at both pixel- and county-levels. Despite all the maps using USFS's plot data for model training, only the three active sensor derived products compare well to USFS's estimates of total biomass (within 10%), while the three passive sensor derived map products underestimated total biomass by as much as 47%. Our evaluation demonstrates that the biomass map generated using combined Light Detection and Ranging (LiDAR) and auxiliary data achieve accurate estimates at plot-level (R2 = 0.67; RMSE = 97.9 Mg.ha-1). This comparison study confirmed that missing direct height information either from active sensors tends to underestimate total biomass and mean biomass density at county-level.*

Huggins, D. R., Clapp, C. E., Allmaras, R. R., & Lamb, J. A. (2018). Carbon sequestration in corn-soybean agroecosystems. In *Soil Management and Greenhouse Effect* (pp. 61-68).

Research Tags: Crops, Soil

Abstract: *Soil organic matter (SOM) has been reduced by cultivation in many agroecosystems, irrespective of climatic and edaphic characteristics. Losses of soil carbon (C) have contributed significantly to global carbon dioxide (CO2) levels. Quantifying SOM dynamics as related to agroecosystem management is fundamental to identifying pathways for soil C sequestration. This chapter examines the effect of crop sequence on soil organic C concentration, source, and C dynamics. A field study with 14 crop sequence treatments was initiated in 1981 at the University of Minnesota Southwest Experiment Station near Lamberton, MN. The treatments consisted of various lengths of corn and soybean crop sequences including continuous corn and continuous soybean. The chapter analyses only eight of these treatments. Soil samples from continuous corn and continuous soybean crop sequence treatments were physically separated into primary size fractions. Sub-samples were gently crushed by hand and passed through a 2 mm sieve.*

Hulke, B. S., Markell, S. G., Kane, N. C., & Mathew, F. M. (2019). Phomopsis stem canker of sunflower in North America: Correlation with climate and solutions through breeding and management. *OCL - Oilseeds and fats, Crops and Lipids, 26*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063944164&doi=10.1051%2focl%2f2019011&partnerID=40&md5=92882b8b15f70890fa5c3ec2989ebc30. doi:10.1051/ocl/2019011

Research Tags: Crops

Abstract: *Climate change is occurring in the central US and is interacting with agroecological factors to increase biotic stress in sunflower. Certain species of Diaporthe cause Phomopsis stem canker in sunflower and other dicotyledonous weeds and crops. The increase in precipitation already observed in the states of North Dakota, South Dakota, and Minnesota have increased the chances of outbreaks of necrotrophic pathogens, like Diaporthe. We discuss how climate trends, combined with technological, management, and economic interactions, are correlated with increasing incidence of Phomopsis stem canker in these and adjacent areas in North America. Further, we discuss management options and the role of improved sunflower genetics in reducing Phomopsis stem canker outbreak risk.*

Hurteau, M. D., North, M. P., Koch, G. W., & Hungate, B. A. (2019). Managing for disturbance stabilizes forest carbon. *Proceedings of the National Academy of Sciences of the United States of America, 116*(21), 10193-10195. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066120639&doi=10.1073%2fpnas.1905146116&partnerID=40&md5=bb0f761cda1c08c71adf0f874307f989. doi:10.1073/pnas.1905146116

Research Tags: Soil

No Abstract (Opinion):

Hurtt, G., Zhao, M., Sahajpal, R., Armstrong, A., Birdsey, R., Campbell, E., . . . Tang, H. (2019). Beyond MRV: High-resolution forest carbon modeling for climate mitigation planning over Maryland, USA. *Environmental Research Letters, 14*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068855417&doi=10.1088%2f1748-9326%2fab0bbe&partnerID=40&md5=119392875b9a087d75bbd6430943d54d. doi:10.1088/1748-9326/ab0bbe

Research Tags: Forestry

Abstract*: Forests are important ecosystems that are under increasing pressure from human use and environmental change, and have a significant ability to remove carbon dioxide from the atmosphere, and are therefore the focus of policy efforts aimed at reducing deforestation and degradation as well as increasing afforestation and reforestation for climate mitigation. Critical to these efforts is the accurate monitoring, reporting and verification of current forest cover and carbon stocks. For planning, the additional step of modeling is required to quantitatively estimate forest carbon sequestration potential in response to alternative land-use and management decisions. To be most useful and of decision-relevant quality, these model estimates must be at very high spatial resolution and with very high accuracy to capture important heterogeneity on the land surface and connect to monitoring efforts. Here, we present results from a new forest carbon monitoring and modeling system that combines high-resolution remote sensing, field data, and ecological modeling to estimate contemporary above-ground forest carbon stocks, and project future forest carbon sequestration potential for the state of Maryland at 90 m resolution. Statewide, the contemporary above-ground carbon stock was estimated to be 110.8 Tg C (100.3–125.8 Tg C), with a corresponding mean above-ground biomass density of 103.7 Mg ha−1 which was within 2% of independent empirically-based estimates. The forest above-ground carbon sequestration potential for the state was estimated to be much larger at 314.8 Tg C, and the forest above-ground carbon sequestration potential gap (i.e. potential-current) was estimated to be 204.1 Tg C, nearly double the current stock. These results imply a large statewide potential for future carbon sequestration from afforestation and reforestation activities. The high spatial resolution of the model estimates underpinning these totals demonstrate important heterogeneity across the state and can inform prioritization of actual afforestation/reforestation opportunities. With this approach, it is now possible to quantify both the forest carbon stock and future carbon sequestration potential over large policy relevant areas with sufficient accuracy and spatial resolution to significantly advance planning.*

Hwang, E. Y., Wei, H., Schroeder, S. G., Fickus, E. W., Quigley, C. V., Elia, P., . . . Song, Q. (2019). Genetic Diversity and Phylogenetic Relationships of Annual and Perennial Glycine Species. *G3 (Bethesda, Md.), 9*(7), 2325-2336. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069627308&doi=10.1534%2fg3.119.400220&partnerID=40&md5=88524710a6e9bc7d7118c7d238f04afd. doi:10.1534/g3.119.400220

Research Tags: Crops

Abstract: *We have estimated the average genetic diversity of two Glycine annual and six perennial species based upon 76 orthologous gene sets and performed phylogenetic analysis, divergence analysis and tests for departure from neutrality of the eight species using 52 orthologous gene sets. In addition, 367 orthologous gene sets were used to estimate the relationships of 11 G. canescens accessions. Among the perennials, G. canescens showed the highest nucleotide diversity. The other perennials, except for G. tomentella, had higher nucleotide diversity than the two annuals. Phylogenetic analysis of the Glycine showed a similar genome grouping with the previous report except for G. cyrtoloba and G. stenophita which formed a sister clade in the study. Divergence analysis supported the phylogenetic relationships that G. falcata was the most divergent from G. max, followed by G. cyrtoloba, G. syndetika, G. tomentella D3, G. stenophita and G. canescens. Most genic sequences were homogeneous in the levels of polymorphism and divergence between G. max and other Glycine species based on the HKA test, thus, Glycine perennials may have experienced a very similar evolution as inferred by trans-specific mutation analysis. The greater genetic diversity of most perennial Glycine species and their origins from the warmer and drier climates of Australia suggests the perennials maybe a potential source of heat and drought resistance that will be of value in the face of climate change.*

Hwang, T., Martin, K. L., Vose, J. M., Wear, D., Miles, B., Kim, Y., & Band, L. E. (2018). Nonstationary Hydrologic Behavior in Forested Watersheds Is Mediated by Climate-Induced Changes in Growing Season Length and Subsequent Vegetation Growth. *Water Resources Research, 54*(8), 5359-5375. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049843688&doi=10.1029%2f2017WR022279&partnerID=40&md5=1511efc75d18842a93488a4d93e97e36. doi:10.1029/2017WR022279

Research Tags: Water, Forestry

Abstract: *Forested watersheds provide important ecosystem services through the provision of high quality freshwater, mitigation of floods, and maintenance of base flows. How alteration of these services under ongoing climate change is mediated by vegetation dynamics is not fully understood. Combining independent remote sensing based vegetation information and distributed hydrological modeling, we investigated the impact of climate-induced vegetation dynamics on long-term non-stationary hydrologic behavior in two forested watersheds in the southern Appalachians. We found significant increases in precipitation-runoff deficit (defined as annual precipitation minus annual runoff), equivalent to annual evapotranspiration plus storage changes, over the last three decades. This non-stationary hydrologic behavior was significantly correlated with long-term and interannual changes in growing season length and subsequent vegetation growth. These patterns in vegetation phenology were attributed primarily to minimum temperature regimes, which showed steeper and more consistent increases than temperature maxima. Using a distributed modeling framework, we also found that the long-term non-stationary hydrologic behavior could not be simulated unless full vegetation dynamics, including vegetation phenology and long-term growth, were incorporated into the model. Incorporating seasonal vegetation dynamics also led to the improved simulation in streamflow dynamics, while its effect spread out through the following dormant seasons. Our study indicates that non-stationary hydrologic behavior has been closely mediated by long-term seasonal and structural forest canopy interaction with climate variables rather than directly driven by climatic variables. This study emphasizes the importance of understanding the ecosystem responses to ongoing climate change for predictions of future freshwater regimes.*

Hyde, J. C., Yedinak, K. M., Talhelm, A. F., Smith, A. M. S., Bowman, D. M. J. S., Johnston, F. H., . . . Tinkham, W. T. (2017). Air quality policy and fire management responses addressing smoke from wildland fires in the United States and Australia. *International Journal of Wildland Fire, 26*(5), 347-363. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019083972&doi=10.1071%2fWF16154&partnerID=40&md5=adfcd5569649062718a706c78e57cea2. doi:10.1071/WF16154

Research Tags: Weather, Forestry

Abstract: *Wildland fire emissions degrade air quality and visibility, having adverse economic, health and*

visibility impacts at large spatial scales globally. Air quality regulations can constrain the goals of landscape resilience and management of fire-dependent ecosystems. Here, we review the air quality regulatory framework in the United States, comparing this framework with that of Australia. In the United States, wildland fire management and air quality policies have evolved independently, yet interact to meet diverse public needs. Australian policy development is more recent and decentralised. We find that (1) for maxiumum effectiveness, smoke and fire regulatory frameworks must keep pace with scientific evidence, environmental and social change, and be accompanied by clear regulatory guidance; (2) episodic, non-stationary qualities of fire, and its role in ecosystems, pose specific challenges to regulators and policy-makers; and (3) the complexity of industry-focused air quality policies often leads to unintended consequences for fire management. More research is needed to create and implement more effective fire and air policies and better prepare social-ecological systems to address the challenges of climate change mitigation. These insights may be helpful for countries initially developing complementary fire and air policies, especially as the role of fire becomes more important geopolitically and globally.

Ibanez, T., Keppel, G., Baider, C., Birkinshaw, C., Culmsee, H., Cordell, S., . . . Birnbaum, P. (2018). Regional forcing explains local species diversity and turnover on tropical islands. *Global Ecology and Biogeography, 27*(4), 474-486. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040240475&doi=10.1111%2fgeb.12712&partnerID=40&md5=f4f4a20fb674c589a07d62659fb1dbd5. doi:10.1111/geb.12712

Research Tags: Forestry

Abstract: *Aim*

To determine the role of regional forcing on plot-level species diversity and composition, and to quantify the relative importance of biogeographical and climatic factors in explaining woody plant diversity and composition at the local-, island- and archipelago-scale.

Location

Forty-one tropical islands of the Indo-Pacific region from Madagascar to Hawai'i Island.

Methods

We analysed the diversity and composition of tropical woody plant communities located across 113 plots, 41 islands and 19 archipelagos. We used generalized linear mixed-effects models and generalized dissimilarity models to determine the role of regional forcing at the island and archipelago scale and to assess the relative importance of biogeographical (area and isolation of islands or archipelagos, geographical distance between plots) and climatic factors in explaining differences in local diversity and composition (species turnover). Analyses were conducted at different geographical scales (local, island and archipelago) and taxonomic levels (species, genus and family).

Results

Variation in local (plot-level) diversity (as species density, the number of species per 100 woody plants) was primarily explained by island and archipelago identity. Maximum species density was positively correlated with the area of an island (or archipelago) and negatively correlated with the isolation of an archipelago. Local climatic variability was also a significant predictor of species density, but less important than regional forcing. Climate variables explained < 20% of the variation in species turnover across all plots. The importance of geographical distance between plots relative to climate in driving species turnover decreased from the species to family level, and from the regional to island level.

Main conclusions

Regional forcing was the key driver of local diversity and composition on islands. Island area and archipelago isolation are likely driving local diversity through their effects on the pool of island species. Geographical distance between plots is the main factor explaining species turnover, while at higher taxonomic levels, climatic factors and niche conservatism are the main drivers.

Ireland, K. B., Hansen, A. J., Keane, R. E., Legg, K., & Gump, R. L. (2018). Putting Climate Adaptation on the Map: Developing Spatial Management Strategies for Whitebark Pine in the Greater Yellowstone Ecosystem. *Environmental Management, 61*(6), 981-1001. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044520175&doi=10.1007%2fs00267-018-1029-2&partnerID=40&md5=c992887d4229317d4115d125eaf0119d. doi:10.1007/s00267-018-1029-2

Research Tags: Forestry
Abstract: *Natural resource managers face the need to develop strategies to adapt to projected future climates. Few existing climate adaptation frameworks prescribe where to place management actions to be most effective under anticipated future climate conditions. We developed an approach to spatially allocate climate adaptation actions and applied the method to whitebark pine (WBP; Pinus albicaulis) in the Greater Yellowstone Ecosystem (GYE). WBP is expected to be vulnerable to climate-mediated shifts in suitable habitat, pests, pathogens, and fire. We spatially prioritized management actions aimed at mitigating climate impacts to WBP under two management strategies: (1) current management and (2) climate-informed management. The current strategy reflected management actions permissible under existing policy and access constraints. Our goal was to understand how consideration of climate might alter the placement of management actions, so the climate-informed strategies did not include these constraints. The spatial distribution of actions differed among the current and climate-informed management strategies, with 33–60% more wilderness area prioritized for action under climate-informed management. High priority areas for implementing management actions include the 1–8% of the GYE where current and climate-informed management agreed, since this is where actions are most likely to be successful in the long-term and where current management permits implementation. Areas where climate-informed strategies agreed with one another but not with current management (6–22% of the GYE) are potential locations for experimental testing of management actions. Our method for spatial climate adaptation planning is applicable to any species for which information regarding climate vulnerability and climate-mediated risk factors is available.*

Irisarri, J. G., Derner, J. D., Ritten, J. P., & Peck, D. E. (2019). Beef production and net revenue variability from grazing systems on semiarid grasslands of North America. *Livestock Science, 220*, 93-99. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058645281&doi=10.1016%2fj.livsci.2018.12.009&partnerID=40&md5=1d0b00116d02f93c49647bb23a59dd93. doi:10.1016/j.livsci.2018.12.009
Research Tags: Livestock, Grassland
Abstract: *Sustainability of ranches and rural economies in the Great Plains of western North America is contingent on the economic vitality of beef production in a changing climate. Our objective was to measure and compare the interannual variability of beef production (kg/ha) and net returns ($/ha) over the past 15 years (2003–2017) from grazing yearlings at three different grazing intensities (light, moderate and heavy) on semiarid shortgrass steppe from mid-May to October. Four useful insights emerged: 1) A ranking of interannual variability, from lowest to highest, reveals that beef production had the lowest coefficient of variation (CV = 17–29%), followed by aboveground net primary production (ANPP, 26–32%), spring/early summer precipitation (36%) and net revenue (107–139%). 2) Beef production increased with grazing intensity during average and wet years, but not during dry years. Beef production increased from early August to early September but became negligible from early September to the end of the grazing season. Overall, beef production and net revenue were 41% and 38% greater for the heavy grazing intensity compared to the recommended moderate grazing intensity, respectively. 3) Removing yearlings from pastures in early September rather than the traditional October timing would provide opportunities for ranchers to increase net returns. 4) Forage production, estimated through remote sensing information, was positively associated with beef production, but with a steeper slope for the heavy grazing intensity, indicating greater sensitivity at this grazing intensity level. Economic sustainability of beef production in this rangeland ecosystem is challenged by high interannual variability in net revenues. This variability suggests that ranchers should focus on understanding agricultural economic principles, livestock marketing, and available options for reducing price risk. These efforts would enhance both the economic sustainability of individual ranching operations and rural economies.*

Isaak, D. J., Luce, C. H., Horan, D. L., Chandler, G. L., Wollrab, S. P., & Nagel, D. E. (2018). Global Warming of Salmon and Trout Rivers in the Northwestern U.S.: Road to Ruin or Path Through Purgatory? *Transactions of the American Fisheries Society, 147*(3), 566-587. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046338149&doi=10.1002%2ftafs.10059&partnerID=40&md5=1b0a73bf21246b8211eed185909b0e01. doi:10.1002/tafs.10059
Research Tags: Water, Wildlife
Abstract: *Large rivers constitute small portions of drainage networks but provide important migratory habitats*

and fisheries for salmon and trout when and where temperatures are sufficiently cold. Management and conservation of coldwater fishes in the current era of rapid climate change require knowing how riverine thermal environments are evolving and the potential for detrimental biological impacts. Robust estimates of warming rates, however, are lacking due to limited long-term temperature monitoring, so we compiled the best available multidecadal records and estimated trends at 391 sites in the 56,500-km river network of the northwestern USA. Warming trends were prevalent during summer and early fall months in recent 20- and 40-year periods (0.18–0.35°C per decade during 1996–2015 and 0.14–0.27°C per decade during 1976–2015), paralleled air temperature trends, and were mediated by discharge trends at regional and local levels. To illustrate the biological consequences of warming later in this century, trend estimates were used to inform selection of river temperature scenarios and assess changes in thermal exposure of adult Sockeye Salmon Oncorhynchus nerka migrating to four population areas as well as thermal habitat shifts for resident Brown Trout Salmo trutta and Rainbow Trout O. mykiss populations throughout the region. Future warming of 1–3°C would increase Sockeye Salmon exposure by 5–16% (3–143 degree-days) and reduce thermally suitable riverine trout habitats by 8–31% while causing their upstream shift. Effects of those changes on population persistence and fisheries are likely to be context dependent, and strategic habitat restoration or adaptation strategies could ameliorate some biological impairments, but effectiveness will be tempered by the size of rivers, high costs, and pervasiveness of thermal effects. Most salmon and trout rivers will continue to provide suitable habitats for the foreseeable future, but it also appears inevitable that some river reaches will gradually become too warm to provide traditional habitats.

Isaak, D. J., Wenger, S. J., Peterson, E. E., Ver Hoef, J. M., Nagel, D. E., Luce, C. H., . . . Parkes-Payne, S. (2017). The NorWeST Summer Stream Temperature Model and Scenarios for the Western U.S.: A Crowd-Sourced Database and New Geospatial Tools Foster a User Community and Predict Broad Climate Warming of Rivers and Streams. *Water Resources Research, 53*(11), 9181-9205. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033780438&doi=10.1002%2f2017WR020969&partnerID=40&md5=9c4c04e0d601969428d5e0083fa3d448. doi:10.1002/2017WR020969
Research Tags: Weather
Abstract: *Thermal regimes are fundamental determinants of aquatic ecosystems, which makes description and prediction of temperatures critical during a period of rapid global change. The advent of inexpensive temperature sensors dramatically increased monitoring in recent decades, and although most monitoring is done by individuals for agency-specific purposes, collectively these efforts constitute a massive distributed sensing array that generates an untapped wealth of data. Using the framework provided by the National Hydrography Dataset, we organized temperature records from dozens of agencies in the western U.S. to create the NorWeST database that hosts >220,000,000 temperature recordings from >22,700 stream and river sites. Spatial-stream-network models were fit to a subset of those data that described mean August water temperatures (AugTw) during 63,641 monitoring site-years to develop accurate temperature models (r2 = 0.91; RMSPE = 1.10°C; MAPE = 0.72°C), assess covariate effects, and make predictions at 1 km intervals to create summer climate scenarios. AugTw averaged 14.2°C (SD = 4.0°C) during the baseline period of 1993–2011 in 343,000 km of western perennial streams but trend reconstructions also indicated warming had occurred at the rate of 0.17°C/decade (SD = 0.067°C/decade) during the 40 year period of 1976–2015. Future scenarios suggest continued warming, although variation will occur within and among river networks due to differences in local climate forcing and stream responsiveness. NorWeST scenarios and data are available online in user-friendly digital formats and are widely used to coordinate monitoring efforts among agencies, for new research, and for conservation planning.*

Isaak, D. J., Wenger, S. J., & Young, M. K. (2017). Big biology meets microclimatology: Defining thermal niches of ectotherms at landscape scales for conservation planning. *Ecological Applications, 27*(3), 977-990. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017173736&doi=10.1002%2feap.1501&partnerID=40&md5=ea1803d9ddbb1ba5f94de3a02c0efa4b. doi:10.1002/eap.1501
Research Tags: Weather
Abstract: *Temperature profoundly affects ecology, a fact ever more evident as the ability to measure thermal environments increases and global changes alter these environments. The spatial structure of thermalscapes is*

especially relevant to the distribution and abundance of ectothermic organisms, but the ability to describe biothermal relationships at extents and grains relevant to conservation planning has been limited by small or sparse data sets. Here, we combine a large occurrence database of >23 000 aquatic species surveys with stream microclimate scenarios supported by an equally large temperature database for a 149 000-km mountain stream network to describe thermal relationships for 14 fish and amphibian species. Species occurrence probabilities peaked across a wide range of temperatures (7.0–18.8°C) but distinct warm- or cold-edge distribution boundaries were apparent for all species and represented environments where populations may be most sensitive to thermal changes. Warm-edge boundary temperatures for a native species of conservation concern were used with geospatial data sets and a habitat occupancy model to highlight subsets of the network where conservation measures could benefit local populations by maintaining cool temperatures. Linking that strategic approach to local estimates of habitat impairment remains a key challenge but is also an opportunity to build relationships and develop synergies between the research, management, and regulatory communities. As with any data mining or species distribution modeling exercise, care is required in analysis and interpretation of results, but the use of large biological data sets with accurate microclimate scenarios can provide valuable information about the thermal ecology of many ectotherms and a spatially explicit way of guiding conservation investments.

Iseyemi, O., Farris, J. L., Moore, M. T., Green, V. S., Locke, M. A., & Choi, S. E. (2019). Characterizing organic carbon storage in experimental agricultural ditch systems in northeast Arkansas. *Soil Science Society of America Journal, 83*(3), 751-760. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069177338&doi=10.2136%2fsssaj2018.10.0370&partnerID=40&md5=fa16e87cb2b83a7d0c387898fd15ade6. doi:10.2136/sssaj2018.10.0370

Research Tags: Soil, Crops, Water

Abstract: *Agricultural ditches are capable of many ecological functions, including flood control and edge of field nutrient filtration. This study investigated the potential for carbon sequestration within mowed and unmowed experimental conventional and controlled (with weirs) agricultural drainage ditches. The study analyzed and compared spatial and temporal variation in soil organic carbon (OC) concentration (g C kg−1) and OC pool (kg C m–2) within a 3-cm soil depth between treatments. Soil OC concentrations were quantified through combustion of organic matter (OM) at 400°C in a muffle furnace for 16 h using the loss on ignition (LOI) method. Soil bulk density was also determined for each ditch treatment. In both summer and winter, mean soil C concentration in ditches with weirs was similar to mean soil C concentration in ditches with no weirs (16.68 ± 0.49 vs. 16.47 ± 0.46 g C kg–1 in summer; 14.47 ± 0.75 vs. 16.27 ± 0.72 g C kg–1 in winter). Similar bulk densities (0.67 Mg m–3, on average) and OC contents in ditches furnished comparable C pools in ditches with weirs and no weirs respectively (28.08 ± 0.75 vs. 27.88 ± 0.68 kg C m–2 in summer; 26.44 ± 1.56 vs. 30.24 ± 1.40 g C kg–1 in winter). The studied drainage ditches can therefore be considered for their contributions to the C sink, given the high values of C pool observed in the ditch treatments. This suggests agricultural drainage ditches can offer a suitable environment for C sequestration.*

Ivan, J. S., Seglund, A. E., Truex, R. L., & Newkirk, E. S. (2018). Mammalian responses to changed forest conditions resulting from bark beetle outbreaks in the southern Rocky Mountains. *Ecosphere, 9*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054075280&doi=10.1002%2fecs2.2369&partnerID=40&md5=4d9bd59cd4e59019efffb487b085b86a. doi:10.1002/ecs2.2369

Research Tags: Wildlife, Forestry

Abstract: *Spruce beetle (Dendroctonus rufipennis) and mountain pine beetle (Dendroctonus ponderosae) outbreaks have impacted millions of acres of conifer forest from Alaska to northern Mexico. These species are native to North America, and periodic outbreaks have shaped the structure and composition of conifer forests for millennia. However, the extent and severity of current outbreaks, fueled by favorable climatic conditions and increased susceptibility of forests, are unmatched in recorded history. To characterize the response of a suite of mammalian species to beetle-induced changes in vegetation in the southern Rocky Mountains, we deployed cameras at 300 randomly selected sites during summer 2013–2014. Selected sites spanned gradients of years elapsed since bark beetle outbreaks (YSO) and severity. We fit single-season occupancy models to detection/non-detection data collected for each species to examine a variety of plausible relationships between use of a given stand and YSO, severity, or both. Ungulates exhibited a positive association with bark beetle*

activity, although the nature of these associations varied by species. Elk (Cervus canadensis) were positively associated with severity, but not YSO; mule deer (Odocoileus hemionus) exhibited the opposite relationship. Moose (Alces alces) responded in a quadratic fashion; use of forest stands adjacent to preferred willow habitat peaked 3–7 yr after an outbreak commenced, but only at high severity. Similarly, yellow-bellied marmot use of impacted stands adjacent to rock outcroppings followed a quadratic trend, but only at high severity. Red squirrel (Tamiasciurus hudsonicus) use declined in severely impacted stands, likely as a response to diminished cone crops. Golden-mantled ground squirrels (Callospermophilus lateralis) and chipmunks (Neotamias spp.) exhibited a shallow negative relationship with YSO, as did coyotes (Canis latrans). Contrary to our hypotheses, black bears (Ursus americanus), American marten (Martes americana), snowshoe hares (Lepus americanus), and porcupines (Erethizon dorsatum) did not appear to be substantially influenced by beetle activity. Red fox (Vulpes vulpes) use was positively associated with YSO, but overall use declined as severity increased. Note that changes in probability of use described here could reflect changes in abundance, home range size, habitat use, or some combination, and in several cases, there was considerable uncertainty across competing models.

Iverson, L. R., Peters, M. P., Bartig, J. L., Rebbeck, J., Hutchinson, T. F., Matthews, S. N., & Stout, S. (2018). Spatial modeling and inventories for prioritizing investment into oak-hickory restoration. *Forest Ecology and Management, 424*, 355-366. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047078167&doi=10.1016%2fj.foreco.2018.05.018&partnerID=40&md5=1c95b5508fc8207e35fab512586e89e6. doi:10.1016/j.foreco.2018.05.018

Research Tags: Forestry

Abstract: *Oak (Quercus spp.) and hickory (Carya spp.) forests in the eastern United States provide a host of ecosystem services as their mast are prized by wildlife, the timber is a valued commodity, and they are generally more tolerant of extreme weather events under a changing climate. They are, however, undergoing a severe decline in prominence throughout the region, yielding to more mesic and shade-tolerant species, largely red maple (Acer rubrum). Two decades of research in Ohio have shown that silviculture and/or natural disturbances that reduce understory shade during seedling establishment and early growth, followed by canopy opening and competition management through prescribed fire and partial cutting, can encourage oak and hickory regeneration, most successfully on drier ridges and south- and southwest-facing slopes. We employed an ecological classification and mapping approach to prioritize areas across a 17-county region (~22,000 km2) that may be more receptive, and thus more cost effective, to successful oak regeneration following silvicultural treatment. The ecomapping effort was comprised of two parts; a GIS model of the terrain, and a stand inventory of current vegetation condition coupled with the SILVAH decision-support system to recommend needed silvicultural treatments. The GIS model is based primarily on topography as vegetation patterns in the project area are largely driven by landscape position and soil moisture regimes. It uses transformed aspect, slope angle, topographic position index, and slope position as inputs to define six classes of landtype phases: ridge, southwest upper slopes, southwest lower slopes, northeast upper slopes, northeast lower slopes, and bottomland. The first three and following two classes, respectively, were hierarchically nested to form Dry Oak Forest and Dry-mesic Mixed Oak Hardwood Forest classes at the landtype level. Dry Oak Forests require the least silvicultural intervention to sustain or restore oak, while the other two landtypes normally require serious intervention to sustain oak into the future. To determine whether sufficient stocking is present for adequate regeneration, we use forest inventory data to represent current vegetation conditions including both overstory and understory stocking. Overall, these tools allow managers to identify 'zones of investment', i.e., those stands with the bulk of the area in the Dry Oak Forest landtype and with some level of advance oak regeneration, which will have a greater likelihood of growing into oak-dominated stands with minimal investment of scarce funding resources.*

Iverson, L. R., Peters, M. P., Prasad, A. M., & Matthews, S. N. (2019). Analysis of climate change impacts on tree species of the eastern US: Results of DISTRIB-II modeling. *Forests, 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065884872&doi=10.3390%2ff10040302&partnerID=40&md5=20110e5478f6e8298dae882e9b410938. doi:10.3390/f10040302

Research Tags: Forestry

Abstract: *Forests across the globe are faced with a rapidly changing climate and an enhanced understanding of how these changing conditions may impact these vital resources is needed. Our approach is to use*

DISTRIB-II, an updated version of the Random Forest DISTRIB model, to model 125 tree species individually from the eastern United States to quantify potential current and future habitat responses under two Representative Concentration Pathways (RCP 8.5 -high emissions which is our current trajectory and RCP 4.5 -lower emissions by implementing energy conservation) and three climate models. Climate change could have large impacts on suitable habitat for tree species in the eastern United States, especially under a high emissions trajectory. On average, of the 125 species, approximately 88 species would gain and 26 species would lose at least 10% of their suitable habitat. The projected change in the center of gravity for each species distribution (i.e., mean center) between current and future habitat moves generally northeast, with 81 species habitat centers potentially moving over 100 km under RCP 8.5. Collectively, our results suggest that many species will experience less pressure in tracking their suitable habitats under a path of lower greenhouse gas emissions.

Iverson, L. R., Thompson, F. R., Matthews, S., Peters, M., Prasad, A., Dijak, W. D., . . . Swanston, C. (2017). Multi-model comparison on the effects of climate change on tree species in the eastern U.S.: results from an enhanced niche model and process-based ecosystem and landscape models. *Landscape Ecology, 32*(7), 1327-1346. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84975253325&doi=10.1007%2fs10980-016-0404-8&partnerID=40&md5=6490606b173fd5b33a3203f4e1b9ecda. doi:10.1007/s10980-016-0404-8

Research Tags:

Abstract: Context

Species distribution models (SDM) establish statistical relationships between the current distribution of species and key attributes whereas process-based models simulate ecosystem and tree species dynamics based on representations of physical and biological processes. TreeAtlas, which uses DISTRIB SDM, and Linkages and LANDIS PRO, process-based ecosystem and landscape models, respectively, were used concurrently on four regional climate change assessments in the eastern Unites States.

Objectives

We compared predictions for 30 species from TreeAtlas, Linkages, and LANDIS PRO, using two climate change scenarios on four regions, to derive a more robust assessment of species change in response to climate change.

Methods

We calculated the ratio of future importance or biomass to current for each species, then compared agreement among models by species, region, and climate scenario using change classes, an ordinal agreement score, spearman rank correlations, and model averaged change ratios.

Results

Comparisons indicated high agreement for many species, especially northern species modeled to lose habitat. TreeAtlas and Linkages agreed the most but each also agreed with many species outputs from LANDIS PRO, particularly when succession within LANDIS PRO was simulated to 2300. A geographic analysis showed that a simple difference (in latitude degrees) of the weighted mean center of a species distribution versus the geographic center of the region of interest provides an initial estimate for the species' potential to gain, lose, or remain stable under climate change.

Conclusions

This analysis of multiple models provides a useful approach to compare among disparate models and a more consistent interpretation of the future for use in vulnerability assessments and adaptation planning.

Jackson, J. M., Pimsler, M. L., Oyen, K. J., Koch-Uhuad, J. B., Herndon, J. D., Strange, J. P., . . . Lozier, J. D. (2018). Distance, elevation and environment as drivers of diversity and divergence in bumble bees across latitude and altitude. *Molecular Ecology, 27*(14), 2926-2942. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049781197&doi=10.1111%2fmec.14735&partnerID=40&md5=a7a017ee5d6181fc0f6e229ff6c6af2a. doi:10.1111/mec.14735

Research Tags: Wildlife

Abstract: *Identifying drivers of dispersal limitation and genetic differentiation is a key goal in biogeography. We examine patterns of population connectivity and genetic diversity using restriction site-associated DNA sequencing (RADseq) in two bumble bee species, Bombus vosnesenskii and Bombus bifarius, across latitude and altitude in mountain ranges from California, Oregon and Washington, U.S.A. Bombus vosnesenskii, which occurs across a broader elevational range at most latitudes, exhibits little population structure while B. bifarius,* *which occupies a relatively narrow higher elevation niche across most latitudes, exhibits much stronger population differentiation, although gene flow in both species is best explained by isolation with environmental niche resistance. A relationship between elevational habitat breadth and genetic diversity is also apparent, with B. vosnesenskii exhibiting relatively consistent levels of genetic diversity across its range, while B. bifarius has reduced genetic diversity at low latitudes, where it is restricted to high-elevation habitat. The results of this study highlight the importance of the intersect between elevational range and habitat suitability in influencing population connectivity and suggest that future climate warming will have a fragmenting effect even on populations that are presently well connected, as they track their thermal niches upward in montane systems.*

Jacobs, K. R. (2017). Teams at their core: Implementing an "All Lands Approach to Conservation" requires focusing on relationships, teamwork process, and communications. *Forests, 8*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026265453&doi=10.3390%2ff8070246&partnerID=40&md5=85b81a6251bbf59392e3566611cfad65. doi:10.3390/f8070246
Research Tags: Research
Abstract: *The U.S. Forest Service has found itself in an era of intense human activity, a changing climate; development and loss of open space; resource consumption; and problematic introduced species; and diversity in core beliefs and values. These challenges test our task-relevant maturity and the ability and willingness to meet the growing demands for services. The Forest Service is now on a transformative campaign to improve abilities and meet these challenges. The "All-Lands Approach to Conservation" brings agencies, organizations, landowners and stakeholders together across boundaries to decide on common goals for the landscapes they share. This approach is part of a larger transformation occurring in the American Conservation Movement where large-scale conservation partnerships possibly define the fourth or contemporary era. The intent of this communication is to present one perspective of what large-scale conservation partnerships should include, namely an emphasis on rethinking what leadership looks like in a collaborative context, relational governance, cooperative teamwork procedures, and communications.*

Jaeger, W. K., Amos, A., Bigelow, D. P., Chang, H., Conklin, D. R., Haggerty, R., . . . Turner, D. P. (2017). Finding water scarcity amid abundance using human–natural system models. *Proceedings of the National Academy of Sciences of the United States of America, 114*(45), 11884-11889. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033782969&doi=10.1073%2fpnas.1706847114&partnerID=40&md5=e280bf3cf74378b72b9bef4464c86df3. doi:10.1073/pnas.1706847114
Research Tags: Water
Abstract: *Water scarcity afflicts societies worldwide. Anticipating water shortages is vital because of water's indispensable role in social-ecological systems. But the challenge is daunting due to heterogeneity, feedbacks, and water's spatial-temporal sequencing throughout such systems. Regional system models with sufficient detail can help address this challenge. In our study, a detailed coupled human–natural system model of one such region identifies how climate change and socioeconomic growth will alter the availability and use of water in coming decades. Results demonstrate how water scarcity varies greatly across small distances and brief time periods, even in basins where water may be relatively abundant overall. Some of these results were unexpected and may appear counterintuitive to some observers. Key determinants of water scarcity are found to be the cost of transporting and storing water, society's institutions that circumscribe human choices, and the opportunity cost of water when alternative uses compete.*

Jahn, A. E., Lerman, S. B., Phillips, L. M., Ryder, T. B., & Williams, E. J. (2019). First tracking of individual American Robins (Turdus migratorius) across seasons. *Wilson Journal of Ornithology, 131*(2), 356-359. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067882678&doi=10.1676%2f18-124&partnerID=40&md5=467c5cefecb35bcaf803dd9c8c1cba7f. doi:10.1676/18-124
Research Tags: Wildlife
Abstract: *The American Robin (Turdus migratorius) is one of the most widespread, common bird species in North America; yet, very little is known about its migratory connectivity, migration timing, and migratory routes. Using archival GPS tags, we tracked the movements of 7 individual robins from 3 breeding populations in the United States. Four robins captured in Denali National Park and Preserve, Alaska, overwintered in Texas, Nebraska, Oklahoma, and Montana, up to 4,500 km from the capture location. One robin captured in Amherst,*

Massachusetts, overwintered in South Carolina 1,210 km from the capture location, whereas 2 robins captured in Washington, D.C., spent the entire year within 6 km of their original capture location. Understanding the annual cycle and differences in migration strategies for a species that exhibits large regional variation in movement has the potential to provide novel insights into how conspecific populations respond to current and future heterogeneity in climate and habitat. The regionspecific patterns presented here suggest robins could serve as sentinels of environmental change at a continental scale.

Jamieson, M. A., Burkle, L. A., Manson, J. S., Runyon, J. B., Trowbridge, A. M., & Zientek, J. (2017). Global change effects on plant–insect interactions: the role of phytochemistry. *Current Opinion in Insect Science, 23*, 70-80. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027585577&doi=10.1016%2fj.cois.2017.07.009&partnerID=40&md5=f12f3062bd39203e41d1db86be8d231e. doi:10.1016/j.cois.2017.07.009
Research Tags: Wildlife
Abstract: *Natural and managed ecosystems are undergoing rapid environmental change due to a growing human population and associated increases in industrial and agricultural activity. Global environmental change directly and indirectly impacts insect herbivores and pollinators. In this review, we highlight recent research examining how environmental change factors affect plant chemistry and, in turn, ecological interactions among plants, herbivores, and pollinators. Recent studies reveal the complex nature of understanding global change effects on plant secondary metabolites and plant–insect interactions. Nonetheless, these studies indicate that phytochemistry mediates insect responses to environmental change. Future research on the chemical ecology of plant–insect interactions will provide critical insight into the ecological effects of climate change and other anthropogenic disturbances. We recommend greater attention to investigations examining interactive effects of multiple environmental change factors in addition to chemically mediated plant–pollinator interactions, given limited research in these areas.*

Janowiak, M. K., Iverson, L. R., Fosgitt, J., Handler, S. D., Dallman, M., Thomasma, S., . . . Swanston, C. W. (2017). Assessing stand-level climate change risk using forest inventory data and species distribution models. *Journal of Forestry, 115*(3), 222-229. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019498134&doi=10.5849%2fjof.2016-023R1&partnerID=40&md5=1b2e443b283ee156eeca3a0e5e1b5eeb. doi:10.5849/jof.2016-023R1
Research Tags: Forestry
Abstract: *Climate change is having important effects on forest ecosystems, presenting a challenge for natural resource professionals to reduce climate-associated impacts while still achieving diverse management objectives. Regional projections of climate change and forest response are becoming more readily available, but managers are still searching for practical ways to apply this information. We propose that commonly collected forest inventory data be used in conjunction with species distribution models to better understand the potential response of forests to climate change and inform management at the site level. In this article, we propose a new climate risk metric that incorporates stand-level forest inventory data with projections of tree species habitat from the Climate Change Tree Atlas. This climate risk metric can serve as a starting point for managers to consider how forests may be altered by climate change. We also describe two examples of how this metric was used in real-world management situations.*
Management and Policy Implications The forests of today, and the ecosystem services they provide, will continue to undergo changes as a result of direct (e.g., temperature and precipitation) and indirect (e.g., pests and pathogens) effects of climate change. Forest and natural resource managers are increasingly looking for actions that enhance forest resilience and improve the ability of forests to adapt. By integrating climate change information into existing forest inventory data sets and protocols, managers will be better able to make science-based decisions regarding possible interventions for climate change adaptation. The combined consideration of management goals, landscape context, site conditions, and climate change vulnerability under different scenarios of climate change will help identify opportunities to suit a range of management needs. These opportunities could range widely depending on management goals and constraints, such as protecting species through climate refugia, promoting diversity to reduce risk, or facilitating changes in species composition via corridor promotion or assisted migration.

Jaradat, A. A. (2017). Agriculture in the Fertile Crescent: Continuity and change under climate change. *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 12*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035198504&doi=10.1079%2fPAVSNNR201712034&partnerID=40&md5=b612a97a7d44d5ab1a501f85793e4ba0. doi:10.1079/PAVSNNR201712034

Research Tags: Crops

Abstract: *The Fertile Crescent in Southwest Asia is a highly biodiverse region where most of the world temperate-zone agricultural cereal, legume, oil, and forage crops; fruit trees; and vegetables originated and were first domesticated. A favorable environment, a special plant community, and an adaptive population combined to initiate the transition from hunter-gatherer to agriculture and food production. Early farmers in the Fertile Crescent, for centuries, pioneered solutions to the management problems of prosperous agricultural societies. However, over time, the region became the largest water and food deficient part of the world due to environmental and demographic factors. Possible reorientation of agriculture in the Fertile Crescent, although very important but not a small challenge, will shape the welfare of its people for generations. This also may serve as a living example for other parts of the developing world in order to develop and implement solutions to emerging agricultural challenges.*

Jaradat, A. A. (2018). Simulated climate change deferentially impacts phenotypic plasticity and stoichiometric homeostasis in major food crops. *Emirates Journal of Food and Agriculture, 30*(6), 429-442. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052131941&doi=10.9755%2fejfa.2018.v30.i6.1705&partnerID=40&md5=3474a0677d0ece40708f5f1f96cccf32. doi:10.9755/ejfa.2018.v30.i6.1705

Research Tags: Crops

Abstract: *Grain yield and product quality responses of major food crops to variation in resource availability continue to be important considerations in agronomic research, particularly under abiotic stresses. Indices of grain quality and phenotypic plasticity of crop cultivars with C3 or C4 metabolic pathways and producing seed with either carbohydrate, protein, oil; or a combination of carbohydrate-protein or oil-protein as their major product, were quantified for six years under two phases of single and multiple abiotic stresses. Decreasing resource availability caused by short growing season and high population density, singly or in combination, resulted in significant changes in allometric relationships among most traits under study. Temporal quantitative and qualitative differences between "heatmaps" of stress phases, partitioning and analysis of total variance due to fixed and random factors, and functional relationship at hierarchical levels of organization, indicated a shift over time of phenotypic plasticity and quality indices. Moreover, relationships of phenotypic plasticity and quality index with biomass, grain yield, macro- and micronutrients, and nutrient ratios were largely modulated by differences between crop products within metabolic pathways. However, further research is needed for in-depth understanding and insights into the interdependencies of the large number of traits that crop plants should optimize to produce economic yield combined with adequate nutritional quality under abiotic stress.*

Jaradat, A. A. (2018). Statistical modeling of phenotypic plasticity under abiotic stress in triticum durum l. And triticum aestivum l. Genotypes. *Agronomy, 8*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051867094&doi=10.3390%2fagronomy8080139&partnerID=40&md5=c73cf64d54f1671f509f06a14a0ff7b6. doi:10.3390/agronomy8080139

Research Tags: Crops

Abstract: *Future challenges to the role of durum and bread wheat in global food security will be shaped by their potential to produce larger yields and better nutritional quality, while increasingly adapting to multiple biotic and abiotic stresses in the view of global climate change. There is a dearth of information on comparative assessment of phenotypic plasticity in both wheat species under long-term multiple abiotic stresses. Phenotypic plasticities of two durum and bread wheat genotypes were assessed under increasing abiotic and edaphic stresses for six years. Combinations of normal and reduced length of growing season and population density, with or without rotation, generated increasing levels of competition for resources and impacted phenotypic plasticity of several plant and yield attributes, including protein and micronutrients contents. All the phenotypic plasticity (PPs) estimates, except for the C:N ratio in both genotypes and grain protein content in T. aestivum genotype, were impacted by abiotic stresses during the second stress phase (PS II) compared with the first (PS I); whereas, covariate effects were limited to a few PPs (e.g., biomass, population density, fertile tillers, grain yield,*

and grain protein content). Discrimination between factor levels decreased from abiotic phases > growth stages > stress treatments and provided selection criteria of trait combinations that can be positively resilient under abiotic stress (e.g., spike harvest and fertility indices combined with biomass and grain yield in both genotypes). Validation and confirmatory factor models and multiway cluster analyses revealed major differences in phenotypic plasticities between wheat genotypes that can be attributed to differences in ploidy level, length of domestication history, or constitutive differences in resources allocation. Discriminant analyses helped to identify genotypic differences or similarities in the level of trait decoupling in relation to the strength of their correlation and heritability estimates. This information is useful in targeted improvement of traits directly contributing to micronutrient densities, yield components, and yield. New wheat ideotype(s) can be designed for larger grain yield potential under abiotic stress by manipulating yield components that affect kernels m^{-2} *(e.g., number of tillers, number of florets per spikelet, and eventually spike fertility and harvest indices) without impacting nutrient densities and kernel weight, thus raising harvest index beyond its current maximum.*

Jayawardena, D. M., Heckathorn, S. A., Bista, D. R., & Boldt, J. K. (2019). Elevated carbon dioxide plus chronic warming causes dramatic increases in leaf angle in tomato, which correlates with reduced plant growth. *Plant Cell and Environment, 42*(4), 1247-1256. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060185829&doi=10.1111%2fpce.13489&partnerID=40&md5=7d96321203fb84aecdde87ddb2e9924e. doi:10.1111/pce.13489

Research Tags: Weather, Crops

Abstract: *Limited evidence indicates that moderate leaf hyponasty can be induced by high temperatures or unnaturally high* CO_2*. Here, we report that the combination of warming plus elevated* CO_2 *(*eCO_2*) induces severe leaf hyponasty in tomato (Solanum lycopersicum L.). To characterize this phenomenon, tomato plants were grown at two levels of* CO_2 *(400 vs. 700 ppm) and two temperature regimes (30 vs. 37°C) for 16–18 days. Leaf hyponasty increased dramatically with warming plus* eCO_2 *but increased only slightly with either factor alone and was slowly reversible upon transfer to control treatments. Increases in leaf angle were not correlated with leaf temperature, leaf water stress, or heat-related damage to photosynthesis. However, steeper leaf angles were correlated with decreases in leaf area and biomass, which could be explained by decreased light interception and thus in situ photosynthesis, as leaves became more vertical. Petiole hyponasty and leaf-blade cupping were also observed with warming +* eCO_2 *in marigold and soybean, respectively, which are compound-leaved species like tomato, but no such hyponasty was observed in sunflower and okra, which have simple leaves. If severe leaf hyponasty is common under* eCO_2 *and warming, then this may have serious consequences for food production in the future.*

Jayawardena, D. M., Heckathorn, S. A., Bista, D. R., Mishra, S., Boldt, J. K., & Krause, C. R. (2017). Elevated CO<inf>2</inf> plus chronic warming reduce nitrogen uptake and levels or activities of nitrogen-uptake and -assimilatory proteins in tomato roots. *Physiologia Plantarum, 159*(3), 354-365. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013057119&doi=10.1111%2fppl.12532&partnerID=40&md5=21b4e7f43e2b32fdc564dd46fded3f4a. doi:10.1111/ppl.12532

Research Tags: Weather, Crops

Abstract: *Atmospheric* CO_2 *enrichment is expected to often benefit plant growth, despite causing global warming and nitrogen (N) dilution in plants. Most plants primarily procure N as inorganic nitrate (*NO_3^-*) or ammonium (*NH_4^+*), using membrane-localized transport proteins in roots, which are key targets for improving N use. Although interactive effects of elevated* CO_2*, chronic warming and N form on N relations are expected, these have not been studied. In this study, tomato (Solanum lycopersicum) plants were grown at two levels of* CO_2 *(400 or 700 ppm) and two temperature regimes (30 or 37°C), with* NO_3^- *or* NH_4^+ *as the N source. Elevated* CO_2 *plus chronic warming severely inhibited plant growth, regardless of N form, while individually they had smaller effects on growth. Although %N in roots was similar among all treatments, elevated* CO_2 *plus warming decreased (1) N-uptake rate by roots, (2) total protein concentration in roots, indicating an inhibition of N assimilation and (3) shoot %N, indicating a potential inhibition of N translocation from roots to shoots. Under elevated* CO_2 *plus warming, reduced* NO_3^-*-uptake rate per g root was correlated with a decrease in the concentration of* NO_3^-*-uptake proteins per g root, reduced* NH_4^+ *uptake was correlated with decreased activity of* NH_4^+*-uptake proteins and reduced N assimilation was correlated with decreased concentration of N-assimilatory proteins. These results indicate that elevated* CO_2 *and chronic warming can act synergistically*

to decrease plant N uptake and assimilation; hence, future global warming may decrease both plant growth and food quality (%N).

Jennings, M. D., & Harris, G. M. (2017). Climate change and ecosystem composition across large landscapes. *Landscape Ecology, 32*(1), 195-207. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84983490399&doi=10.1007%2fs10980-016-0435-1&partnerID=40&md5=a0cb653070ddb8167add888796d9f42c. doi:10.1007/s10980-016-0435-1
Research Tags: Research
Abstract: Context
Climate change alters the vegetation composition and functioning of ecosystems. Measuring the magnitude, direction, and rate of changes in vegetation composition induced by climate remains a serious and unmet challenge. Such information is required for a predictive capability of how individual ecosystem will respond to future climates.
Objectives
Our objectives were to identify the relationships between 20 climate variables and 39 ecosystems across the southwestern USA. We sought to understand the magnitude of relationships between variation in vegetation composition and bioclimatic variables as well as the amount of ecosystem area expected to be affected by future climate changes.
Methods
Bioclimatic variables best explaining the plant species composition of each ecosystem were identified. The strength of relationships between beta turnover and bioclimate gradients was calculated, the spatial concordance of ecosystem and bioclimate configurations was shown, and the area of suitable climate remaining within the boundaries of contemporary ecosystems under future climate projections was measured.
Results
Across the southwestern USA, four climate variables account for most of the climate related variation in vegetation composition. Twelve ecosystems are highly sensitive to climate change. By 2070, two ecosystems lose about 4000 (15 %) and 7000 (31 %) km2 of suitable climate area within their current boundaries (the Western Great Plains Sandhill Steppe and Sonora-Mojave Creosotebush-White Bursage Desert Scrub ecosystems, respectively). The climatic areas of riparian ecosystems are expected to be reduced by half.
Conclusions
Results provide specific climate and vegetation parameters for anticipating how, where and when ecosystem vegetation transforms with climate change. Projecting the loss of suitable climate for the vegetation composition of ecosystems is important for assessing ecosystem threats from climate change and for setting priorities for ecosystem conservation and restoration across the southwestern USA.

Jennings, M. D., & Harris, G. M. (2018). Correction to: Climate change and ecosystem composition across large landscapes (Landscape Ecology, (2017), 32, 1, (195-207), 10.1007/s10980-016-0435-1). *Landscape Ecology, 33*(5), 845. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044089781&doi=10.1007%2fs10980-018-0633-0&partnerID=40&md5=c16f720301726fe7f522a90152c23105. doi:10.1007/s10980-018-0633-0
Research Tags: Research
No Abstract:

Jensen, D., Reager, J. T., Zajic, B., Rousseau, N., Rodell, M., & Hinkley, E. (2018). The sensitivity of US wildfire occurrence to pre-season soil moisture conditions across ecosystems. *Environmental Research Letters, 13*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041242412&doi=10.1088%2f1748-9326%2faa9853&partnerID=40&md5=c7e755fa955820131f92f80113537186. doi:10.1088/1748-9326/aa9853
Research Tags: Soil, Weather
Abstract: *It is generally accepted that year-to-year variability in moisture conditions and drought are linked with increased wildfire occurrence. However, quantifying the sensitivity of wildfire to surface moisture state at seasonal lead-times has been challenging due to the absence of a long soil moisture record with the appropriate coverage and spatial resolution for continental-scale analysis. Here we apply model simulations of*

surface soil moisture that numerically assimilate observations from NASA's Gravity Recovery and Climate Experiment (GRACE) mission with the USDA Forest Service's historical Fire-Occurrence Database over the contiguous United States. We quantify the relationships between pre-fire-season soil moisture and subsequent-year wildfire occurrence by land-cover type and produce annual probable wildfire occurrence and burned area maps at 0.25 degree resolution. Cross-validated results generally indicate a higher occurrence of smaller fires when months preceding fire season are wet, while larger fires are more frequent when soils are dry. This is consistent with the concept of increased fuel accumulation under wet conditions in the pre-season. These results demonstrate the fundamental strength of the relationship between soil moisture and fire activity at long lead-times and are indicative of that relationship's utility for the future development of national-scale predictive capability.

Jeon, D. J., Ligaray, M., Kim, M., Kim, G., Lee, G., Pachepsky, Y. A., . . . Cho, K. H. (2019). Evaluating the influence of climate change on the fate and transport of fecal coliform bacteria using the modified SWAT model. *Science of the Total Environment, 658*, 753-762. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058818803&doi=10.1016%2fj.scitotenv.2018.12.213&partnerID=40&md5=cfec83ee8a9190ef4fe405d26d5ab64a. doi:10.1016/j.scitotenv.2018.12.213

Research Tags: Water

Abstract: *Fecal coliform bacteria (FCB) contamination of natural waters is a serious public health issue. Therefore, understanding and anticipating the fate and transport of FCB are important for reducing the risk of contracting diseases. The objective of this study was to analyze the impacts of climate change on the fate and transport of FCB. We modified both the soil and the in-stream bacteria modules in the soil and water assessment tool (SWAT) model and verified the prediction accuracy of seasonal variability of FCB loads using observations. Forty bias-correcting GCM-RCM projections were applied in the modified SWAT model to examine various future climate conditions at the end of this century (2076–2100). Lastly, we also compared the variability of FCB loads under current and future weather conditions using multi-model ensemble simulations (MMES). The modified SWAT model yielded a satisfactory performance with regard to the seasonal variability of FCB amounts in the soil and FCB loading to water bodies. The modified SWAT model presented substantial proliferation of FCB in the soil (30.1%–147.5%) due to an increase in temperature (25.1%). Also, increase in precipitation (53.3%) led to an increase in FCB loads (96.0%–115.5%) from the soil to water body. In the in-stream environment, resuspension from the stream bed was the dominant process affecting the amount of FCB in stream. Therefore, the final FCB loads increased by 71.2% because of the growing peak channel velocity and volume of water used due to an increase in precipitation. Based on the results of MMES, we concluded that the level of FCB would increase simultaneously in the soil as well as in stream by the end of this century. This study will aid in understanding the future variability of FCB loads as well as in preparing an effective management plan for FCB levels in natural waters.*

Jiang, Y., Kim, J. B., Still, C. J., Kerns, B. K., Kline, J. D., & Cunningham, P. G. (2018). Inter-comparison of multiple statistically downscaled climate datasets for the Pacific Northwest, USA. *Scientific Data, 5*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042221968&doi=10.1038%2fsdata.2018.16&partnerID=40&md5=99722f31d360c321e822e29916bbc3bd. doi:10.1038/sdata.2018.16

Research Tags: Weather

Abstract: *Statistically downscaled climate data have been widely used to explore possible impacts of climate change in various fields of study. Although many studies have focused on characterizing differences in the downscaling methods, few studies have evaluated actual downscaled datasets being distributed publicly. Spatially focusing on the Pacific Northwest, we compare five statistically downscaled climate datasets distributed publicly in the US: ClimateNA, NASA NEX-DCP30, MACAv2-METDATA, MACAv2-LIVNEH and WorldClim. We compare the downscaled projections of climate change, and the associated observational data used as training data for downscaling. We map and quantify the variability among the datasets and characterize the spatio-temporal patterns of agreement and disagreement among the datasets. Pair-wise comparisons of datasets identify the coast and high-elevation areas as areas of disagreement for temperature. For precipitation, high-elevation areas, rainshadows and the dry, eastern portion of the study area have high dissimilarity among the datasets. By spatially aggregating the variability measures into watersheds, we develop guidance for selecting datasets within the Pacific Northwest climate change impact studies.*

Jiang, Y., Kim, J. B., Trugman, A. T., Kim, Y., & Still, C. J. (2019). Linking tree physiological constraints with predictions of carbon and water fluxes at an old-growth coniferous forest. *Ecosphere, 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065020917&doi=10.1002%2fecs2.2692&partnerID=40&md5=ae2a32816a876157b66a80975f3349cd. doi:10.1002/ecs2.2692

Research Tags: Forestry

Abstract: *Old-growth coniferous forests of the Pacific Northwest are among the most productive temperate ecosystems and have the capacity to store large amounts of carbon for multiple centuries. To date, there are considerable gaps in modeling ecosystem fluxes and their responses to physiological constraints in these old-growth forests. These model shortcomings limit our ability to understand and project how the old-growth forests of the Pacific Northwest will respond to global climate change. This study applies the cohort-based Ecosystem Demography Model 2 (ED2) to the Wind River Experimental Forest (Washington, USA), a well-studied old-growth Douglas-fir–western hemlock ecosystem. ED2 is calibrated and validated using an extensive suite of forest inventory, eddy covariance, and biophysical observations. ED2 is able to reproduce observed forest composition and canopy structure, and carbon, water, and energy fluxes at the site. In the simulations, the effect of limited water supply on ecosystem carbon fluxes is mediated primarily by the forest's gross primary productivity (GPP) response, rather than its heterotrophic respiration response. The simulation indicates that stomatal conductance is mainly determined by soil moisture during periods of low vapor pressure deficit (VPD). However, when VPD is high, stomatal conductance is greatly reduced regardless of soil moisture status. During summer droughts, reduced soil moisture and increased VPD result in considerable stomatal closure and GPP reduction, which in turn decreases net carbon uptake. Cohort-based scheme integrates all canopy layers (species) that have distinct sensitivity to microclimate and respond distinctly to drought. This study is an initial first step to explore the potential importance of cohort-based model in simulating forest with complex structure, and to lay the foundation for applying cohort-based model at regional scales across the Pacific Northwest.*

Jiao, T., Williams, C. A., Ghimire, B., Masek, J., Gao, F., & Schaaf, C. (2017). Global climate forcing from albedo change caused by large-scale deforestation and reforestation: Quantification and attribution of geographic variation. *Climatic Change, 142*(3-4), 463-476. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018524044&doi=10.1007%2fs10584-017-1962-8&partnerID=40&md5=5bcbc177390ddec201cf36a15dbbca14. doi:10.1007/s10584-017-1962-8

Research Tags: Forestry, Weather

Abstract: *Large-scale deforestation and reforestation have contributed substantially to historical and contemporary global climate change in part through albedo-induced radiative forcing, with meaningful implications for forest management aiming to mitigate climate change. Associated warming or cooling varies widely across the globe due to a range of factors including forest type, snow cover, and insolation, but resulting geographic variation remains poorly described and has been largely based on model assessments. This study provides an observation-based approach to quantify local and global radiative forcings from large-scale deforestation and reforestation and further examines mechanisms that result in the spatial heterogeneity of radiative forcing. We incorporate a new spatially and temporally explicit land cover-specific albedo product derived from Moderate Resolution Imaging Spectroradiometer with a historical land use data set (Land Use Harmonization product). Spatial variation in radiative forcing was attributed to four mechanisms, including the change in snow-covered albedo, change in snow-free albedo, snow cover fraction, and incoming solar radiation. We find an albedo-only radiative forcing (RF) of −0.819 W m−2 if year 2000 forests were completely deforested and converted to croplands. Albedo RF from global reforestation of present-day croplands to recover year 1700 forests is estimated to be 0.161 W m−2. Snow-cover fraction is identified as the primary factor in determining the spatial variation of radiative forcing in winter, while the magnitude of the change in snow-free albedo is the primary factor determining variations in summertime RF. Findings reinforce the notion that, for conifers at the snowier high latitudes, albedo RF diminishes the warming from forest loss and the cooling from forest gain more so than for other forest types, latitudes, and climate settings.*

Jin, V. L., Schmer, M. R., Stewart, C. E., Sindelar, A. J., Varvel, G. E., & Wienhold, B. J. (2017). Long-term no-till and stover retention each decrease the global warming potential of irrigated continuous corn. *Global Change Biology,* *23*(7), 2848-2862. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013928072&doi=10.1111%2fgcb.13637&partnerID=40&md5=740e62c1c8500849d7a1d65e68c83dfa. doi:10.1111/gcb.13637

Research Tags: Crops, Soil, Emissions

Abstract: *Over the last 50 years, the most increase in cultivated land area globally has been due to a doubling of irrigated land. Long-term agronomic management impacts on soil organic carbon (SOC) stocks, soil greenhouse gas (GHG) emissions, and global warming potential (GWP) in irrigated systems, however, remain relatively unknown. Here, residue and tillage management effects were quantified by measuring soil nitrous oxide (N2O) and methane (CH4) fluxes and SOC changes (ΔSOC) at a long-term, irrigated continuous corn (Zea mays L.) system in eastern Nebraska, United States. Management treatments began in 2002, and measured treatments included no or high stover removal (0 or 6.8 Mg DM ha−1 yr−1, respectively) under no-till (NT) or conventional disk tillage (CT) with full irrigation (n = 4). Soil N2O and CH4 fluxes were measured for five crop-years (2011–2015), and ΔSOC was determined on an equivalent mass basis to ~30 cm soil depth. Both area- and yield-scaled soil N2O emissions were greater with stover retention compared to removal and for CT compared to NT, with no interaction between stover and tillage practices. Methane comprised <1% of total emissions, with NT being CH4 neutral and CT a CH4 source. Surface SOC decreased with stover removal and with CT after 14 years of management. When ΔSOC, soil GHG emissions, and agronomic energy usage were used to calculate system GWP, all management systems were net GHG sources. Conservation practices (NT, stover retention) each decreased system GWP compared to conventional practices (CT, stover removal), but pairing conservation practices conferred no additional mitigation benefit. Although cropping system, management equipment/timing/history, soil type, location, weather, and the depth to which ΔSOC is measured affect the GWP outcomes of irrigated systems at large, this long-term irrigated study provides valuable empirical evidence of how management decisions can impact soil GHG emissions and surface SOC stocks.*

Jin, W., He, H. S., Thompson, F. R., Wang, W. J., Fraser, J. S., Shifley, S. R., . . . Dijak, W. D. (2017). Future forest aboveground carbon dynamics in the central United States: The importance of forest demographic processes. *Scientific Reports, 7*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011878986&doi=10.1038%2fsrep41821&partnerID=40&md5=c151fac46d706d7208df46b2ba4c676d. doi:10.1038/srep41821

Research Tags: Forestry

Abstract: *The Central Hardwood Forest (CHF) in the United States is currently a major carbon sink, there are uncertainties in how long the current carbon sink will persist and if the CHF will eventually become a carbon source. We used a multi-model ensemble to investigate aboveground carbon density of the CHF from 2010 to 2300 under current climate. Simulations were done using one representative model for each of the simple, intermediate, and complex demographic approaches (ED2, LANDIS PRO, and LINKAGES, respectively). All approaches agreed that the current carbon sink would persist at least to 2100. However, carbon dynamics after current carbon sink diminishes to zero differ for different demographic modelling approaches. Both the simple and the complex demographic approaches predicted prolonged periods of relatively stable carbon densities after 2100, with minor declines, until the end of simulations in 2300. In contrast, the intermediate demographic approach predicted the CHF would become a carbon source between 2110 and 2260, followed by another carbon sink period. The disagreement between these patterns can be partly explained by differences in the capacity of models to simulate gross growth (both birth and subsequent growth) and mortality of short-lived, relatively shade-intolerant tree species.*

Jin, Z., Ainsworth, E. A., Leakey, A. D. B., & Lobell, D. B. (2018). Increasing drought and diminishing benefits of elevated carbon dioxide for soybean yields across the US Midwest. *Global Change Biology, 24*(2), e522-e533. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041296423&doi=10.1111%2fgcb.13946&partnerID=40&md5=6cc8d8d3ef6b16280472b8c1ac02ecb4. doi:10.1111/gcb.13946

Research Tags: Weather, Crops

Abstract: *Elevated atmospheric CO2 concentrations ([CO2]) are expected to increase C3 crop yield through the CO2 fertilization effect (CFE) by stimulating photosynthesis and by reducing stomatal conductance and transpiration. The latter effect is widely believed to lead to greater benefits in dry rather than wet conditions,* *although some recent experimental evidence challenges this view. Here we used a process-based crop model, the Agricultural Production Systems sIMulator (APSIM), to quantify the contemporary and future CFE on soybean in one of its primary production area of the US Midwest. APSIM accurately reproduced experimental data from the Soybean Free-Air CO2 Enrichment site showing that the CFE declined with increasing drought stress. This resulted from greater radiation use efficiency (RUE) and above-ground biomass production at elevated [CO2] that outpaced gains in transpiration efficiency (TE). Using an ensemble of eight climate model projections, we found that drought frequency in the US Midwest is projected to increase from once every 5 years currently to once every other year by 2050. In addition to directly driving yield loss, greater drought also significantly limited the benefit from rising [CO2]. This study provides a link between localized experiments and regional-scale modeling to highlight that increased drought frequency and severity pose a formidable challenge to maintaining soybean yield progress that is not offset by rising [CO2] as previously anticipated. Evaluating the relative sensitivity of RUE and TE to elevated [CO2] will be an important target for future modeling and experimental studies of climate change impacts and adaptation in C3 crops.*

Jo, I., Fei, S., Oswalt, C. M., Domke, G. M., & Phillips, R. P. (2019). Shifts in dominant tree mycorrhizal associations in response to anthropogenic impacts. *Science Advances, 5*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064755236&doi=10.1126%2fsciadv.aav6358&partnerID=40&md5=8b8f7e38c440a14158d368b452df68db. doi:10.1126/sciadv.aav6358
Research Tags: Forestry
Abstract: *Plant-fungal symbioses play critical roles in vegetation dynamics and nutrient cycling, modulating the impacts of global changes on ecosystem functioning. Here, we used forest inventory data consisting of more than 3 million trees to develop a spatially resolved "mycorrhizal tree map" of the contiguous United States. We show that abundances of the two dominant mycorrhizal tree groups—arbuscular mycorrhizal (AM) and ectomycorrhizal trees—are associated primarily with climate. Further, we show that anthropogenic influences, primarily nitrogen (N) deposition and fire suppression, in concert with climate change, have increased AM tree dominance during the past three decades in the eastern United States. Given that most AM-dominated forests in this region are underlain by soils with high N availability, our results suggest that the increasing abundance of AM trees has the potential to induce nutrient acceleration, with critical consequences for forest productivity, ecosystem carbon and nutrient retention, and feedbacks to climate change.*

Johnson, A. C., Noel, J., Gregovich, D. P., Kruger, L. E., & Buma, B. (2019). Impacts of submerging and emerging shorelines on various biota and indigenous alaskan harvesting patterns. *Journal of Coastal Research, 35*(4), 765-775. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068481319&doi=10.2112%2fJCOASTRES-D-18-00119.1&partnerID=40&md5=e3ec78dc8310bcc236565fd626d75b62. doi:10.2112/JCOASTRES-D-18-00119.1
Research Tags: Water, Economics, Wildlife
Abstract: *Future alongshore benthic species shoreline lengths undergoing both sea level rise and relative sea level lowering (postglacial isostatic rebound) where SE Alaska Natives regularly conduct traditional and cultural harvests were approximated. From 30-km radii of six community centers, shorelines were examined by merging relevant portions of the NOAA ShoreZone database (utilizing alongshore bioband length segments as accounting units) with nearshore bathymetry and measures of mean global sea-level rise along with local GPS information of isostatic rebound rate. For this analysis, adjustments for the year 2108 were made by using 9868 alongshore length units (totaling 3466 km), each unit having uniform substrate and biologic type, by conducting geometric analysis of shoreline attributes. Given up to 1.8 m of sea level lowering, up to 30% decreases in estuary shoreline lengths are predicted. Trends, verified with both archeologic and land ownership records, confirm utility of simple geometric-based assessments (bathtub approach), particularly for low-energy bays with minimal stream input and bedrock/sediment–dominated shorelines and sites dominated by either isostatic rebound, sea level rise, or both. Predicted changes have implications for traditional and cultural gathering, food webs, and ocean carbon sequestration rates. For example, greater change in shoreline length segments is predicted for protected low-slope gradient bays and estuaries dominated by eelgrass (Zostera marina) and inferred butter clam (Saxidomus gigantean) habitats than for exposed, rocky, steep-gradient peninsulas with red foliose algae, including dulce (Palmaria sp.) and bull kelp (Nereocystis luetkeana).*

Johnson, D. J., Needham, J., Xu, C., Massoud, E. C., Davies, S. J., Anderson-Teixeira, K. J., . . . McMahon, S. M. (2018). Climate sensitive size-dependent survival in tropical trees. *Nature Ecology and Evolution, 2*(9), 1436-1442. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052154355&doi=10.1038%2fs41559-018-0626-z&partnerID=40&md5=6262feb47e0577c1e82b478017253ea2. doi:10.1038/s41559-018-0626-z

Research Tags: Forestry

Abstract: *Survival rates of large trees determine forest biomass dynamics. Survival rates of small trees have been linked to mechanisms that maintain biodiversity across tropical forests. How species survival rates change with size offers insight into the links between biodiversity and ecosystem function across tropical forests. We tested patterns of size-dependent tree survival across the tropics using data from 1,781 species and over 2 million individuals to assess whether tropical forests can be characterized by size-dependent life-history survival strategies. We found that species were classifiable into four 'survival modes' that explain life-history variation that shapes carbon cycling and the relative abundance within forests. Frequently collected functional traits, such as wood density, leaf mass per area and seed mass, were not generally predictive of the survival modes of species. Mean annual temperature and cumulative water deficit predicted the proportion of biomass of survival modes, indicating important links between evolutionary strategies, climate and carbon cycling. The application of survival modes in demographic simulations predicted biomass change across forest sites. Our results reveal globally identifiable size-dependent survival strategies that differ across diverse systems in a consistent way. The abundance of survival modes and interaction with climate ultimately determine forest structure, carbon storage in biomass and future forest trajectories.*

Johnson, D. M., Domec, J. C., Carter Berry, Z., Schwantes, A. M., McCulloh, K. A., Woodruff, D. R., . . . Jackson, R. B. (2018). Co-occurring woody species have diverse hydraulic strategies and mortality rates during an extreme drought. *Plant Cell and Environment, 41*(3), 576-588. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041061525&doi=10.1111%2fpce.13121&partnerID=40&md5=35be82f652905018b5b7bcaf671b6074. doi:10.1111/pce.13121

Research Tags: Weather, Forestry

Abstract: *From 2011 to 2013, Texas experienced its worst drought in recorded history. This event provided a unique natural experiment to assess species-specific responses to extreme drought and mortality of four co-occurring woody species: Quercus fusiformis, Diospyros texana, Prosopis glandulosa, and Juniperus ashei. We examined hypothesized mechanisms that could promote these species' diverse mortality patterns using postdrought measurements on surviving trees coupled to retrospective process modelling. The species exhibited a wide range of gas exchange responses, hydraulic strategies, and mortality rates. Multiple proposed indices of mortality mechanisms were inconsistent with the observed mortality patterns across species, including measures of the degree of iso/anisohydry, photosynthesis, carbohydrate depletion, and hydraulic safety margins. Large losses of spring and summer whole-tree conductance (driven by belowground losses of conductance) and shallower rooting depths were associated with species that exhibited greater mortality. Based on this retrospective analysis, we suggest that species more vulnerable to drought were more likely to have succumbed to hydraulic failure belowground.*

Johnson, H. E., Lewis, D. L., Verzuh, T. L., Wallace, C. F., Much, R. M., Willmarth, L. K., & Breck, S. W. (2018). Human development and climate affect hibernation in a large carnivore with implications for human–carnivore conflicts. *Journal of Applied Ecology, 55*(2), 663-672. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041533893&doi=10.1111%2f1365-2664.13021&partnerID=40&md5=1b1619dce4ef4b3e411532b16b3587c8. doi:10.1111/1365-2664.13021

Research Tags: Wildlife

Abstract: *Expanding human development and climate change are dramatically altering habitat conditions for wildlife. While the initial response of wildlife to changing environmental conditions is typically a shift in behaviour, little is known about the effects of these stressors on hibernation behaviour, an important life-history trait that can subsequently affect animal physiology, demography, interspecific interactions and human-wildlife interactions. Given future trajectories of land use and climate change, it is important that wildlife professionals understand how animals that hibernate are adapting to altered landscape conditions so that management activities can be appropriately tailored.*

We investigated the influence of human development and weather on hibernation in black bears (Ursus americanus), a species of high management concern, whose behaviour is strongly tied to natural food availability, anthropogenic foods around development and variation in annual weather conditions. Using GPS collar data from 131 den events of adult female bears (n = 51), we employed fine-scale, animal-specific habitat information to evaluate the relative and cumulative influence of natural food availability, anthropogenic food and weather on the start, duration and end of hibernation.

We found that weather and food availability (both natural and human) additively shaped black bear hibernation behaviour. Of the habitat variables we examined, warmer temperatures were most strongly associated with denning chronology, reducing the duration of hibernation and expediting emergence in the spring. Bears appeared to respond to natural and anthropogenic foods similarly, as more natural foods, and greater use of human foods around development, both postponed hibernation in the fall and decreased its duration.

Synthesis and applications. Warmer temperatures and use of anthropogenic food subsides additively reduced black bear hibernation, suggesting that future changes in climate and land use may further alter bear behaviour and increase the length of their active season. We speculate that longer active periods for bears will result in subsequent increases in human–bear conflicts and human-caused bear mortalities. These metrics are commonly used by wildlife agencies to index trends in bear populations, but have the potential to be misleading when bear behaviour dynamically adapts to changing environmental conditions, and should be substituted with reliable demographic methods.

Johnson, J. M. F., & Barbour, N. W. (2019). Stover harvest did not change nitrous oxide emissions in two Minnesota fields. *Agronomy Journal, 111*(1), 143-155. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060239534&doi=10.2134%2fagronj2018.09.0591&partnerID=40&md5=0380edf79e9f77a61439faa727f6ddb8. doi:10.2134/agronj2018.09.0591

Research Tags: Crops, Emissions

Abstract: *Corn (Zea mays L.) is grown across vast acreages producing massive quantities of stover making corn a desirable cellulosic bioenergy feedstock. Nitrous oxide (N2O) is a potent greenhouse gas (GHG) so small changes in direct soil N2O emissions may have substantial influence on global warming potential (GWP) from the agricultural sector. Harvesting stover alters soil properties such as soil moisture, oxygen availability, temperature, and substrate availability (C and N). Thus, harvesting stover might reduce soil N2O emissions by reducing substrate and by warming and drying the soil. The goal of the study was to determine how harvesting corn stover altered soil N2O emissions. Therefore, soil N2O emissions were measured for four crop-years (planting to planting) in two independent studies, one in a field managed without tillage (NT1995) and the other was in a field tilled annually with a chisel plow (Chisel). Each field was in a corn–soybean (Glycine max L. [Merr.]) rotation, with (i) corn grain (Grain) only, (ii) grain plus about 50% of the stover harvested (Grain+Moderate), and (iii) grain plus harvesting as much stover as possible (Grain+Aggressive) treatments. Cumulative soil N2O emissions did not differ among treatments in either field during any of the crop-years monitored. Flux events occurred corresponding to fertilizer applications and to spring freeze-thaw events. Cumulative fertilizer stimulated emissions tended to be greater for corn than soybean because of N-fertilizer application. These results are valuable to modelers for enhancing estimates of the N2O component of the stover management C-footprint.*

Johnson, J. M. F., Jin, V. L., Colnenne-David, C., Stewart, C. E., Jantalia, C. P., & Xiong, Z. (2017). Row-Crop Production Practices Effects on Greenhouse Gas Emissions. In *Soil Health and Intensification of Agroecosystems* (pp. 257-275).

Research Tags: Crops, Emissions

Abstract: *One of the grand challenges facing humankind is meeting projected demands for agricultural products in a world undergoing global climate change. As demands increase for the reliable and environmentally responsible supply of food and fiber, how management is adapted to meet these demands will determine the sustainability and climate change mitigation potential of row-crop production systems. This chapter addresses direct greenhouse gas (GHG) emissions from agricultural soils resulting from row-crop production practices. The chapter is focused on globally dominant grain cropping systems (maize, wheat, rice) and on identifying agronomic management practices that help reduce GHG emissions, increase SOC*

sequestration, and subsequently improve soil health.

Johnson, K. D., Domke, G. M., Russell, M. B., Walters, B., Hom, J., Peduzzi, A., . . . Huang, W. (2017). Estimating aboveground live understory vegetation carbon in the United States. *Environmental Research Letters, 12*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038890794&doi=10.1088%2f1748-9326%2faa8fdb&partnerID=40&md5=33ac82e615585975765c04900ec2513a. doi:10.1088/1748-9326/aa8fdb
Research Tags: Forestry
Abstract: *Despite the key role that understory vegetation plays in ecosystems and the terrestrial carbon cycle, it is often overlooked and has few quantitative measurements, especially at national scales. To understand the contribution of understory carbon to the United States (US) carbon budget, we developed an approach that relies on field measurements of understory vegetation cover and height on US Department of Agriculture Forest Service, Forest Inventory and Analysis (FIA) subplots. Allometric models were developed to estimate aboveground understory carbon. A spatial model based on stand characteristics and remotely sensed data was also applied to estimate understory carbon on all FIA plots. We found that most understory carbon was comprised of woody shrub species (64%), followed by nonwoody forbs and graminoid species (35%) and seedlings (1%). The largest estimates were found in temperate or warm humid locations such as the Pacific Northwest and southeastern US, thus following the same broad trend as aboveground tree biomass. The average understory aboveground carbon density was estimated to be 0.977 Mg ha−1, for a total estimate of 272 Tg carbon across all managed forest land in the US (approximately 2% of the total aboveground live tree carbon pool). This estimate is more than twice as low as previous FIA modeled estimates that did not rely on understory measurements, suggesting that this pool may currently be overestimated in US National Greenhouse Gas reporting.*

Johnson, R. C., Leger, E. A., & Vance-Borland, K. (2017). Genecology of Thurber's Needlegrass (Achnatherum thurberianum [Piper] Barkworth) in the Western United States. *Rangeland Ecology and Management, 70*(4), 509-517. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028463509&doi=10.1016%2fj.rama.2017.01.004&partnerID=40&md5=4be71b6c232b3b3fca2af22240a6807f. doi:10.1016/j.rama.2017.01.004
Research Tags: Grassland
Abstract: *Thurber's needlegrass (Achnatherum thurberianum [Piper] Barkworth) is a key restoration species in the Great Basin and surrounding areas, yet comprehensive studies of how climate relates to genetic variation and seed zones for restoration projects are lacking. Potentially adaptive phenotypic traits of 66 diverse populations of Thurber's needlegrass were measured in common gardens at Central Ferry, Washington and Reno, Nevada in 2012 and 2013. Extensive genetic variation was observed among phenology, morphology, and production traits (P < 0.01), and canonical correlation was used to relate traits to source climate variables. Only with the first two canonical variates were F values significant (P < 0.05), explaining 42% and 18% of the variation, respectively. For variates 1 and 2, strong canonical correlations of 0.97 and 0.94 linked genetic variation with source climates, providing evidence for climate-driven evolution. Pearson linear correlations indicated that populations from warmer, drier locations generally had earlier blooming and longer awns than those from cooler, wetter locations. Plants from warmer, drier locations also had higher survival at Central Ferry and higher leaf length to width (narrower leaves) at Reno in 2012. Regression of the canonical variates 1 and 2 for traits with source climate variables produced very strong models, explaining 94% and 87% of the variation in plant traits. These models were used to map 12 seed zones encompassing 465 079 km2 in the Great Basin and surrounding areas with six seed zones representing 90% of the mapped area. We recommend using these seed zones to guide restoration of Thurber's needlegrass.*

Joiner, J., Yoshida, Y., Anderson, M., Holmes, T., Hain, C., Reichle, R., . . . Zeng, F. W. (2018). Global relationships among traditional reflectance vegetation indices (NDVI and NDII), evapotranspiration (ET), and soil moisture variability on weekly timescales. *Remote Sensing of Environment, 219*, 339-352. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055355804&doi=10.1016%2fj.rse.2018.10.020&partnerID=40&md5=ce4020fefdc42a30bc9e835c5835b1b7. doi:10.1016/j.rse.2018.10.020
Research Tags: Water, Soil

Abstract: *Monitoring the effects of water availability on vegetation globally using satellites is important for applications such as drought early warning, precision agriculture, and food security as well as for more broadly understanding relationships between water and carbon cycles. In this global study, we examine how quickly several satellite-based indicators, assumed to have relationships with water availability, respond, on timescales of days to weeks, in comparison with variations in root-zone soil moisture (RZM) that extends to about 1 m depth. The satellite indicators considered are the normalized difference vegetation and infrared indices (NDVI and NDII, respectively) derived from reflectances obtained with moderately wide (20–40 nm) spectral bands in the visible and near-infrared (NIR) and evapotranspiration (ET) estimated from thermal infrared observations and normalized by a reference ET. NDVI is primarily sensitive to chlorophyll contributions and vegetation structure while NDII may contain additional information on water content in leaves and canopy. ET includes both the loss of root zone soil water through transpiration (modulated by stomatal conductance) as well as evaporation from bare soil. We find that variations of these satellite-based drought indicators on time scales of days to weeks have significant correlations with those of RZM in the same water-limited geographical locations that are dominated by grasslands, shrublands, and savannas whose root systems are generally contained within the 1 m RZM layer. Normalized ET interannual variations show generally a faster response to water deficits and enhancements as compared with those of NDVI and NDII, particularly in sparsely vegetated regions.*

Jones, I. M., & Koptur, S. (2017). Dead land walking: the value of continued conservation efforts in South Florida's imperiled pine rocklands. *Biodiversity and Conservation, 26*(14), 3241-3253. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029512836&doi=10.1007%2fs10531-017-1433-6&partnerID=40&md5=86e5dade66bf8a2188a3cdd91e2f86aa. doi:10.1007/s10531-017-1433-6

Research Tags: Forestry

Abstract: Pine rocklands are deeply imperiled habitats restricted to South Florida and the Caribbean. In South Florida, more than 98% of pine rockland habitat has been destroyed in the past century (outside of Everglades National Park). Due to their proximity to human populations, management options in the remaining fragments are sometimes limited, and fires that are necessary to maintain healthy habitat structure are often excluded. Despite these pressures, conservation initiatives in pine rocklands have been surprisingly successful, and plant extinction has been avoided. In the coming decades, however, sea-level rise threatens to all but eliminate the pine rocklands, and efforts to preserve their many endemic species will likely fail. We synthesize the results of numerous ecological studies and review the successes and failures of conservation in South Florida's pine rocklands. Further, we illustrate the value of continued conservation efforts, and provide direction in the light of the habitats long-term fate. We advocate the increased use of prescribed fire and, as the effects of climate change become more apparent, the translocation of some endemic species. Finally, we acclaim pine rocklands as a model system for studying how plant communities respond to environmental change. South Florida's fragmented landscape, with shifting gradients of elevation, salinity, inundation and nutrient availability, should continue to inspire ecologists to address important questions, and better prepare the region, and the world, for the challenges of the coming decades.

Jones, L. A., Kimball, J. S., Reichle, R. H., Madani, N., Glassy, J., Ardizzone, J. V., . . . Scott, R. L. (2017). The SMAP Level 4 Carbon Product for Monitoring Ecosystem Land-Atmosphere CO<inf>2</inf> Exchange. *IEEE Transactions on Geoscience and Remote Sensing, 55*(11), 6517-6532. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029006058&doi=10.1109%2fTGRS.2017.2729343&partnerID=40&md5=6c498f30da3a4283ef2fb6dd2186cf3c. doi:10.1109/TGRS.2017.2729343

Research Tags: Soil, Water, Research

Abstract: *The National Aeronautics and Space Administration's Soil Moisture Active Passive (SMAP) mission Level 4 Carbon (L4C) product provides model estimates of the Net Ecosystem CO 2 exchange (NEE) incorporating SMAP soil moisture information. The L4C product includes NEE, computed as total ecosystem respiration less gross photosynthesis, at a daily time step posted to a 9-km global grid by plant functional type.*

Component carbon fluxes, surface soil organic carbon stocks, underlying environmental constraints, and detailed uncertainty metrics are also included. The L4C model is driven by the SMAP Level 4 Soil Moisture data assimilation product, with additional inputs from the Goddard Earth Observing System, Version 5 weather analysis, and Moderate Resolution Imaging Spectroradiometer satellite vegetation data. The L4C data record extends from March 31, 2015 to present with ongoing production and 8-12 day latency. Comparisons against concurrent global CO 2 eddy flux tower measurements, satellite solar-induced canopy florescence, and other independent observation benchmarks show favorable L4C performance and accuracy, capturing the dynamic biosphere response to recent weather anomalies. Model experiments and L4C spatiotemporal variability were analyzed to understand the independent value of soil moisture and SMAP observations relative to other sources of input information. This analysis highlights the potential for microwave observations to inform models where soil moisture strongly controls land CO 2 flux variability; however, skill improvement relative to flux towers is not yet discernable within the relatively short validation period. These results indicate that SMAP provides a unique and promising capability for monitoring the linked global terrestrial water and carbon cycles.

Jones, M. I., Gould, J. R., & Fierke, M. K. (2017). Mortality of overwintering emerald ash borer (Coleoptera: Buprestidae) associated with an extreme cold event in New York, United States of America. *Canadian Entomologist, 149*(4), 482-486. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019565647&doi=10.4039%2ftce.2017.17&partnerID=40&md5=4e81cbe1af8f10da514864619664dffe. doi:10.4039/tce.2017.17

Research Tags: Forestry, Wildlife, Weather

Abstract: *Severe mortality (93%) of overwintering larvae of emerald ash borer, Agrilus planipennis Fairmaire (Coleoptera: Buprestidae), was recorded in March 2016 from green ash, Fraxinus pennsylvanica Marshall (Oleaceae), in Syracuse, New York, United States of America. In contrast, larvae collected from the same area in January exhibited <1% mortality. A strong cold front moved across New York from 13 to 15 February 2016 with temperatures plunging to nearly −40 °C in some areas. In many regions of New York where A. planipennis is established, temperatures dropped well below the reported supercooling point of overwintering larvae. To evaluate whether the extreme cold was linked to extensive mortality of larvae, trees were sampled from four areas that experienced a gradient of minimum temperatures on 14 February 2016. Overwintering mortality varied from ⩽5% to 93% among regions, with lowest survival in the coldest regions. When excised from their galleries, dead larvae were discoloured with brown spots or had black necrotic tissue in the spiracles or foregut. This is the first report of extensive cold-related mortality for this species in North America and highlights the stochastic nature of climatic extremes on invasive species populations.*

Jones, M. O., Allred, B. W., Naugle, D. E., Maestas, J. D., Donnelly, P., Metz, L. J., . . . McIver, J. D. (2018). Innovation in rangeland monitoring: annual, 30 m, plant functional type percent cover maps for U.S. rangelands, 1984–2017. *Ecosphere, 9*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054833588&doi=10.1002%2fecs2.2430&partnerID=40&md5=de119c9c5d884c6ac53fbbda435ddbe0. doi:10.1002/ecs2.2430

Research Tags: Grassland, Research

Abstract: *Innovations in machine learning and cloud-based computing were merged with historical remote sensing and field data to provide the first moderate resolution, annual, percent cover maps of plant functional types across rangeland ecosystems to effectively and efficiently respond to pressing challenges facing conservation of biodiversity and ecosystem services. We utilized the historical Landsat satellite record, gridded meteorology, abiotic land surface data, and over 30,000 field plots within a Random Forests model to predict per-pixel percent cover of annual forbs and grasses, perennial forbs and grasses, shrubs, and bare ground over the western United States from 1984 to 2017. Results were validated using three independent collections of plot-level measurements, and resulting maps display land cover variation in response to changes in climate, disturbance, and management. The maps, which will be updated annually at the end of each year, provide exciting opportunities to expand and improve rangeland conservation, monitoring, and management. The data open new doors for scientific investigation at an unprecedented blend of temporal fidelity, spatial resolution, and geographic scale.*

Jorgenson, A. K., Fiske, S., Hubacek, K., Li, J., McGovern, T., Rick, T., . . . Zycherman, A. (2019). Social science perspectives on drivers of and responses to global climate change. *Wiley Interdisciplinary Reviews: Climate Change, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052918802&doi=10.1002%2fwcc.554&partnerID=40&md5=900f4881b510c65d6445317a7a94f956. doi:10.1002/wcc.554

Research Tags: Economics

Abstract: *This article provides a review of recent anthropological, archeological, geographical, and sociological research on anthropogenic drivers of climate change, with a particular focus on drivers of carbon emissions, mitigation and adaptation. The four disciplines emphasize cultural, economic, geographic, historical, political, and social-structural factors to be important drivers of and responses to climate change. Each of these disciplines has unique perspectives and makes noteworthy contributions to our shared understanding of anthropogenic drivers, but they also complement one another and contribute to integrated, multidisciplinary frameworks. The article begins with discussions of research on temporal dimensions of human drivers of carbon emissions, highlighting interactions between long-term and near-term drivers. Next, descriptions of the disciplines' contributions to the understanding of mitigation and adaptation are provided. It concludes with a summary of key lessons offered by the four disciplines as well as suggestions for future research.*

Joshi, S., Garbrecht, J., & Brown, D. (2019). Observed spatiotemporal trends in intense precipitation events across United States: Applications for stochastic weather generation. *Climate, 7*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063768001&doi=10.3390%2fcli7030036&partnerID=40&md5=126745a7c24c2b0a8c4e7321eb49eee8. doi:10.3390/cli7030036

Research Tags: Weather

Abstract: *An increasing focus of climate change studies is the projection of storm events characterized by heavy, very heavy, extreme, and/or intense precipitation. Projected changes in the spatiotemporal distributions of such intense precipitation events remain uncertain due to large measures of variability in both the definition and evidence of increased intensity in the upper percentile range of observed daily precipitation distributions, particularly on a regional basis. As a result, projecting changes in future precipitation at the upper tail of the distribution (i.e., the heavy to heaviest events), such as through the use of stochastic weather generator programs, remains challenging. One approach to address this challenge is to better define what constitutes intense precipitation events and the degree of location-specific adjustment needed for the weather generator programs to appropriately account for potential increases in precipitation intensity due to climate change. In this study, we synthesized information on categories of intense precipitation events and assessed reported trends in the categories at national and regional scales within the context of applying this information to stochastic weather generation. Investigations of adjusting weather generation models to include long-term regional trends in intense precipitation events are limited, and modeling trends in site-specific future precipitation distributions forecasted by weather generator programs remains challenging. Probability exceedance curves and variations between simulated and observed distributions can help in modeling and assessment of trends in future extreme precipitation events that reflect changes in precipitation intensity due to climate change.*

Joyce, L. A., Bentrup, G., Cheng, A. S., Kolb, P., Schoeneberger, M., & Derner, J. (2018). Native and agricultural forests at risk to a changing climate in the Northern Plains. *Climatic Change, 146*(1-2), 59-74. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029416059&doi=10.1007%2fs10584-017-2070-5&partnerID=40&md5=04c54ab713893018442519b625f8caef. doi:10.1007/s10584-017-2070-5

Research Tags: Forestry

Abstract: *Native and agricultural forests in the Northern Plains provide ecosystem services that benefit human society—diversified agricultural systems, forest-based products, and rural vitality. The impacts of recent trends in temperature and disturbances are impairing the delivery of these services. Climate change projections identify future stressors of greater impact, placing at risk crops, soils, livestock, biodiversity, and agricultural and forest-based livelihoods. While these native and agricultural forests are also a viable option for providing mitigation and adaptation services to the Northern Plains, they themselves must be managed in terms of climate change risks. Because agricultural forests are planted systems, the primary approaches for reducing risks are through design, plant selection and management. For native forests, management, natural disturbances, and collaboration of multiple ownerships will be needed to address key risks.*

Joyce, L. A., Talbert, M., Sharp, D., & Stevenson, J. (2018) Historical and Projected Climate in the Northern Rockies Region. In*: Vol. 63*. *Advances in Global Change Research* (pp. 17-23).

Research Tags: Weather

Abstract: *Climate influences the ecosystem services we obtain from forest and rangelands. Climate is described by the long-term characteristics of precipitation, temperature, wind, snowfall, and other measures of weather that occur over a long period in a particular place, and is typically expressed as long-term average conditions. Resource management practices are implemented day-to-day in response to weather conditions; resource management strategies and plans are developed using our understanding of climate. With the need to consider climate change in planning and management, an understanding of how climate may change in the future in a resource management planning area is valuable. In this chapter, we present the current understanding of potential changes in climate for the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and the Greater Yellowstone Area (GYA), hereafter called the Northern Rockies region.*

Junker, L. V., Kleiber, A., Jansen, K., Wildhagen, H., Hess, M., Kayler, Z., . . . Ensminger, I. (2017). Variation in short-term and long-term responses of photosynthesis and isoprenoid-mediated photoprotection to soil water availability in four Douglas-fir provenances. *Scientific Reports, 7*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009183690&doi=10.1038%2fsrep40145&partnerID=40&md5=f0e44bba5b146b6196e0aa81b0b48e10. doi:10.1038/srep40145

Research Tags: Forestry

Abstract: *For long-lived forest tree species, the understanding of intraspecific variation among populations and their response to water availability can reveal their ability to cope with and adapt to climate change. Dissipation of excess excitation energy, mediated by photoprotective isoprenoids, is an important defense mechanism against drought and high light when photosynthesis is hampered. We used 50-year-old Douglas-fir trees of four provenances at two common garden experiments to characterize provenance-specific variation in photosynthesis and photoprotective mechanisms mediated by essential and non-essential isoprenoids in response to soil water availability and solar radiation. All provenances revealed uniform photoprotective responses to high solar radiation, including increased de-epoxidation of photoprotective xanthophyll cycle pigments and enhanced emission of volatile monoterpenes. In contrast, we observed differences between provenances in response to drought, where provenances sustaining higher CO_2 assimilation rates also revealed increased water-use efficiency, carotenoid-chlorophyll ratios, pools of xanthophyll cycle pigments, β-carotene and stored monoterpenes. Our results demonstrate that local adaptation to contrasting habitats affected chlorophyll-carotenoid ratios, pool sizes of photoprotective xanthophylls, β-carotene, and stored volatile isoprenoids. We conclude that intraspecific variation in isoprenoid-mediated photoprotective mechanisms contributes to the adaptive potential of Douglas-fir provenances to climate change.*

Jurgensen, M. F., Page-Dumroese, D. S., Brown, R. E., Tirocke, J. M., Miller, C. A., Pickens, J. B., & Wang, M. (2017). Estimating carbon and nitrogen pools in a forest soil: Influence of soil bulk density methods and rock content. *Soil Science Society of America Journal, 81*(6), 1689-1696. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040597545&doi=10.2136%2fsssaj2017.02.0069&partnerID=40&md5=209d7114846b3e873529834a07ee7241. doi:10.2136/sssaj2017.02.0069

Research Tags: Soil

Abstract: *Soils with high rock content are common in many US forests, and contain large amounts of stored C. Accurate measurements of soil bulk density and rock content are critical for calculating and assessing changes in both C and nutrient pool size, but bulk density sampling methods have limitations and sources of variability. Therefore, we evaluated the use of small-diameter soil cores (SD), irregular soil volume excavation (IR), and a nuclear density gauge (ND) to measure bulk density and rock content, and estimate C and N pools in three 10-cm increments to a 30-cm depth in a glacial till soil in northern Wisconsin. Total and fine bulk densities were lower when measured with SD cores than with larger soil volume IR and ND methods. No differences in C pools among bulk density sampling methods were found in the 10-cm increments, but when combined to 30 cm, the C pool estimate with IR (81.6 Mg ha–1) was significantly higher than those of ND (75.3 Mg ha–1) and SD (73.4 Mg ha–1). No significant differences in N pools were detected in the 10-cm increments, but the 0- to 30-cm N pool estimates by IR (5.65 Mg ha–1) and ND (5 Mg ha–1) were higher than that of SD (4.22 Mg ha–1).*

Surface rocks could lower soil C and N pools by 20% or more. Overall, the bulk density method had little effect on soil C and N pool estimates in the surface 20 cm of this soil but did when sampled to 30 cm soil depth.

Kabrick, J. M., Clark, K. L., D'Amato, A. W., Dey, D. C., Kenefic, L. S., Kern, C. C., . . . Waskiewicz, J. D. (2017). Managing hardwood-softwood mixtures for future forests in eastern North America: Assessing suitability to projected climate change. *Journal of Forestry, 115*(3), 190-201. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019399769&doi=10.5849%2fjof.2016-024&partnerID=40&md5=9b55555c287f352bc0016ec67d7bc2cd. doi:10.5849/jof.2016-024
Research Tags: Forestry
Abstract: *Despite growing interest in management strategies for climate change adaptation, there are few methods for assessing the ability of stands to endure or adapt to projected future climates. We developed a means for assigning climate "Compatibility" and "Adaptability" scores to stands for assessing the suitability of tree species for projected climate scenarios. We used these scores to determine whether mixed hardwood-softwood stands or "mixedwoods" were better suited to projected future climates than pure hardwood or pure softwood stands. We also examined the quantity of aboveground carbon (C) sequestered in the overstory of these mixtures. In the four different mixedwood types that we examined, we found that Pinus echinata-Quercus mixtures in the Ozark Highlands had greater Compatibility scores than hardwood stands and greater Adaptability scores than pure Pinus echinata stands; however, these mixtures did not store more aboveground overstory C than pure stands. For Pinus strobus-Quercus rubra, Picea-Abies-hardwood, and Tsuga canadensis-hardwood mixtures, scores indicated that there were no advantages or disadvantages related to climate compatibility. Those mixtures generally had greater Adaptability scores than their pure softwood analogs but stored less aboveground overstory C. Despite the many benefits of maintaining mixedwoods, regenerating and/or recruiting the softwood component of these mixtures remains a persistent silvicultural challenge.*
Management and Policy Implications Forest management agencies are increasingly interested in establishing desired future conditions that are compatible with projected changes in climate. Maintaining, conserving, or restoring tree species diversity and enhancing carbon stocks are often identified as important climate mitigation strategies. Mixed hardwood-softwood stands or "mixedwoods" are often structurally and compositionally diverse because of the differing shade tolerances, growth rates, longevities, phenology, and crown and root structures of the constituent species. There has long been interest in the benefits of mixedwoods because of their potential to produce a greater timber volume or biomass, to provide more diverse habitats, and to be more resistant or resilient to contemporary pests and pathogens than pure stands. They also may be better suited for projected climates although assessing this has remained a challenge. We adapted a method for assessing the compatibility and adaptability of contemporary mixedwood stands to projected climate scenarios. Our assessment suggests that some mixedwoods are more compatible with projected future climates than are others but that all of the mixedwoods that we examined appeared to be better adapted than pure softwood stands.

Kakumanu, M. L., Ma, L., & Williams, M. A. (2019). Drought-induced soil microbial amino acid and polysaccharide change and their implications for C-N cycles in a climate change world. *Scientific Reports, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069896376&doi=10.1038%2fs41598-019-46984-1&partnerID=40&md5=08a0632b71d33e68bd5cd5944cdbd249. doi:10.1038/s41598-019-46984-1
Research Tags: Soil
Abstract: *High microbial carbon (MBC) demand, a proxy for energy demand (cost), during soil microbial response to stressors such as drought are a major gap in understanding global biogeochemical cycling of carbon (C) and nitrogen (N). The dynamics of two dominant microbial pools (amino acids; AA and exopolymeric substances; EPS) in soils exposed to drying and C and N amendment to mimic both low and high nutrient soil habitats were examined. It was hypothesized that dynamics of EPS and AA (osmolytes) would be greater when soil drying was preceded by a pulse of bioavailable C and N. Drying reduced AA content, even as overall soil MBC increased (~35%). The increase in absolute amounts and mol% of certain AA (eg: Taurine, glutamine, tyrosine, phenylalanine) in the driest treatment (−10 MPa) were similar in both soils regardless of amendment suggesting a common mechanism underlying the energy intensive acclimation across soils. MBC*

and EPS, both increased ~1.5X and ~3X due to drying and especially drying associated with amendment. Overall major pools of C and N based microbial metabolites are dynamic to drying (drought), and thus have implications for earth's biogeochemical fluxes of C and N, perhaps costing 4–7% of forest fixed photosynthetic C input during a single drying (drought) period.

Kallenbach, C. M., Conant, R. T., Calderón, F., & Wallenstein, M. D. (2019). A novel soil amendment for enhancing soil moisture retention and soil carbon in drought-prone soils. *Geoderma, 337*, 256-265. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053757531&doi=10.1016%2fj.geoderma.2018.09.027&partnerID=40&md5=dd649f2627ca49539ecb24791399df03. doi:10.1016/j.geoderma.2018.09.027

Research Tags: Soil, Weather

Abstract: *Crop yield reductions are common in drought-stressed agroecosystems and are likely to become more frequent with climate change. To combat this, soil amendments are often used to enhance soil moisture retention but typically only lead to marginal improvements. Moreover, even as concern over agricultural water use mounts, a large fraction of food is wasted. Diverting more food waste and byproducts back to agricultural fields could reduce waste issues while ameliorating critical water limitations. We evaluated lactobionate, a lactose derivative and major dairy industry byproduct, as a potential soil amendment for enhancing both soil moisture and soil organic carbon (SOC). Lactobionate (LB) is a hydrophilic compound consisting primarily of cations and simple sugar acids. These combined properties could synergistically modify numerous controls on soil-water balances*

In a laboratory setting, we compared LB stabilized with various cations (K+, NH4+, and Ca+) across a range of soil types to determine LB effects on soil moisture and SOC retention. All LB amendments increased soil water content relative to unamended soil across a range of soil matric potentials and raised available water content by 37%. Additionally, LB amended soils had on average 70 times more microbial biomass and decreased soil inorganic nitrogen content compared to unamended soils. We found that K+-LB, the most effective amendment, increased soil water content by 100–600% compared to unamended soils and as much as 87% of the increased SOC following LB additions was retained after 2 months. Our results suggest that tapping into novel sources of organic inputs such as LB may be an effective approach for simultaneously enhancing soil moisture and carbon stocks while increasing the economic and energetic value of food production byproducts.

Kane, J. M., Varner, J. M., Metz, M. R., & van Mantgem, P. J. (2017). Characterizing interactions between fire and other disturbances and their impacts on tree mortality in western U.S. Forests. *Forest Ecology and Management, 405*, 188-199. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029591025&doi=10.1016%2fj.foreco.2017.09.037&partnerID=40&md5=93c8ec84df862e871af71859215abebf. doi:10.1016/j.foreco.2017.09.037

Research Tags:

Abstract:

Karlen, D. L., Schmer, M. R., Kaffka, S., Clay, D. E., Wang, M. Q., Horwath, W. R., . . . Chute, A. G. (2019). Unraveling crop residue harvest effects on soil organic carbon. *Agronomy Journal, 111*(1), 93-98. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060129636&doi=10.2134%2fagronj2018.03.0207&partnerID=40&md5=2a7b4552d1f0cc9a4294975f1c00ce9c. doi:10.2134/agronj2018.03.0207

Research Tags: Crops, Soil

Abstract: *Increasing evidence that pervasive warming trends are altering disturbance regimes and their interactions with fire has generated substantial interest and debate over the implications of these changes. Previous work has primarily focused on conditions that promote non-additive interactions of linked and compounded disturbances, but the spectrum of potential interaction patterns has not been fully considered. Here we develop and define terminology, expand on the existing conceptual framework and review the patterns and mechanisms of disturbance interactions with a focus on interactions between fire and other forest disturbances and a specific emphasis on resulting tree mortality. The types of interactions reflect the positive, negative, or neutral responses to the incidence, intensity, and effects of the interaction. These types of interactions are not always mutually exclusive, but can be distinct. The collective effect of the interactions will determine the longer-term ecosystem response that can result in a resistant, resilient, or compounded interaction. Our review indicates that the interactions of drought, bark beetles, or pathogens with fire often result in neutral or maintained interactions that do not negatively or positively influence the incidence or*

intensity following fire. The effect of these disturbance interactions on tree mortality ranged from antagonistic (reduced mortality compared to individual disturbances) to synergistic (greater mortality compared to individual disturbances) within and among disturbance interaction types but often resulted in additive effects (mortality is consistent with the summation of the two disturbances). Synergistic effects on tree mortality have been observed when the severity of the initial disturbance is moderate to high and time between disturbances is relatively short. When the sequence of disturbance interaction is reversed (e.g., fire precedes other disturbances) the conditions can generally promote impeded interactions (lower incidence of interaction), reduced interactions (lower intensity of interaction), and antagonistic interactions (lower tree mortality). While recent research on fire-disturbance interactions has increased over the last decade and provided important insights, more research that identifies the specific thresholds of incidence, intensity, and effects of interaction by region and forest type are needed to better assist management solutions that promote desired outcomes in rapidly changing ecosystems.

Kaur, H., Huggins, D. R., Rupp, R. A., Abatzoglou, J. T., Stöckle, C. O., & Reganold, J. P. (2017). Agro-ecological class stability decreases in response to climate change projections for the Pacific Northwest, USA. *Frontiers in Ecology and Evolution, 5*(JUL). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029633872&doi=10.3389%2ffevo.2017.00074&partnerID=40&md5=3eee471295b7a6b46f85584126a86a8d. doi:10.3389/fevo.2017.00074

Research Tags: Economics

Abstract: *Climate change will impact bioclimatic drivers that regulate the geospatial distribution of dryland agro-ecological classes (AECs). Characterizing the geospatial relationship between present AECs and their bioclimatic controls will provide insights into potential future shifts in AECs as climate changes. The major objectives of this study are to quantify empirical relationships between bioclimatic variables and the current geospatial distribution of six dryland AECs of the inland Pacific Northwest (iPNW) of the United States; and apply bioclimatic projections from downscaled climate models to assess geospatial shifts of AECs under current production practices. Two Random Forest variable selection algorithms, VarSelRF and Boruta, were used to identify relevant bioclimatic variables. Three bioclimatic variables were identified by VarSelRF as useful for predictive Random Forest modeling of six AECs: (1) Holdridge evapotranspiration index; (2) spring precipitation (March, April, and May); and (3) precipitation of the warmest 4-month season (June, July, August, and September). Super-imposing future climate scenarios onto current agricultural production systems resulted in significant geospatial shifts in AECs. The Random Forest model projected a 58 and 63% increase in area under dynamic annual crop-fallow-transition (AC-T) and dynamic grain-fallow (GF) AECs, respectively. By contrast, a 46% decrease in area was projected for stable AC-T and dynamic annual crop (AC) AECs across all future time periods for Representative Concentration Pathway (RCP) 8.5. For the same scenarios, the stable AC and GF AECs showed the least declines in area (8 and 13%, respectively), compared to other AECs. Future spatial shifts from stable to dynamic AECs, particularly to dynamic AC-T and dynamic GF AECs would result in more use of fallow, a greater hazard for soil erosion, greater cropping system uncertainty, and potentially less cropping system flexibility. These projections are counter to cropping system goals of increasing intensification, diversification, and productivity.*

Kavetskiy, A., Yakubova, G., Sargsyan, N., Wikle, C., Prior, S. A., Torbert, H. A., & Chin, B. A. (2019). Scanning Mode Application of Neutron-Gamma Analysis for Soil Carbon Mapping. *Pedosphere, 29*(3), 334-343. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065667677&doi=10.1016%2fS1002-0160%2819%2960806-4&partnerID=40&md5=e10b137ed8a8c794119f889e468c43e1. doi:10.1016/S1002-0160(19)60806-4

Research Tags: Soil, Research

Abstract: *Soil carbon mapping is extremely useful in assessing the effect of land management practices on soil carbon storage. Applications of neutron-gamma analysis in scanning mode for mapping of soil carbon are discussed. A Global Positioning System (GPS) device and softwares required to simultaneously acquire gamma signals and geographical positions during scanning operations were added to an existing measurement system. The reliability of soil carbon measurements in scanning mode was demonstrated to be in agreement with results acquired from static mode. The error analysis indicated that scanning measurements can be conducted with the same accuracy as static measurements in approximately one fourth the time. To obtain results suitable* *for mapping analogous to traditional chemical analyses (i.e., ± 0.5 in weight percent or ± 0.5 w%), scanning time over a given site should be ca. 15 min using the current measurement system configuration. Based on this measurement time, a reasonable towing speed of 3–5 km h−1, the necessity for complete site coverage during scanning, the number of sites (within the surveyed field), and the required total measurement time can be estimated. Soil carbon measurements for 28 field sites (total area ca. 2.5 ha) were conducted in ca. 8 h. Based on acquired data, a soil carbon distribution map was constructed utilizing various softwares. The surveyed field area included an asphalt road that had carbon readings higher than the surrounding land. The clarity with which these carbon-rich zones were delineated on the constructed map represents evidence supporting the veracity of this method. Neutron-gamma analysis technology can greatly facilitate timely construction of soil carbon maps.*

Kay, S. L., Fischer, J. W., Monaghan, A. J., Beasley, J. C., Boughton, R., Campbell, T. A., . . . Pepin, K. M. (2017). Quantifying drivers of wild pig movement across multiple spatial and temporal scales. *Movement Ecology, 5*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020734367&doi=10.1186%2fs40462-017-0105-1&partnerID=40&md5=054722a1c6a07006f2e173124d7f2b41. doi:10.1186/s40462-017-0105-1

Research Tags: Wildlife

Abstract: *Background*

The movement behavior of an animal is determined by extrinsic and intrinsic factors that operate at multiple spatio-temporal scales, yet much of our knowledge of animal movement comes from studies that examine only one or two scales concurrently. Understanding the drivers of animal movement across multiple scales is crucial for understanding the fundamentals of movement ecology, predicting changes in distribution, describing disease dynamics, and identifying efficient methods of wildlife conservation and management.

Methods

We obtained over 400,000 GPS locations of wild pigs from 13 different studies spanning six states in southern U.S.A., and quantified movement rates and home range size within a single analytical framework. We used a generalized additive mixed model framework to quantify the effects of five broad predictor categories on movement: individual-level attributes, geographic factors, landscape attributes, meteorological conditions, and temporal variables. We examined effects of predictors across three temporal scales: daily, monthly, and using all data during the study period. We considered both local environmental factors such as daily weather data and distance to various resources on the landscape, as well as factors acting at a broader spatial scale such as ecoregion and season.

Results

We found meteorological variables (temperature and pressure), landscape features (distance to water sources), a broad-scale geographic factor (ecoregion), and individual-level characteristics (sex-age class), drove wild pig movement across all scales, but both the magnitude and shape of covariate relationships to movement differed across temporal scales.

Conclusions

The analytical framework we present can be used to assess movement patterns arising from multiple data sources for a range of species while accounting for spatio-temporal correlations. Our analyses show the magnitude by which reaction norms can change based on the temporal scale of response data, illustrating the importance of appropriately defining temporal scales of both the movement response and covariates depending on the intended implications of research (e.g., predicting effects of movement due to climate change versus planning local-scale management). We argue that consideration of multiple spatial scales within the same framework (rather than comparing across separate studies post-hoc) gives a more accurate quantification of cross-scale spatial effects by appropriately accounting for error correlation.

Keane, R. E., Holsinger, L. M., Mahalovich, M. F., & Tomback, D. F. (2017). Evaluating future success of whitebark pine ecosystem restoration under climate change using simulation modeling. *Restoration Ecology, 25*(2), 220-233. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84981717764&doi=10.1111%2frec.12419&partnerID=40&md5=e06cbf825548f4bcd7b789dbebb3d6eb. doi:10.1111/rec.12419

Research Tags: Forestry, Wildlife

Abstract: *Major declines of whitebark pine forests throughout western North America from the combined effects of mountain pine beetle (Dendroctonus ponderosae) outbreaks, fire exclusion policies, and the exotic disease white pine blister rust (WPBR) have spurred many restoration actions. However, projected future warming and drying may further exacerbate the species' decline and possibly compromise long-term success of today's restoration activities. We evaluated successes of restoration treatments under future climate using a comprehensive landscape simulation experiment. The spatially explicit, ecological process model FireBGCv2 was used to simulate whitebark pine populations on two U.S. Northern Rocky Mountain landscapes over 95 years under two climate, three restoration, and two fire management scenarios. Major findings were that (1) whitebark pine can remain on some high mountain landscapes in a future climate albeit at lower basal areas (50% decrease), (2) restoration efforts, such as thinning and prescribed burning, are vital to ensure future whitebark pine forests, and (3) climate change impacts on whitebark pine vary by local setting. Whitebark pine restoration efforts will mostly be successful in the future but only if future populations are somewhat resistant to WPBR. Results were used to develop general guidelines that address climate change impacts for planning, designing, implementing, and evaluating fine-scale restoration activities.*

Keane, R. E., Holsinger, L. M., Mahalovich, M. F., & Tomback, D. F. (2017). Restoring whitebark pine ecosystems in the face of climate change. *USDA Forest Service - General Technical Report RMRS-GTR, 2017*(361), 1-123. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032329902&partnerID=40&md5=5cf2865e9a6c2e46e316eee88a1ede28.

Research Tags: Forestry, Wildlife

Abstract*: Whitebark pine (Pinus albicaulis) forests have been declining throughout their range in western North America from the combined effects of mountain pine beetle (Dendroctonus ponderosae) outbreaks, fire exclusion policies, and the exotic disease white pine blister rust (Cronartium ribicola). Projected warming and drying trends in climate may exacerbate this decline; however, whitebark pine has a wide climatic tolerance because of its broad distribution coupled with high genetic diversity. A rangewide whitebark pine restoration strategy (Keane et al. 2012b) was developed recently to inform restoration efforts for whitebark pine across Federal, State, and Provincial land management agencies. This strategy, however, did not address the effects of climate change on existing whitebark pine populations and restoration efforts. In this report, we present guidelines for restoring whitebark pine under future climates using the rangewide restoration strategy structure. The information to create the guidelines came from two sources: (1) a comprehensive review of the literature and (2) a modeling experiment that simulated various climate change, management, and fire exclusion scenarios. The general guidelines presented here are to be used with the rangewide strategy to address climate change impacts for planning, designing, implementing, and evaluating fine-scale restoration activities for whitebark pine by public land management agencies*

Keane, R. E., Loehman, R. A., Holsinger, L. M., Falk, D. A., Higuera, P., Hood, S. M., & Hessburg, P. F. (2018). Use of landscape simulation modeling to quantify resilience for ecological applications. *Ecosphere*, *9*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054863553&doi=10.1002%2fecs2.2414&partnerID=40&md5=0011b9d7023b1d4d55265339eb332c7d. doi:10.1002/ecs2.2414

Research Tags: Research

Abstract: *Goals of fostering ecological resilience are increasingly used to guide U.S. public land management in the context of anthropogenic climate change and increasing landscape disturbances. There are, however, few operational means of assessing the resilience of a landscape or ecosystem. We present a method to evaluate resilience using simulation modeling. In this method, we use historical conditions (e.g., in North America, prior to European settlement), quantified using simulation modeling, to provide a comparative reference for contemporary conditions, where substantial departures indicate loss of resilience. Contemporary ecological conditions are compared statistically to the historical time series to create a resilience index, which can be used to prioritize landscapes for treatment and inform possible treatments. However, managing for resilience based on historical conditions is tenuous in the Anthropocene, which is characterized by rapid climate change, extensive human land use, altered disturbance regimes, and exotic species introductions. To account for the future variability of ecosystems resulting from climate and disturbance regime shifts, we augment historical* *simulations with simulations of ecosystem dynamics under projected climate and land use changes to assess the degree of departure from benchmark historical conditions. We use a mechanistic landscape model (FireBGCv2) applied to a large landscape in western Montana, USA, to illustrate the methods presented in this paper. Spatially explicit ecosystem modeling provides the vehicle to generate the historical and future time series needed to quantify potential resilience conditions associated with past and potential future conditions. Our methods show that given selection of a useful set of metrics, managers could use simulations like ours to evaluate potential future management directions.*

Keane, R. E., Mahalovich, M. F., Bollenbacher, B. L., Manning, M. E., Loehman, R. A., Jain, T. B., . . . Larson, A. J. (2018) Effects of Climate Change on Forest Vegetation in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 59-95).
Research Tags: Forestry, Weather
Abstract: *Increasing air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of tree, shrub, and grass species throughout the Northern Rockies, with drought tolerant species becoming more competitive. The earliest changes will be at ecotones between lifeforms (e.g., upper and lower treelines). Ecological disturbance, including wildfire and insect outbreaks, will be the primary facilitator of vegetation change, and future forest landscapes may be dominated by younger age classes and smaller trees. High-elevation forests will be especially vulnerable if disturbance frequency increases significantly. Increased abundance and distribution of non-native plant species, as well as the legacy of past land uses, create additional stress for regeneration of native forest species.*
Most strategies for conserving native tree, shrub, and grassland systems focus on increasing resilience to chronic low soil moisture, and to more frequent and extensive ecological disturbance. These strategies generally include managing landscapes to reduce the severity and patch size of disturbances, encouraging fire to play a more natural role, and protecting refugia where fire-sensitive species can persist. Increasing species, genetic, and landscape diversity (spatial pattern, structure) is an important "hedge your bets" strategy that will reduce the risk of major forest loss. Adaptation tactics include using silvicultural prescriptions (especially stand density management) and fuel treatments to reduce fuel continuity, reducing populations of nonnative species, potentially using multiple genotypes in reforestation, and revising grazing policies and practices. Rare and disjunct species and communities (e.g., whitebark pine, quaking aspen) require adaptation strategies and tactics focused on encouraging regeneration, preventing damage from disturbance, and establishing refugia.

Keena, M. A., & Sánchez, V. (2018). Reproductive Behaviors of Anoplophora glabripennis (Coleoptera: Cerambycidae) in the Laboratory. *Journal of Economic Entomology, 111*(2), 620-628. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045146267&doi=10.1093%2fjee%2ftox355&partnerID=40&md5=6fb4f9608b205d471db042dfe7fba47d. doi:10.1093/jee/tox355
Research Tags:
Abstract:

Kelley, C. J., Keller, C. K., Brooks, E. S., Smith, J. L., Huyck Orr, C., & Evans, R. D. (2017). Water and nitrogen movement through a semiarid dryland agricultural catchment: Seasonal and decadal trends. *Hydrological Processes, 31*(10), 1889-1899. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016563143&doi=10.1002%2fhyp.11152&partnerID=40&md5=34361b12c07a94833ce882e99ebc76d8. doi:10.1002/hyp.11152
Research Tags: Wildlife
Abstract: *The reproductive behaviors of individual pairs of Anoplophora glabripennis (Motschulsky) (Coleoptera: Cerambycidae)—all combinations of three populations and three different ages—were observed in glass jars in the laboratory on Acer saccharum Marshall (Sapindales: Sapindaceae) host material. The virgin female occasionally made first contact, but mounting did not occur until the male antennated or palpated the female. If the female was receptive (older females initially less receptive than younger ones), the male mated with her immediately after mounting and initiated a prolonged pair-bond. When the female was not receptive, some males abandoned the attempt while most performed a short antennal wagging behavior. During the pair-bond, the male continuously grasped the female's elytral margins with his prothoracic tarsi or both pro- and mesothoracic tarsi. The male copulated in a series of three to four bouts (averaging three to five*

copulations each) during which the female chewed oviposition sites or walked on the host. Between bouts, the female oviposited and fertile eggs were deposited as soon as 43 min after the first copulation. Females became unreceptive again after copulation and the duration of the pair-bond depended on the male's ability to remain mounted. Some population differences were seen which may be climatic adaptations. A single pair-bond was sufficient for the female to achieve ~60% fertility for her lifetime, but female fecundity declined with age at mating. Under eradication conditions, mates will become more difficult to find and females that find mates will likely produce fewer progeny because they will be older at the time of mating.

Kennedy, M. C., McKenzie, D., Tague, C., & Dugger, A. L. (2017). Balancing uncertainty and complexity to incorporate fire spread in an eco-hydrological model. *International Journal of Wildland Fire, 26*(8), 706-718. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027270885&doi=10.1071%2fWF16169&partnerID=40&md5=34e44de8b505b318b6c6ea2d1706ea52. doi:10.1071/WF16169

Research Tags: Weather, Water

Abstract: *Wildfire affects the ecosystem services of watersheds, and climate change will modify fire regimes and watershed dynamics. In many eco-hydrological simulations, fire is included as an exogenous force. Rarely are the bidirectional feedbacks between watersheds and fire regimes integrated in a simulation system because the eco-hydrological model predicts variables that are incompatible with the requirements of fire models. WMFire is a fire-spread model of intermediate complexity designed to be integrated with the Regional Hydro-ecological Simulation System (RHESSys). Spread in WMFire is based on four variables that (i) represent known influences on fire spread: litter load, relative moisture deficit, wind direction and topographic slope, and (ii) are derived directly from RHESSys outputs. The probability that a fire spreads from pixel to pixel depends on these variables as predicted by RHESSys. We tested a partial integration between WMFire and RHESSys on the Santa Fe (New Mexico) and the HJ Andrews (Oregon State) watersheds. Model assessment showed correspondence between expected spatial patterns of spread and seasonality in both watersheds. These results demonstrate the efficacy of an approach to link eco-hydrologic model outputs with a fire spread model. Future work will develop a fire effects module in RHESSys for a fully coupled, bidirectional model.*

Kerns, B. K., Powell, D. C., Mellmann-Brown, S., Carnwath, G., & Kim, J. B. (2018). Effects of projected climate change on vegetation in the Blue Mountains ecoregion, USA. *10*, 33-43. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85024125536&doi=10.1016%2fj.cliser.2017.07.002&partnerID=40&md5=1127190b507d727fcecaa998c90ef4f4. doi:10.1016/j.cliser.2017.07.002

Research Tags: Research, Forestry

Abstract: *We used autecological, paleoecological, and modeling information to explore the potential effects of climate change on vegetation in the Blue Mountains ecoregion, Oregon (USA). Although uncertainty exists about the exact nature of future vegetation change, we infer that the following are likely to occur by the end of the century: (1) dominance of ponderosa pine and sagebrush will increase in many locations, (2) the forest-steppe ecotone will move upward in latitude and elevation, (3) ponderosa pine will be distributed at higher elevations, (4) subalpine and alpine systems will be replaced by grass species, pine, and Douglas-fir, (5) moist forest types may increase under wetter scenarios, (6) the distribution and abundance of juniper woodlands may decrease if the frequency and extent of wildfire increase, and (7) grasslands and shrublands will increase at lower elevations. Tree growth in energy-limited landscapes (high elevations, north aspects) will increase as the climate warms and snowpack decreases, whereas tree growth in water-limited landscapes (low elevations, south aspects) will decrease. Ecological disturbances, including wildfire, insect outbreaks, and non-native species, which are expected to increase in a warmer climate, will affect species distribution, tree age, and vegetation structure, facilitating transitions to new combinations of species and vegetation patterns. In dry forests where fire has not occurred for several decades, crown fires may result in high tree mortality, and the interaction of multiple disturbances and stressors will probably exacerbate stress complexes. Increased disturbance will favor species with physiological and phenological traits that allow them to tolerate frequent disturbance.*

Kerr, A., Dialesandro, J., Steenwerth, K., Lopez-Brody, N., & Elias, E. (2018). Vulnerability of California specialty crops to projected mid-century temperature changes. *Climatic Change, 148*(3), 419-436. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028976740&doi=10.1007%2fs10584-017-2011-3&partnerID=40&md5=2bde519e15c4038bde1b45c72d2d1332. doi:10.1007/s10584-017-2011-3

Research Tags: Crops, Weather

Abstract: *Increasing global temperatures are likely to have major impacts on agriculture, but the effects will vary by crop and location. This paper describes the temperature sensitivity and exposure of selected specialty crops in California. We used literature synthesis to create several sensitivity indices (from 1 to 4) to changes in winter minimum and summer maximum temperature for the top 14 specialty crops. To estimate exposure, we used seasonal period change analysis of mid-century minimum and maximum temperature changes downscaled to county level from CMIP5 models. We described crop vulnerability on a county basis as (crop sensitivity index × county climate exposure × area of crop in county); individual crop vulnerabilities were combined to create an aggregate index of specialty crop vulnerability by county. We also conducted analyses scaled by crop value rather than area, and normalized to total specialty crop area in each county. Our analyses yielded a spatial assessment highlighting seasons and counties of highest vulnerability. Winter and summer vulnerability are correlated, but not highly so. High-producing counties (e.g., Fresno County in the San Joaquin Valley) are the most vulnerable in absolute terms, while northern Sacramento Valley counties are the most vulnerable in relative terms, due to their reliance on heat-sensitive perennial crops. Our results illustrate the importance of examining crop vulnerability from different angles. More physiological and economic research is needed to build a comprehensive picture of specialty crop vulnerability to climate change.*

Khaleel, A. A., Sauer, T. J., & Tyndall, J. C. (2019). Changes in deep soil organic carbon and soil properties beneath tree windbreak plantings in the U.S. Great Plains. *Agroforestry Systems*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070074207&doi=10.1007%2fs10457-019-00425-0&partnerID=40&md5=ed2c578c13cfdf16e52fcfc2d227ed38. doi:10.1007/s10457-019-00425-0

Research Tags: Grassland, Soil

Abstract: *Agroforestry systems such as tree windbreaks became a common practice in the U.S. Great Plains following a large tree planting program during the Dust Bowl of the 1930s. Tree windbreaks combine the potential to increase biomass and soil carbon (C) storage while maintaining agricultural production. However, our understanding of the effect of trees on soil organic carbon (SOC) is largely limited to the upper 30 cm of the soil. This study was conducted in the Great Plains to examine the impact of tree plantings ranging in age from 15 to ~ 115-years on SOC storage and relevant soil properties. We quantified SOC stocks to 1.25 m depth within eight tree plantings and in the adjacent farmed fields within the same soil map unit. Soil samples were also analyzed for inorganic carbon, total nitrogen, pH (in water and KCl), bulk density, and water stable aggregates. Averaged across sites, SOC stocks in the 1.25 m were 16% higher beneath trees than the adjacent farmed fields. Differences ranged from + 10.54 to a – 5.05 kg m−2 depending on the site, climate, and tree species and age. The subsurface soils (30-125 cm) beneath trees stored 7% more SOC stocks than the surface 30 cm (9.54 vs. 8.84 kg m−2), respectively. This finding demonstrates the importance of quantifying C stored at deeper depths under tree-based systems when tree SOC sequestration is being assessed. Overall, our results indicate the potential of trees to store C in soils and at deeper depths.*

Khan, I. M. P., Moglen, G. E., Hubacek, K., & Brubaker, K. L. (2019). Future Storm Frequency and Runoff in Small US Mid-Atlantic Watersheds Evaluated Using Capture Depth. *Journal of Sustainable Water in the Built Environment, 5*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065228421&doi=10.1061%2fJSWBAY.0000879&partnerID=40&md5=fcca23f039c0b3923b835d6a5a51e4ef. doi:10.1061/JSWBAY.0000879

Research Tags: Water

Abstract: *Due to climate change and urbanization, runoff events will become more frequent, resulting in increased potential for flooding and soil erosion. To understand the hydrologic impacts of various climate change and urbanization scenarios in the state of Maryland, this study assesses the frequency, intensity, and associated runoff conditions of index storm events as hydrologic indicators for stormwater management. The analyzed events are defined as capture depth, that is, the depth of event precipitation that accounts for a specified fraction (85%, 90%, 95%, and 99%) of total rainfall when all event depths are ranked and cumulated. Four representative watersheds (area of approximately 3 km2) are analyzed across four populous counties in Maryland. A statistically significant increasing trend in the frequency of these events is observed during the* *historical period 1981–2015. For the future period 2016–2035, an ensemble of bias-corrected Coupled Model Intercomparison Project (CMIP5) models shows an increase of 1%–5% in mean precipitation. Two different downscaling methods are applied to generate time series of future event precipitation for the study watersheds from the CMIP models: change factor (CF) and multivariate adaptive constructed analogs (MACA). Modest increases in the frequency of events in the 85%–99% range of capture depth are observed across all counties. Runoff associated with events greater than the 85% capture depth is computed using the Natural Resources Conservation Service curve number method. Both the CF and MACA projected future precipitation time series are used to calculate the response to 24-h precipitation under two scenarios: (1) climate change, and (2) climate change plus urbanization. Runoff frequency distribution modeled under both scenarios indicate that climate change is more influential than urbanization in this region. In addition, storage volumes for enhanced bioretention using CF-based future climate projections show that both climate change and urbanization have similar potential to affect stormwater management costs.*

Kim, B., Cho, I. S., Kim, I. H., Choi, G. W., Ju, H. K., Hu, W. X., . . . Lim, H. S. (2019). Length of poly(A) tail affects transcript infectivity of three ZYMV symptom variants differing at only five amino acid positions. *Journal of Plant Pathology*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066903907&doi=10.1007%2fs42161-019-00316-4&partnerID=40&md5=7886efd1bdf39d74a7b04418fc4c774b. doi:10.1007/s42161-019-00316-4
Research Tags: Crops
Abstract: *The incidence of plant virus diseases infecting important cucurbit vegetables in Korea has increased as new isolates have been introduced, associated with warming temperatures and vector movement caused by climate change. Transcript infectivity of full-length infectious clones of three new ZYMV isolates was dependent upon the length of the poly(A) tract; transcripts with 55 A residues were inefficiently infectious, whereas 60 A residues resulted in highly efficient infection and significantly reduced time to production of systemic symptoms. Sequences of isolates BR1 (MH042024), BR2 (MH042025), and BR3 (MH042026) showed 99% pair-wise identity and differed at only five amino acid positions in: HC-Pro (D134N in BR2), CI (F31 L in BR1), and 6 K2 (A24V in BR3), and two positions in NIb (T300S in BR2, H429Q in BR3). Cucurbita pepo plants inoculated with transcripts of clones with these amino acid differences showed symptoms that ranged from mild to severe. Phylogenetic analysis of these new ZYMV isolates with previously characterized isolates indicated that the new isolates had 87.8–97.5% identity to other ZYMV isolates and were most closely related to recent ZYMV isolates from Australia and Spain.*

Kim, D., Oren, R., Clark, J. S., Palmroth, S., Oishi, A. C., McCarthy, H. R., . . . Johnsen, K. (2017). Dynamics of soil CO<inf>2</inf> efflux under varying atmospheric CO<inf>2</inf> concentrations reveal dominance of slow processes. *Global Change Biology, 23*(9), 3501-3512. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019074899&doi=10.1111%2fgcb.13713&partnerID=40&md5=1fb1c435b797dd261f2c008d534e828a. doi:10.1111/gcb.13713
Research Tags: Soil
Abstract: *We evaluated the effect on soil CO2 efflux (FCO2) of sudden changes in photosynthetic rates by altering CO2 concentration in plots subjected to +200 ppmv for 15 years. Five-day intervals of exposure to elevated CO2 (eCO2) ranging 1.0–1.8 times ambient did not affect FCO2. FCO2 did not decrease until 4 months after termination of the long-term eCO2 treatment, longer than the 10 days observed for decrease of FCO2 after experimental blocking of C flow to belowground, but shorter than the ~13 months it took for increase of FCO2 following the initiation of eCO2. The reduction of FCO2 upon termination of enrichment (~35%) cannot be explained by the reduction of leaf area (~15%) and associated carbohydrate production and allocation, suggesting a disproportionate contraction of the belowground ecosystem components; this was consistent with the reductions in base respiration and FCO2-temperature sensitivity. These asymmetric responses pose a tractable challenge to process-based models attempting to isolate the effect of individual processes on FCO2.*

Kim, D., Stoddart, N., Rotz, C. A., Veltman, K., Chase, L., Cooper, J., . . . Thoma, G. J. (2019). Analysis of beneficial management practices to mitigate environmental impacts in dairy production systems around the Great Lakes. *Agricultural Systems, 176*. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069674195&doi=10.1016%2fj.agsy.2019.102660&partnerID=40&md5=dceda17a4c0905f6c2d3ac8a3b9998a5. doi:10.1016/j.agsy.2019.102660
Research Tags: Livestock, Water
Abstract: *The influence of farm-specific beneficial management practices (BMPs) on a set of comprehensive environmental impacts was characterized and quantified for two representative dairy farms in the Great Lakes region (a large 1500-cow farm in New York (NY) and a smaller 150-cow farm in Wisconsin (WI)). Comparative benefits or drawbacks of the effect of the adoption of selected management scenarios to environmental impacts were estimated by coupling the output from the Integrated Farm System Model (IFSM) to provide lifecycle inventory data for SimaPro©. The small dairy farm in WI generated a consistently larger carbon footprint than the large dairy farm in NY due to greater enteric methane (CH4) emissions from different feeds fed and greater nitrous oxide (N2O) emissions from the bedded pack housing facility for young stock. The flare scenario of burning biogas produced in a covered manure storage on the small farm and a whole-farm mitigation plan of combined feed, field, and manure management in the large farm demonstrate significant potential to reduce overall carbon footprint by 20.0% and 25.8%, respectively, compared to the baselines. The assessments of selective impact categories such as fossil energy use, water use, land occupation, aquatic eutrophication, terrestrial acidification, respiratory effects, human toxicity, and ecotoxicity are discussed and highlight hot spots relevant for sustainable dairy farm management. Normalization analysis indicates that eutrophication potential is the largest relative impact profile, which suggests that efforts to mitigate eutrophication can achieve relatively greater environmental impact reduction. Although this study identifies the beneficial adaptation of sustainable dairy production practices on individual impact profiles, trade-offs between impact categories make the analysis more complex when considering the comprehensive suite of environmental impacts.*

Kim, J. B., Kerns, B. K., Drapek, R. J., Pitts, G. S., & Halofsky, J. E. (2018). Simulating vegetation response to climate change in the Blue Mountains with MC2 dynamic global vegetation model. *10*, 20-32. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045835466&doi=10.1016%2fj.cliser.2018.04.001&partnerID=40&md5=f0a8cfa1c07a2e3bd367b91b0e940f91. doi:10.1016/j.cliser.2018.04.001
Research Tags: Forestry, Weather
Abstract: *Warming temperatures are projected to greatly alter many forests in the Pacific Northwest. MC2 is a dynamic global vegetation model, a climate-aware, process-based, and gridded vegetation model. We calibrated and ran MC2 simulations for the Blue Mountains Ecoregion, Oregon, USA, at 30 arc-second spatial resolution. We calibrated MC2 using the best available spatial datasets from land managers. We ran future simulations using climate projections from four global circulation models (GCM) under representative concentration pathway 8.5. Under this scenario, forest productivity is projected to increase as the growing season lengthens, and fire occurrence is projected to increase steeply throughout the century, with burned area peaking early- to mid-century. Subalpine forests are projected to disappear, and the coniferous forests to contract by 32.8%. Large portions of the dry and mesic forests are projected to convert to woodlands, unless precipitation were to increase. Low levels of change are projected for the Umatilla National Forest consistently across the four GCM's. For the Wallowa-Whitman and the Malheur National Forest, forest conversions are projected to vary more across the four GCM-based simulations, reflecting high levels of uncertainty arising from climate. For simulations based on three of the four GCMs, sharply increased fire activity results in decreases in forest carbon stocks by the mid-century, and the fire activity catalyzes widespread biome shift across the study area. We document the full cycle of a structured approach to calibrating and running MC2 for transparency and to serve as a template for applications of MC2.*

Kim, J. B., Marcot, B. G., Olson, D. H., Van Horne, B., Vano, J. A., Hand, M. S., . . . D'amore, D. V. (2017). Climate-smart approaches to managing forests. In *People, Forests, and Change: Lessons from the Pacific Northwest* (pp. 225-242).
Research Tags: Forestry
No Abstract:

Kim, J. B., Monier, E., Sohngen, B., Pitts, G. S., Drapek, R., McFarland, J., . . . Cole, J. (2017). Assessing climate change impacts, benefits of mitigation, and uncertainties on major global forest regions under multiple

socioeconomic and emissions scenarios. *Environmental Research Letters, 12*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018513427&doi=10.1088%2f1748-9326%2faa63fc&partnerID=40&md5=ec4a8208d266d8cdfe1a446c35b9aa07. doi:10.1088/1748-9326/aa63fc
Research Tags: Forestry, Research
Abstract: *We analyze a set of simulations to assess the impact of climate change on global forests where MC2 dynamic global vegetation model (DGVM) was run with climate simulations from the MIT Integrated Global System Model-Community Atmosphere Model (IGSM-CAM) modeling framework. The core study relies on an ensemble of climate simulations under two emissions scenarios: a business-as-usual reference scenario (REF) analogous to the IPCC RCP8.5 scenario, and a greenhouse gas mitigation scenario, called POL3.7, which is in between the IPCC RCP2.6 and RCP4.5 scenarios, and is consistent with a 2 °C global mean warming from pre-industrial by 2100. Evaluating the outcomes of both climate change scenarios in the MC2 model shows that the carbon stocks of most forests around the world increased, with the greatest gains in tropical forest regions. Temperate forest regions are projected to see strong increases in productivity offset by carbon loss to fire. The greatest cost of mitigation in terms of effects on forest carbon stocks are projected to be borne by regions in the southern hemisphere. We compare three sources of uncertainty in climate change impacts on the world's forests: emissions scenarios, the global system climate response (i.e. climate sensitivity), and natural variability. The role of natural variability on changes in forest carbon and net primary productivity (NPP) is small, but it is substantial for impacts of wildfire. Forest productivity under the REF scenario benefits substantially from the CO2 fertilization effect and that higher warming alone does not necessarily increase global forest carbon levels. Our analysis underlines why using an ensemble of climate simulations is necessary to derive robust estimates of the benefits of greenhouse gas mitigation. It also demonstrates that constraining estimates of climate sensitivity and advancing our understanding of CO2 fertilization effects may considerably reduce the range of projections.*

Kim, J. H., Hwang, T., Yang, Y., Schaaf, C. L., Boose, E., & Munger, J. W. (2018). Warming-Induced Earlier Greenup Leads to Reduced Stream Discharge in a Temperate Mixed Forest Catchment. *Journal of Geophysical Research: Biogeosciences, 123*(6), 1960-1975. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049846561&doi=10.1029%2f2018JG004438&partnerID=40&md5=576fe64268b5fbfa3b61602eb66aabf9. doi:10.1029/2018JG004438
Research Tags: Forestry, Weather
Abstract: *The phenological response of vegetation to ongoing climate change may have great implications for hydrological regimes in the eastern United States. However, there have been few studies that analyze its resultant effect on catchment discharge dynamics, separating from dominant climatic controls. In this study, we examined the net effect of phenological variations on the long-term and interannual gross primary production (GPP) and evapotranspiration (ET) fluxes in a temperate deciduous forest, as well as on the catchment discharge behavior in a mixed deciduous-conifer forest catchment. First, we calibrated the spring and autumn leaf phenology models for the Harvard Forest in the northeastern United States, where the onsets of greenup and senescence have been significantly advanced and delayed, 10.3 and 6.0 days respectively, over the past two decades (1992–2011). We then integrated the phenology models into a mechanistic watershed ecohydrological model (RHESSys), which improved the interannual and long-term simulations of both the plot-scale daily GPP and ET fluxes and the catchment discharge dynamics. We found that the phenological changes amplified the long-term increases in GPP and ET driven by the climatic controls. In particular, the earlier greenup onsets resulted in increases in annual ET significantly, while the delayed senescence onsets had less influence. Consequently, the earlier greenup onsets reduced stream discharge not only during the growing season but also during the following dormant season due to soil water depletion. This study highlights the importance of understanding vegetation response to ongoing climate change in order to predict the future hydrological nonstationarity in this region.*

Kim, M., Boithias, L., Cho, K. H., Silvera, N., Thammahacksa, C., Latsachack, K., . . . Ribolzi, O. (2017). Hydrological modeling of Fecal Indicator Bacteria in a tropical mountain catchment. *Water Research, 119*, 102-113. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018516545&doi=10.1016%2fj.watres.2017.04.038&partnerID=40&md5=882c3b59a5f864ba7c6d0406a6443999. doi:10.1016/j.watres.2017.04.038

Research Tags: Water
Abstract: *The occurrence of pathogen bacteria in surface waters is a threat to public health worldwide. In particular, inadequate sanitation resulting in high contamination of surface water with pathogens of fecal origin is a serious issue in developing countries such as Lao P.D.R. Despite the health implications of the consumption of contaminated surface water, the environmental fate and transport of pathogens of fecal origin and their indicators (Fecal Indicator Bacteria or FIB) are still poorly known in tropical areas. In this study, we used measurements of flow rates, suspended sediments and of the FIB Escherichia coli (E. coli) in a 60-ha catchment in Northern Laos to explore the ability of the Soil and Water Assessment Tool (SWAT) to simulate watershed-scale FIB fate and transport. We assessed the influences of 3 in-stream processes, namely bacteria deposition and resuspension, bacterial regrowth, and hyporheic exchange (i.e. transient storage) on predicted FIB numbers. We showed that the SWAT model in its original version does not correctly simulate small E. coli numbers during the dry season. We showed that model's performance could be improved when considering the release of E. coli together with sediment resuspension. We demonstrated that the hyporheic exchange of bacteria across the Sediment-Water Interface (SWI) should be considered when simulating FIB concentration not only during wet weather, but also during the dry season, or baseflow period. In contrast, the implementation of the regrowth process did not improve the model during the dry season without inducing an overestimation during the wet season. This work thus underlines the importance of taking into account in-stream processes, such as deposition and resuspension, regrowth and hyporheic exchange, when using SWAT to simulate FIB dynamics in surface waters.*

Kim, M. S., Fonseca, N. R., Hauff, R. D., Cannon, P. G., Hanna, J. W., & Klopfenstein, N. B. (2017). First report of the root-rot pathogen, Armillaria gallica, on koa (Acacia koa) and ʻŌhiʻa lehua (Metrosideros polymorpha) on the Island of Kauaʻi, Hawaiʻi. *Plant Disease, 101*(1), 255. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012933593&doi=10.1094%2fPDIS-07-16-1043-PDN&partnerID=40&md5=e8f221fcfd1ab9f935724d9669665f73. doi:10.1094/PDIS-07-16-1043-PDN
Research Tags: Forestry
Abstract: *Koa (Acacia koa) and ʻōhiʻa lehua (Metrosideros polymorpha) are the two most dominant native tree species in Hawaiʻi. Their populations are continuously decreasing, primarily because of forest disease (Dudley et al. 2007; Keith et al. 2015) and other biotic disturbances. In April 2015, Armillaria rhizomorphs were collected from woody hosts on the island of Kauaʻi, Hawaiʻi. Based on somatic pairing tests, isolates were assigned to two genets or clones (Kōkeʻe-3 and Nuʻalolo-2) of the same species. Subsequently, these two genets were identified as A. gallica on the basis of pairing against 18 tester isolates representing six North American Armillaria spp. and translation elongation factor 1α (tef1) nucleotide sequences (GenBank accession nos. KX772408 for Kōkeʻe-3 and KX772409 for Nuʻalolo-2). From 15 replications of somatic incompatibility tests, both genets showed reasonably high intraspecific compatibility (colorless antagonism) with three A. gallica tester isolates (average 62%), but low compatibility with closely related Armillaria spp. (average 1 to 31%). Sequences of tef1 for both genets showed an identity of 98% (KF156775) and 97% (KF156772) to A. gallica with 99 to 100% coverage. In Hawaiʻi, A. gallica has been reported on the Big Island of Hawaiʻi on Monterey pine (Pinus radiata), loblolly pine (P. taeda), māmane (Sophora chrysophylla), and Methley plum (Prunus sp.) (Kim et al. 2010). This study identified four new host associations in Kauaʻi, but only two of these hosts showed both signs and symptoms of root disease. Genet Kōkeʻe-3 comprised one isolate collected from a dying, mature koa tree in the west Puʻu ka Pele Forest Reserve (22°05'38.34" N, 159°41'27.42" W, elevation 876 m) approximately 1.45 km northwest of Lua Reservoir. The crown of the koa tree showed severe dieback (>75% dead) with decayed roots and flaccid/senescing leaves. Genet Nuʻalolo-2 consisted of five isolates collected at the head of Nuʻalolo trail (22°07'46.08" N, 159°39'35.82" W, elevation 1,124 m), approximately 5.07 km northeast of the Kōkeʻe-3 collection. These isolates were collected from koa and ʻōhiʻa lehua with crown dieback/thinning and root decay, in addition to apparently healthy karaka nut (Corynocarpus laevigatus; introduced from New Zealand) and ʻālaʻa (Pouteria sandwicensis; endemic in Hawaiʻi). Koa symptoms at Nuʻalolo trail were similar to those associated with the Kōkeʻe-3 genet, except <25% of the crown was dead/dying at the time of collection. Above-ground symptoms on mature koa trees from each site were similar to koa-wilt disease caused by Fusarium oxysporum f. sp. koae (Dudley et al. 2007); however, the koa-wilt pathogen was not recovered from root samples from either tree. Interestingly, A. gallica genet Nuʻalolo-2 was collected from diseased ʻōhiʻa lehua (50 cm dbh), symptomless karaka nut, and symptomless ʻālaʻa, which were all growing in close proximity. A.*

gallica has a wide host range, it displays diverse ecological behaviors, and phylogenetic studies suggest it likely comprises a species complex (Kim et al. 2012). It can act as an opportunistic and/or primary pathogen (Brazee and Wick 2009), especially under stressors, such as climate change. Although A. gallica was isolated from multiple hosts in forests of Kaua'i and the Big Island of Hawai'i, continued surveys are needed to document distribution of A. gallica on diverse native and exotic tree species throughout the Hawaiian Islands, especially in relation to climate change.

Kim, S., Kiniry, J. R., Williams, A. S., Meki, N., Gaston, L., Brakie, M., . . . Wu, Y. (2017). Adaptation of C<inf>4</inf> bioenergy crop species to various environments within the Southern Great Plains of USA. *Sustainability (Switzerland), 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011019520&doi=10.3390%2fsu9010089&partnerID=40&md5=86772b02904fba3dfd873854faee7c6e. doi:10.3390/su9010089
Research Tags: Energy, Crops, Grassland
Abstract: *As highly productive perennial grasses are evaluated as bioenergy feedstocks, a major consideration is biomass yield stability. Two experiments were conducted to examine some aspects of yield stability for two biofuel species: switchgrass (Panicum vigratum L.) and Miscanthus x giganteus (Mxg). Biomass yields of these species were evaluated under various environmental conditions across the Southern Great Plains (SGP), including some sites with low soil fertility. In the first experiment, measured yields of four switchgrass ecotypes and Mxg varied among locations. Overall, plants showed optimal growth performance in study sites close to their geographical origins. Lowland switchgrass ecotypes and Mxg yields simulated by the ALMANAC model showed reasonable agreement with the measured yields across all study locations, while the simulated yields of upland switchgrass ecotypes were overestimated in northern locations. In the second experiment, examination of different N fertilizer rates revealed switchgrass yield increases over the range of 0, 80, or 160 kg N ha−1 year−1, while Mxg only showed yield increases between the low and medium N rates. This provides useful insights to crop management of two biofuel species and to enhance the predictive accuracy of process-based models, which are critical for developing bioenergy market systems in the SGP.*

Kimball, B. A., Alonso-Rodríguez, A. M., Cavaleri, M. A., Reed, S. C., González, G., & Wood, T. E. (2018). Infrared heater system for warming tropical forest understory plants and soils. *Ecology and Evolution, 8*(4), 1932-1944. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040701512&doi=10.1002%2fece3.3780&partnerID=40&md5=8249ce7359f8252c7ce3f7855b10b0d4. doi:10.1002/ece3.3780
Research Tags: Forestry
Abstract: *The response of tropical forests to global warming is one of the largest uncertainties in predicting the future carbon balance of Earth. To determine the likely effects of elevated temperatures on tropical forest understory plants and soils, as well as other ecosystems, an infrared (IR) heater system was developed to provide in situ warming for the Tropical Responses to Altered Climate Experiment (TRACE) in the Luquillo Experimental Forest in Puerto Rico. Three replicate heated 4-m-diameter plots were warmed to maintain a 4°C increase in understory vegetation compared to three unheated control plots, as sensed by IR thermometers. The equipment was larger than any used previously and was subjected to challenges different from those of many temperate ecosystem warming systems, including frequent power surges and outages, high humidity, heavy rains, hurricanes, saturated clayey soils, and steep slopes. The system was able to maintain the target 4.0°C increase in hourly average vegetation temperatures to within ± 0.1°C. The vegetation was heterogeneous and on a 21° slope, which decreased uniformity of the warming treatment on the plots; yet, the green leaves were fairly uniformly warmed, and there was little difference among 0–10 cm depth soil temperatures at the plot centers, edges, and midway between. Soil temperatures at the 40–50 cm depth increased about 3°C compared to the controls after a month of warming. As expected, the soil in the heated plots dried faster than that of the control plots, but the average soil moisture remained adequate for the plants. The TRACE heating system produced an adequately uniform warming precisely controlled down to at least 50-cm soil depth, thereby creating a treatment that allows for assessing mechanistic responses of tropical plants and soil to warming, with applicability to other ecosystems. No physical obstacles to scaling the approach to taller vegetation (i.e., trees) and larger plots were observed.*

Kimball, H. L., Selmants, P. C., Moreno, A., Running, S. W., & Giardina, C. P. (2017). Evaluating the role of land cover and climate uncertainties in computing gross primary production in Hawaiian Island ecosystems. *PLoS ONE, 12*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029349510&doi=10.1371%2fjournal.pone.0184466&partnerID=40&md5=f6d013997e13cb65a0dc2caa31e9b1c5. doi:10.1371/journal.pone.0184466

Research Tags: Research

Abstract: *Gross primary production (GPP) is the Earth's largest carbon flux into the terrestrial biosphere and plays a critical role in regulating atmospheric chemistry and global climate. The Moderate Resolution Imaging Spectrometer (MODIS)-MOD17 data product is a widely used remote sensing-based model that provides global estimates of spatiotemporal trends in GPP. When the MOD17 algorithm is applied to regional scale heterogeneous landscapes, input data from coarse resolution land cover and climate products may increase uncertainty in GPP estimates, especially in high productivity tropical ecosystems. We examined the influence of using locally specific land cover and high-resolution local climate input data on MOD17 estimates of GPP for the State of Hawaii, a heterogeneous and discontinuous tropical landscape. Replacing the global land cover data input product (MOD12Q1) with Hawaii-specific land cover data reduced statewide GPP estimates by ~8%, primarily because the Hawaii-specific land cover map had less vegetated land area compared to the global land cover product. Replacing coarse resolution GMAO climate data with Hawaii-specific high-resolution climate data also reduced statewide GPP estimates by ~8% because of the higher spatial variability of photosynthetically active radiation (PAR) in the Hawaii-specific climate data. The combined use of both Hawaii-specific land cover and high-resolution Hawaii climate data inputs reduced statewide GPP by ~16%, suggesting equal and independent influence on MOD17 GPP estimates. Our sensitivity analyses within a heterogeneous tropical landscape suggest that refined global land cover and climate data sets may contribute to an enhanced MOD17 product at a variety of spatial scales.*

King, D. T., Wang, G., Yang, Z., & Fischer, J. W. (2017). Advances and environmental conditions of spring migration phenology of American white pelicans. *Scientific Reports, 7*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009874227&doi=10.1038%2fsrep40339&partnerID=40&md5=c6fb4b9c8363c67a0efb31d9e4f7d0b7. doi:10.1038/srep40339

Research Tags: Wildlife, Weather

Abstract: *Spring migration phenology of birds has advanced under warming climate. Migration timing of short-distance migrants is believed to be responsive to environmental changes primarily under exogenous control. However, understanding the ecological causes of the advancement in avian spring migration phenology is still a challenge due to the lack of long-term precise location data. We used 11 years of Global Positioning System relocation data to determine four different migration dates of the annual migration cycle of the American white pelican (Pelecanus erythrorhynchos), a short-distance migrant. We also tested the hypothesis that increases in winter temperature and precipitation on the wintering grounds would advance pelican spring migration. Pelican spring departures and arrivals advanced steadily from 2002 to 2011. Spring departure timing exhibited high repeatability at the upper end of migration timing repeatability reported in literature. However, individual spring departure and arrival dates were not related to winter daily temperature, total winter precipitation, and detrended vegetation green-up dates indexed by the normalized difference vegetation index. Despite high repeatability, the observed between-year variation of spring departure dates was still sufficient for the advancement of spring departure timing.*

Kirker, G., Zelinka, S., Gleber, S. C., Vine, D., Finney, L., Chen, S., . . . Jakes, J. E. (2017). Synchrotron-based X-ray fluorescence microscopy enables multiscale spatial visualization of ions involved in fungal lignocellulose deconstruction. *Scientific Reports, 7*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011266017&doi=10.1038%2fsrep41798&partnerID=40&md5=d8c8b9f1ea7bb2e33d4e683ed4fdf4e0. doi:10.1038/srep41798

Research Tags: Forestry

Abstract: *The role of ions in the fungal decay process of lignocellulose biomaterials, and more broadly fungal metabolism, has implications for diverse research disciplines ranging from plant pathology and forest ecology, to carbon sequestration. Despite the importance of ions in fungal decay mechanisms, the spatial distribution and quantification of ions in lignocellulosic cell walls and fungal hyphae during decay is not known. Here we* *employ synchrotron-based X-ray fluorescence microscopy (XFM) to map and quantify physiologically relevant ions, such as K, Ca, Mn, Fe, and Zn, in wood being decayed by the model brown rot fungus Serpula lacrymans. Two-dimensional XFM maps were obtained to study the ion spatial distributions from mm to submicron length scales in wood, fungal hyphae with the dried extracellular matrix (ECM) from the fungus, and Ca oxalate crystals. Three-dimensional ion volume reconstructions were also acquired of wood cell walls and hyphae with ECM. Results show that the fungus actively transports some ions, such as Fe, into the wood and controls the distribution of ions at both the bulk wood and cell wall length scales. These measurements provide new insights into the movement of ions during decay and illustrate how synchrotron-based XFM is uniquely suited study these ions.*

Kisekka, I., DeJonge, K. C., Ma, L., Paz, J., & Douglas-Mankin, K. (2017). Crop modeling applications in agricultural water management. *Transactions of the ASABE, 60*(6), 1959-1964. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040049228&partnerID=40&md5=2173db49f47d11162afad37c0c1a14b2.
Research Tags: Crops, Water, Research
Abstract: *This article introduces the fourteen articles that comprise the "Crop Modeling and Decision Support for Optimizing Use of Limited Water" collection. This collection was developed from a special session on crop modeling applications in agricultural water management held at the 2016 ASABE Annual International Meeting (AIM) in Orlando, Florida. In addition, other authors who were not able to attend the 2016 ASABE AIM were also invited to submit papers. The articles summarized in this introductory article demonstrate a wide array of applications in which crop models can be used to optimize agricultural water management. The following section titles indicate the topics covered in this collection: (1) evapotranspiration modeling (one article), (2) model development and parameterization (two articles), (3) application of crop models for irrigation scheduling (five articles), (4) coordinated water and nutrient management (one article), (5) soil water management (two articles), (6) risk assessment of water-limited irrigation management (one article), and (7) regional assessments of climate impact (two articles). Changing weather and climate, increasing population, and groundwater depletion will continue to stimulate innovations in agricultural water management, and crop models will play an important role in helping to optimize water use in agriculture.*

Kistner, E., Kellner, O., Andresen, J., Todey, D., & Morton, L. W. (2018). Vulnerability of specialty crops to short-term climatic variability and adaptation strategies in the Midwestern USA. *Climatic Change, 146*(1-2), 145-158. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029761181&doi=10.1007%2fs10584-017-2066-1&partnerID=40&md5=4d9f8de044436398209e647df37e07d3. doi:10.1007/s10584-017-2066-1
Research Tags: Crops, Weather
Abstract: *While the Midwestern USA ranks among the world's most important corn-soybean production regions, the area also produces a variety of high-value specialty crops. These crops are an important component of the region's rural economy with an estimated value of $1.8 billion in 2012. More profitable per-acre than many row crops, specialty crops also have higher production-related risks. They are generally more sensitive to climatic stressors and require more comprehensive management compared to traditional row crops. Temperature and precipitation fluctuations across the Midwest directly impact specialty crop production quantity and quality and indirectly influence the timing of crucial farm operations and the economic impacts of pests, weeds, and diseases. Increasingly variable weather and climate change pose a serious threat to specialty crop production in the Midwest. In this article, we assess how climate variability and observed climatic trends are impacting Midwestern specialty crop production using USDA Risk Management Agency data. In addition, we review current trends in grower perceptions of risks associated with a changing climate and assess sustainable adaptation strategies. Our results indicate that weather-induced losses vary by state with excessive moisture resulting in the highest total number of claims across all Midwestern states followed by freeze and drought events. Overall, specialty crop growers are aware of the increased production risk under a changing climate and have identified the need for crop-specific weather, production, and financial risk management tools and increased crop insurance coverage.*

Kistner, E. J. (2017). Climate Change Impacts on the Potential Distribution and Abundance of the Brown Marmorated

Stink Bug (Hemiptera: Pentatomidae) with Special Reference to North America and Europe. *Environmental Entomology, 46*(6), 1212-1224. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040106492&doi=10.1093%2fee%2fnvx157&partnerID=40&md5=02a77d146f180fc76a53323bff913197. doi:10.1093/ee/nvx157

Research Tags: Crops, Wildlife

Abstract: *The invasive brown marmorated stink bug, Halyomorpha halys (Stål; Hemiptera: Pentatomidae), has recently emerged as a harmful pest of horticultural crops in North America and Europe. Native to East Asia, this highly polyphagous insect is spreading rapidly worldwide. Climate change will add further complications to managing this species in terms of both geographic distribution and population growth. This study used CLIMEX to compare potential H. halys distribution under recent and future climate models using one emission scenario (A2) with two different global circulation models, CSIRO Mk3.0 and MIROC-H. Simulated changes in seasonal phenology and voltinism were examined. Under the possible future climate scenarios, suitable range in Europe expands northward. In North America, the suitable H. halys range shifts northward into Canada and contracts from its southern temperature range limits in the United States due to increased heat stress. Prolonged periods of warm temperatures resulted in longer H. halys growing seasons. However, future climate scenarios indicated that rising summer temperatures decrease H. halys growth potential compared to recent climatic conditions, which in turn, may reduce mid-summer crop damage. Climate change may increase the number of H. halys generations produced annually, thereby enabling the invasive insect to become multivoltine in the northern latitudes of North America and Europe where it is currently reported to be univoltine. These results indicate prime horticultural production areas in Europe, the northeastern United States, and southeastern Canada are at greatest risk from H. halys under both current and possible future climates.*

Kistner-Thomas, E. J. (2019). The Potential Global Distribution and Voltinism of the Japanese Beetle (Coleoptera: Scarabaeidae) Under Current and Future Climates. *Journal of insect science (Online), 19*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063658785&doi=10.1093%2fjisesa%2fiez023&partnerID=40&md5=74cfcc4b37ac3bd6b6b8bbf3f6d514bd. doi:10.1093/jisesa/iez023

Research Tags: Wildlife, Crops

Abstract: *Japanese beetle, Popillia japonica (Newman), is a severe invasive insect pest of turf, landscapes, and horticultural crops. It has successfully colonized much of the United States and has recently established in mainland Europe. The distribution and voltinism of P. japonica will undoubtedly change as a consequence of climate change, posing additional challenges to the management of this species. To assess these challenges, a process-oriented bioclimatic niche model for P. japonica was developed to examine its potential global distribution under current (1981–2010) and projected climatic conditions (2040–2059) using one emission scenario (representative concentration pathway [RCP] 8.5) and two global climate models, ACCESS1-0 and CNRM-CM5. Under current climatic conditions, the bioclimatic niche model agreed well with all credible distribution data. Model projections indicate a strong possibility of further range expansion throughout mainland Europe under both current and future climates. In North America, projected increases in temperature would enable northward range expansion across Canada while simultaneously shifting southern range limits in the United States. In Europe, the suitable range for P. japonica would increase by 23% by midcentury, especially across portions of the United Kingdom, Ireland, and Scandinavia. Under the RCP 8.5 scenario, cumulative growing degree-days increased, thereby reducing the probability of biannual life cycles in northern latitudes where they can occur, including Hokkaido, Japan, northeastern portions of the United States, and southern Ontario, Canada. The results of this study highlight several regions of increasing and emerging risk from P. japonica that should be considered routinely in ongoing biosecurity and pest management surveys.*

Kitchen, S. G., Behrens, P. N., Goodrich, S. K., Green, A., Guyon, J., O'Brien, M., & Tart, D. (2019). Guidelines for aspen restoration in utah with applicability to the intermountain west. *USDA Forest Service - General Technical Report RMRS-GTR, 2019*(390), 1-55. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070493924&partnerID=40&md5=4ea1bf39d7304c7c1316e938f428e2b5.

Research Tags: Forestry

Abstract: *As highly productive and biologically diverse communities, healthy quaking aspen (Populus tremuloides; hereafter aspen) forests provide a wide range of ecosystem services across western North America.*

Western aspen decline during the last century has been attributed to several causes and their interactions, including altered fire regimes, drought, excessive use by domestic and wild ungulates, and conifer encroachment. Today's managers need science-based guidance to develop and implement strategies and practices to restore structure, processes, and resilience to the full range of aspen functional types across multiple spatial scales. In these guidelines, we detail a process for making step-by-step decisions about aspen restoration. The steps are: (1) assessment of aspen condition, (2) identification of problematic conditions, (3) determination of causal factors, (4) selection of appropriate response options, (5) monitoring for improvement, and (6) assessment and adaptation. We describe the need for reference areas in which the full range of natural environmental conditions and ecosystem processes associated with aspen can be observed and quantified, and provide a list of example sites for Utah. These guidelines provide a road map for decision makers to adaptively manage aspen in a time of increasing environmental stress and in anticipation of an uncertain future.

Klasson, K. T. (2017). Biochar characterization and a method for estimating biochar quality from proximate analysis results. *Biomass and Bioenergy, 96*, 50-58. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006750961&doi=10.1016%2fj.biombioe.2016.10.011&partnerID=40&md5=9eb3d5502ab8f31098cec6cb0983f3d4. doi:10.1016/j.biombioe.2016.10.011
Research Tags: Research
Abstract: *Biochar has gained significant interest in the literature, mainly for its ability to improve soil quality and sequester carbon. This work investigated if results from proximate analysis could be used to assess the quality of the biochar. Normally, ultimate analysis results are used for this purpose. A large set of data was collected from literature and various mathematical correlation were investigated to determine if quality parameters such as carbon mass fraction and H/C and O/C mol ratios could be estimated from proximate analysis results. It was determined that the mass fraction of carbon in the biochar could be correlated to the mass fractions of volatile matter (VM), fixed carbon (FC), and ash (ASH) by the relationship $C = 0.474 \times VM+0.963 \times FC+0.067 \times ASH$. The mass fraction of oxygen in biochar could also be correlated to VM, FC, and ASH, while hydrogen was best correlated to a relationship with VM, FC, and VM/FC. Atomic ratios, such as H/C and O/C, used for biochar classification by international standards and carbon sequestration potential, were best correlated to VM/FC by the expressions $H/C = 0.379 \times VM/FC+0.251$ and $O/C = 0.188 \times VM/FC+0.035$. The developed correlations were proven to accurately classify biochar when the biochar had been made at ≥400 °C.*

Klein, L. L., Miller, A. J., Ciotir, C., Hyma, K., Uribe-Convers, S., & Londo, J. (2018). High-throughput sequencing data clarify evolutionary relationships among North American Vitis species and improve identification in USDA Vitis germplasm collections. *American Journal of Botany, 105*(2), 215-226. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043696098&doi=10.1002%2fajb2.1033&partnerID=40&md5=cfc24a3a873dbc7ebb11fb3c136d59b9. doi:10.1002/ajb2.1033
Research Tags: Crops
Abstract:
Premise Of The Study
Grapes are one of the most economically important berry crops worldwide, with the vast majority of production derived from the domesticated Eurasian species Vitis vinifera. Expansion of production into new areas, development of new cultivars, and concerns about adapting grapevines for changing climates necessitate the use of wild grapevine species in breeding programs. Diversity within Vitis has long been a topic of study; however, questions remain regarding relationships between species. Furthermore, the identity of some living accessions is unclear.
Methods
This study generated 11,020 single nucleotide polymorphism (SNP) markers for more than 300 accessions in the USDA-ARS grape germplasm repository using genotyping-by-sequencing. Resulting data sets were used to reconstruct evolutionary relationships among several North American and Eurasian Vitis species, and to suggest taxonomic labels for previously unidentified and misidentified germplasm accessions based on genetic distance.
Key Results
Maximum likelihood analyses of SNP data support the monophyly of Vitis, subg. Vitis, a Eurasian subg. Vitis

clade, and a North American subg. Vitis clade. Data delineate species groups within North America. In addition, analysis of genetic distance suggested taxonomic identities for 20 previously unidentified Vitis accessions and for 28 putatively misidentified accessions.
Conclusions
This work advances understanding of Vitis evolutionary relationships and provides the foundation for ongoing germplasm enhancement. It supports conservation and breeding efforts by contributing to a growing genetic framework for identifying novel genetic variation and for incorporating new, unsampled populations into the germplasm repository system.

Klesse, S., DeRose, R. J., Guiterman, C. H., Lynch, A. M., O'Connor, C. D., Shaw, J. D., & Evans, M. E. K. (2018). Sampling bias overestimates climate change impacts on forest growth in the southwestern United States. *Nature Communications, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058730188&doi=10.1038%2fs41467-018-07800-y&partnerID=40&md5=127c2b896deaa643b1afcaf53cac8737. doi:10.1038/s41467-018-07800-y
Research Tags: Forestry, Research
Abstract: *Climate–tree growth relationships recorded in annual growth rings have recently been the basis for projecting climate change impacts on forests. However, most trees and sample sites represented in the International Tree-Ring Data Bank (ITRDB) were chosen to maximize climate signal and are characterized by marginal growing conditions not representative of the larger forest ecosystem. We evaluate the magnitude of this potential bias using a spatially unbiased tree-ring network collected by the USFS Forest Inventory and Analysis (FIA) program. We show that U.S. Southwest ITRDB samples overestimate regional forest climate sensitivity by 41–59%, because ITRDB trees were sampled at warmer and drier locations, both at the macro- and micro-site scale, and are systematically older compared to the FIA collection. Although there are uncertainties associated with our statistical approach, projection based on representative FIA samples suggests 29% less of a climate change-induced growth decrease compared to projection based on climate-sensitive ITRDB samples.*

Kline, H. N., Fulbright, T. E., Grahmann, E. D., Hernández, F., Wester, D. B., Brennan, L. A., & Hehman, M. W. (2019). Temperature influences resource use by chestnut-bellied scaled quail. *Ecosphere, 10*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062703116&doi=10.1002%2fecs2.2599&partnerID=40&md5=dd98ad11ff696c99a2543203017d41e9. doi:10.1002/ecs2.2599
Research Tags: Wildlife
Abstract: *Animals use physiological and behavioral adaptations to maintain constant body temperatures when environmental temperatures are outside of their thermoneutral zone. We define the temperature suitability bounds as the range of temperatures above and below which animals avoid locations because of unfavorable thermal conditions. Temperatures outside the temperature suitability bounds may trigger behavioral responses such as movement to cooler locations. We tested the hypothesis that temperature during late April to August influences resource selection using chestnut-bellied scaled quail (Callipepla squamata castanogastris) as our study species. We estimated temperature suitability bounds for scaled quail and tested the prediction that ground surface temperature is a better predictor of habitat space use than black globe temperature. We compared models containing ground surface temperature and woody vegetation structure variables to test the hypothesis that including woody vegetation variables improves prediction of relative probability of use. We trapped scaled quail at five different locations in southern Texas. We located quail fitted with necklace-style transmitters three times/week during 2013–2014. We measured ground surface and black globe temperatures at locations used by scaled quail and at random locations. We estimated percent canopy cover of cacti, subshrubs, and woody plants using 20 × 50 cm Daubenmire frames at each used and random location. We also estimated height and vertical obstruction of woody vegetation. Temperature suitability bounds of scaled were 24–43°C for the ground surface and 23–39°C for black globes. Ground surface temperature was a better predictor of relative probability of use than black globe temperature. Ground surface temperature during the warmest time of day (early afternoon, 13:30–17:29) decreased with increasing vertical obstruction after accounting for the influence of other structural variables. The best model for predicting relative probability of use by scaled quail during the warmest time of day included ground surface temperature and vertical obstruction. Use of microsites where vegetation structure is conducive to cooler temperatures is an important*

driver of resource selection by scaled quail during the warmest time of day in southern Texas, but availability of thermal refugia appears to be limited.

Knoepp, J. D., See, C. R., Vose, J. M., Miniat, C. F., & Clark, J. S. (2018). Total C and N Pools and Fluxes Vary with Time, Soil Temperature, and Moisture Along an Elevation, Precipitation, and Vegetation Gradient in Southern Appalachian Forests. *Ecosystems, 21*(8), 1623-1638. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045125489&doi=10.1007%2fs10021-018-0244-2&partnerID=40&md5=d2dda9e080f4ed78d37231779f0dacaa. doi:10.1007/s10021-018-0244-2
Research Tags: Forestry, Soil
Abstract: *The interactions of terrestrial C pools and fluxes with spatial and temporal variation in climate are not well understood. We conducted this study in the southern Appalachian Mountains where complex topography provides variability in temperature, precipitation, and forest communities. In 1990, we established five large plots across an elevation gradient allowing us to study the regulation of C and N pools and cycling by temperature and water, in reference watersheds in Coweeta Hydrologic Laboratory, a USDA Forest Service Experimental Forest, in western NC, USA. Communities included mixed-oak pine, mixed-oak, cove hardwood, and northern hardwood. We examined 20-year changes in overstory productivity and biomass, leaf litterfall C and N fluxes, and total C and N pools in organic and surface mineral soil horizons, and coarse wood, and relationships with growing season soil temperature and precipitation. Productivity increased over time and with precipitation. Litterfall C and N flux increased over time and with increasing temperature and precipitation, respectively. Organic horizon C and N did not change over time and were not correlated to litterfall inputs. Mineral soil C and N did not change over time, and the negative effect of temperature on soil pools was evident across the gradient. Our data show that increasing temperature and variability in precipitation will result in altered aboveground productivity. Variation in surface soil C and N is related to topographic variation in temperature which is confounded with vegetation community. Data suggest that climatic changes will result in altered aboveground and soil C and N sequestration and fluxes.*

Knott, J. A., Desprez, J. M., Oswalt, C. M., & Fei, S. (2019). Shifts in forest composition in the eastern United States. *Forest Ecology and Management, 433*, 176-183. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056238120&doi=10.1016%2fj.foreco.2018.10.061&partnerID=40&md5=c62eacb27194ee1dc79786afb1f84c1d. doi:10.1016/j.foreco.2018.10.061
Research Tags: Forestry
Abstract: *Forest ecosystems in the United States (U.S.) are facing major challenges such as climate change, exotic species invasions, and landscape fragmentation. It is widely believed that forest composition in the eastern U.S. is transitioning from shade-intolerant, fire-tolerant species to shade-tolerant, fire-intolerant species, but most evidence is anecdotal or localized. No comprehensive studies exist to quantify the shifts in forest composition across multiple genera at a regional scale. Here, we examined the genus-level compositional changes in eastern U.S. forests to: (1) quantify the extent and magnitude of this transition, and (2) assess the influence of shade and fire tolerance traits on abundance change. Genus-level data were compiled from the Forest Inventory and Analysis (FIA) database across 37 states in the eastern U.S. for the last three decades. We analyzed shifts in forest composition with three metrics—stem density, basal area, and importance value—for 10 of the most abundant genera (Acer, Betula, Carya, Fraxinus, Nyssa, Pinus, Populus, Prunus, Quercus, and Ulmus). In addition, we estimated density-weighted fire and shade tolerances for each genus using species-level published data, assessed the shifts in spatial patterns of these traits, and analyzed the associations between these traits and county-level abundance changes. In general, Acer, Fraxinus, Pinus, and Prunus increased in abundance during the study period. Acer experienced the largest increase in abundance across the study area. In contrast, Carya, Nyssa, Quercus and Ulmus decreased in abundance in the majority of the study region, with Quercus having the largest and most extensive decline. Although density-weighted shade and fire tolerances were correlated at the genus level, shade tolerance was a better predictor of genus-level abundance change than fire tolerance. Traits of fire and shade tolerance are not always interchangeable when used to predict the dynamics of a genus, and management decision making based on traits should focus at the species level when possible. Our analyses provide evidence that forest composition has shifted in the last three decades in the eastern United States across multiple genera, and the shifts are more closely related to species' shade tolerance than fire tolerance.*

Knowlton, J. L., Flaspohler, D. J., Paxton, E. H., Fukami, T., Giardina, C. P., Gruner, D. S., & Rankin, E. E. W. (2017). Movements of four native Hawaiian birds across a naturally fragmented landscape. *Journal of Avian Biology, 48*(7), 921-931. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018360903&doi=10.1111%2fjav.00924&partnerID=40&md5=3a48c443b72752ba96f0cc0314a61d56. doi:10.1111/jav.00924

Research Tags: Wildlife

Abstract: *Animals often increase their fitness by moving across space in response to temporal variation in habitat quality and resource availability, and as a result of intra and inter-specific interactions. The long-term persistence of populations and even whole species depends on the collective patterns of individual movements, yet animal movements have been poorly studied at the landscape level. We quantified movement behavior within four native species of Hawaiian forest birds in a complex lava-fragmented landscape: Hawai`i ʻamakihi Chlorodrepanis virens, ʻomaʻo Myadestes obscurus, ʻapapane Himatione sanguinea, and ʻiʻiwi Drepanis coccinea. We evaluated the relative importance of six potential intrinsic and extrinsic drivers of movement behavior and patch fidelity: 1) forest fragment size, 2) the presence or absence of invasive rats (Rattus sp.), 3) season, 4) species, 5) age, and 6) sex. The study was conducted across a landscape of 34 forest fragments varying in size from 0.07 to 12.37 ha, of which 16 had rats removed using a treatment-control design. We found the largest movements in the nectivorous ʻapapane and ʻiʻiwi, intermediate levels in the generalist Hawai`i ʻamakihi, and shortest average movement for the ʻomaʻo, a frugivore. We found evidence for larger patch sizes increasing patch fidelity only in the ʻomaʻo, and an effect of rat-removal increasing patch fidelity of Hawai`i ʻamakihi only after two years of rat-removal. Greater movement during the non-breeding season was observed in all species, and season was an important factor in explaining higher patch fidelity in the breeding season for ʻapapane and ʻiʻiwi. Sex was important in explaining patch fidelity in ʻomaʻo only, with males showing higher patch fidelity. Our results provide new insights into how these native Hawaiian species will respond to a changing environment, including habitat fragmentation and changing distribution of threats from climate change.*

Koch, J. B., Looney, C., Sheppard, W. S., & Strange, J. P. (2017). Patterns of population genetic structure and diversity across bumble bee communities in the Pacific Northwest. *Conservation Genetics, 18*(3), 507-520. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013674311&doi=10.1007%2fs10592-017-0944-8&partnerID=40&md5=8e9895b5be0eff6707c35a3fcebf483c. doi:10.1007/s10592-017-0944-8

Research Tags: Wildlife

Abstract: *Patterns of genetic structure and diversity are largely mediated by a species' ecological niche and sensitivity to climate variation. Some species with narrow ecological niches have been found to exhibit increased population differentiation, limited gene flow across populations, and reduced population genetic diversity. In this study, we examine patterns of population genetic structure and diversity of four bumble bee species that are broadly sympatric, but do not necessarily inhabit the same ecological niche in the Pacific Northwest of the United States. Testing for the effect of isolation by geographic distance (IBD) with linearized F st and D est found that Bombus sylvicola and B. mixtus exhibited significant IBD across populations. In contrast, both B. melanopygus and B. flavifrons, two species that are distributed across a broad elevation gradient, exhibited no IBD, a result further corroborated by Bayesian a priori population assignment tests. Furthermore, we discovered that B. sylvicola populations distributed on the Olympic Peninsula have significantly less average allelic diversity than populations distributed in the Cascade Mountains. Our results suggest that populations distributed in the Olympic Mountains represent a distinct genetic cluster relative to the Cascade Mountains, with B. sylvicola and B. mixtus likely experiencing the greatest degree of population genetic differentiation relative to B. flavifrons and B. melanopygus. While bumble bees are known to co-exist across a diversity of habitats, our results demonstrate that underlying population genetic structure and diversity may not necessarily be similar across species, and are largely governed by their respective niches.*

Kodandapani, N., & Parks, S. A. (2019). Effects of drought on wildfires in forest landscapes of the Western Ghats, India. *International Journal of Wildland Fire, 28*(6), 431-444. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064490738&doi=10.1071%2fWF18188&partnerID

=40&md5=a9b0c41092a6c584b844f0bd49ef172c. doi:10.1071/WF18188
Research Tags: Weather
Abstract: *Wildland fire is an understudied yet highly important disturbance agent on the Indian subcontinent. In particular, there is uncertainty regarding the degree to which annual climate variation influences inter-annual variability in fire activity. In this study, we evaluate wildland fire at two complementary spatial scales in the southern portion of the Western Ghats mountain range (hereafter 'Western Ghats') in India. At the larger regional scale, we evaluate temporal and spatial variability in fire activity from 2001 to 2015. At the smaller scale, we evaluate the relationship between annual area burned and climate variation within two landscapes nested within the Western Ghats (from c. 1996 to 2015). At the regional scale, we found that most fire activity was restricted to January–March, although substantial inter-annual variation was evident. For example, in 2004, 2009 and 2012, fire activity was approximately five times greater compared with the 3 years with the lowest fire activity. The landscape-scale analysis also revealed weak to strong correlations between annual area burned and climate variation in both landscapes. Although not the only factor influencing area burned, episodes of drought could be exerting an increasingly significant effect on wildfire activity in the Western Ghats.*

Köhler, I. H., Huber, S. C., Bernacchi, C. J., & Baxter, I. R. (2019). Increased temperatures may safeguard the nutritional quality of crops under future elevated CO<inf>2</inf> concentrations. *Plant Journal, 97*(5), 872-886. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060234067&doi=10.1111%2ftpj.14166&partnerID=40&md5=a2f075f87dcde4da7b5008816b9f0060. doi:10.1111/tpj.14166
Research Tags: Crops, Economics
Abstract: *Iron (Fe) and zinc (Zn) deficiencies are a global human health problem that may worsen by the growth of crops at elevated atmospheric CO2 concentration (eCO2). However, climate change will also involve higher temperature, but it is unclear how the combined effect of eCO2 and higher temperature will affect the nutritional quality of food crops. To begin to address this question, we grew soybean (Glycine max) in a Temperature by Free-Air CO2 Enrichment (T-FACE) experiment in 2014 and 2015 under ambient (400 μmol mol−1) and elevated (600 μmol mol−1) CO2 concentrations, and under ambient and elevated temperatures (+2.7°C day and +3.4°C at night). In our study, eCO2 significantly decreased Fe concentration in soybean seeds in both seasons (−8.7 and −7.7%) and Zn concentration in one season (−8.9%), while higher temperature (at ambient CO2 concentration) had the opposite effect. The combination of eCO2 with elevated temperature generally restored seed Fe and Zn concentrations to levels obtained under ambient CO2 and temperature conditions, suggesting that the potential threat to human nutrition by increasing CO2 concentration may not be realized. In general, seed Fe concentration was negatively correlated with yield, suggesting inherent limitations to increasing seed Fe. In addition, we confirm our previous report that the concentration of seed storage products and several minerals varies with node position at which the seeds developed. Overall, these results demonstrate the complexity of predicting climate change effects on food and nutritional security when various environmental parameters change in an interactive manner.*

Köhler, I. H., Ruiz-Vera, U. M., VanLoocke, A., Thomey, M. L., Clemente, T., Long, S. P., . . . Bernacchi, C. J. (2017). Expression of cyanobacterial FBP/SBPase in soybean prevents yield depression under future climate conditions. *Journal of Experimental Botany, 68*(3), 715-726. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016217589&doi=10.1093%2fjxb%2ferw435&partnerID=40&md5=c5f6a6127c4fb3d47426b847f5b829b7. doi:10.1093/jxb/erw435
Research Tags: Crops
Abstract: *Predictions suggest that current crop production needs to double by 2050 to meet global food and energy demands. Based on theory and experimental studies, overexpression of the photosynthetic enzyme sedoheptulose-1,7-bisphosphatase (SBPase) is expected to enhance C3 crop photosynthesis and yields. Here we test how expression of the cyanobacterial, bifunctional fructose-1,6/sedoheptulose-1,7-bisphosphatase (FBP/SBPase) affects carbon assimilation and seed yield (SY) in a major crop (soybean, Glycine max). For three growing seasons, wild-type (WT) and FBP/SBPase-expressing (FS) plants were grown in the field under ambient (400 μmol mol−1) and elevated (600 μmol mol−1) CO2 concentrations [CO2] and under ambient and elevated temperatures (+2.7 °C during daytime, +3.4 °C at night) at the SoyFACE research site. Across treatments, FS*

plants had significantly higher carbon assimilation (4–14%), Vc,max (5–8%), and Jmax (4–8%). Under ambient [CO2], elevated temperature led to significant reductions of SY of both genotypes by 19–31%. However, under elevated [CO2] and elevated temperature, FS plants maintained SY levels, while the WT showed significant reductions between 11% and 22% compared with plants under elevated [CO2] alone. These results show that the manipulation of the photosynthetic carbon reduction cycle can mitigate the effects of future high CO2 and high temperature environments on soybean yield.

Kolka, R. K., Riggs, C. E., Nater, E. A., Wickman, T. R., Witt, E. L., & Butcher, J. T. (2019). Temporal fluctuations in young-of-the-year yellow perch mercury bioaccumulation in lakes of northeastern Minnesota. *Science of the Total Environment, 656*, 475-481. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057574529&doi=10.1016%2fj.scitotenv.2018.11.280&partnerID=40&md5=387fc587439a3da080a707401de71ea7. doi:10.1016/j.scitotenv.2018.11.280

Research Tags: Water

Abstract: *Identifying what determines fish mercury (Hg) bioaccumulation remains a key scientific challenge. While there has been substantial research on spatial variation in fish Hg bioaccumulation, the factors that influence temporal fluctuations in fish Hg have received less attention to date. In this study, we built upon a growing body of research investigating young-of-the-year (YOY) yellow perch Hg bioaccumulation and investigated annual fluctuations in YOY yellow perch Hg in six lakes in northeastern Minnesota over eight years. After accounting for spatial variation between the study lakes, we used model averaging to identify the lake physiochemical and climate factors that best explain temporal variation in fish biomass and fish Hg. Fish biomass of YOY yellow perch had a positive relationship with chlorophyll-α and total Kjeldahl nitrogen and a negative relationship with dissolved iron and dissolved oxygen. There was a positive relationship between annual variation in yellow perch Hg concentration and annual variation in lake total suspended solids, dissolved Fe and pH. Additionally, there was a negative relationship between fish Hg concentration and lake total Kjeldahl nitrogen and growing degree days. Together, our results suggest that annual variation in allochthonous inputs from the watershed, in-lake processes, and climate variables can explain temporal patterns in Hg bioaccumulation and growth biodilution is an important process controlling yellow perch Hg concentrations.*

Kolka, R. K., Sturtevant, B. R., Miesel, J. R., Singh, A., Wolter, P. T., Fraver, S., . . . Townsend, P. A. (2017). Emissions of forest floor and mineral soil carbon, nitrogen and mercury pools and relationships with fire severity for the Pagami Creek Fire in the Boreal Forest of northern Minnesota. *International Journal of Wildland Fire, 26*(4), 296-305. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017311784&doi=10.1071%2fWF16128&partnerID=40&md5=52cb06d6f029888d8a86527d054e651d. doi:10.1071/WF16128

Research Tags: Forestry, Weather, Emissions

Abstract*: Forest fires cause large emissions of C (carbon), N (nitrogen) and Hg (mercury) to the atmosphere and thus have important implications for global warming (e.g. via CO2 and N2O emissions), anthropogenic fertilisation of natural ecosystems (e.g. via N deposition), and bioaccumulation of harmful metals in aquatic and terrestrial systems (e.g. via Hg deposition). Research indicates that fires are becoming more severe over much of North America, thus increasing element emissions during fire. However, there has been little research relating forest floor and mineral soil losses of C, N and Hg to on-the-ground indices of fire severity that enable scaling up those losses for larger-scale accounting of fire-level emissions. We investigated the relationships between forest floor and mineral soil elemental pools across a range of soil-level fire severities following the 2011 Pagami Creek wildfire in northern Minnesota, USA. We were able to statistically differentiate losses of forest floor C, N and Hg among a five-class soil-level fire severity classification system. Regression relationships using soil fire severity class were able to predict remaining forest floor C, N and Hg pools with 82–96% confidence. We correlated National Aeronautics and Space Administration Airborne Visible and Infrared Imaging Spectrometer-Classic imagery to ground-based plot-scale estimates of soil fire severity to upscale emissions of C, N and Hg to the fire level. We estimate that 468 000 Mg C, 11 000 Mg of N and over 122 g of Hg were emitted from the forest floor during the burning of the 28 310 ha upland area of the Pagami Creek fire.*

Kosiba, A. M., Meigs, G. W., Duncan, J. A., Pontius, J. A., Keeton, W. S., & Tait, E. R. (2018). Spatiotemporal patterns of

forest damage and disturbance in the northeastern United States: 2000–2016. *Forest Ecology and Management, 430*, 94-104. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051400878&doi=10.1016%2fj.foreco.2018.07.047&partnerID=40&md5=45d6c143c56cc3afa2354cf8e1bfc5dc. doi:10.1016/j.foreco.2018.07.047
Research Tags: Forestry
Abstract: *Forest damage and disturbance can have significant influences on tree vigor, species composition, biodiversity, and associated ecosystem services. Recognizing the importance of monitoring spatiotemporal patterns of forest health, federal and state agencies in the United States (US) have conducted aerial insect and disease surveys (IDS) annually to quantify the extent of forest damage by type and causal agent. Although agencies have collected these geospatial data for decades, long-term trends and patterns have not been synthesized across the predominantly forested region of northern New England and New York. Here, we utilized a novel, online forest damage and disturbance mapping portal, the Northeastern Forest Health Atlas, to investigate inter-annual and long-term patterns (2000–2016). Our analysis indicated that ∼11.0 million ha of forestland (10% of the study region) experienced at least one damage event (i.e., an IDS polygon) over the 17-year period, averaging 647,425 ± 215,482 ha (3.4 ± 1.1% of the region's forestland) annually. While there were no detectable linear, long-term trends in annual extent or relative abundance of damage by agent category, we found that some ecoregions experienced relatively higher damage rates (e.g., Acadian Plains and Hills, Atlantic Coastal Pine Barrens). Across the region, insects were the most extensive damage agent category mapped (~8 million ha), with a relatively small number of invasive insects (19 species) accounting for half of this damage. Because climate change may alter the type, severity, and frequency of forest disturbance, quantifying baseline patterns of forest damage is critical for detecting shifts in forest dynamics and developing adaptive management strategies.*

Kosiba, A. M., Schaberg, P. G., Rayback, S. A., & Hawley, G. J. (2018). The surprising recovery of red spruce growth shows links to decreased acid deposition and elevated temperature. *Science of the Total Environment, 637-638*, 1480-1491. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047180205&doi=10.1016%2fj.scitotenv.2018.05.010&partnerID=40&md5=518c675a570a9651ed9c132b26893f41. doi:10.1016/j.scitotenv.2018.05.010
Research Tags: Forestry, Weather
Abstract: *Following growth declines and increased mortality linked to acid deposition-induced calcium depletion, red spruce (Picea rubens Sarg.) in the northeastern United States are experiencing a recovery. We found that more than 75% of red spruce trees and 90% of the plots examined in this study exhibited increasing growth since 2001. To understand this change, we assessed the relationship between red spruce radial growth and factors that may influence growth: tree age and diameter, stand dynamics, plot characteristics (elevation, slope, aspect, geographical position), and a suite of environmental variables (temperature, precipitation, climate and precipitation indices (degree days, SPEI [standardized precipitation evapotranspiration index], and acid deposition [SO_4^{2-}, NO_3^-, pH of rainfall, cation:anion ratio of rainfall]) for 52 plots (658 trees) from five states (spanning 2.5°N × 5°W). Examining the growth relationships from 1925 to 2012, we found that while there was variability in response to climate and acid deposition (limited to 1980–2012) by elevation and location, plot and tree factors did not adequately explain growth. Higher temperatures outside the traditional growing season (e.g., fall, winter, and spring) were related to increased growth. Nitrogen deposition (1980–2012) was associated with lower growth, but the strength of this relationship has lessened over time. Overall, we predict sustained favorable conditions for red spruce in the near term as acid deposition continues to decline and non-traditional growing season (fall through spring) temperatures moderate, provided that overall temperatures and precipitation remain adequate for growth.*

Kothari, K., Ale, S., Bordovsky, J. P., Thorp, K. R., Porter, D. O., & Munster, C. L. (2019). Simulation of efficient irrigation management strategies for grain sorghum production over different climate variability classes. *Agricultural Systems, 170*, 49-62. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059346959&doi=10.1016%2fj.agsy.2018.12.011&partnerID=40&md5=e4cfc93ec68ec882e2c51481937cc861. doi:10.1016/j.agsy.2018.12.011
Research Tags: Water, Crops
Abstract: *The Texas High Plains (THP) is a productive agricultural region, and it relies heavily on the*

exhaustible Ogallala Aquifer for irrigation water for crop production. Efficient use of irrigation water is critical for the sustainability of agriculture in the THP. Grain sorghum is one of the major crops grown in the region, and it is known for its drought tolerance and lower water requirement compared to other cereal crops such as corn. In this study, the CERES-Sorghum and CROPGRO-Cotton modules of the Decision Support System for Agrotechnology Transfer (DSSAT) were evaluated using data from cotton-sorghum rotation experiments at Halfway, Texas over a period of nine years (2006–2014). The evaluated CERES-Sorghum model was then used to identify the optimum (i) initial soil moisture at planting (ISM); (ii) threshold to start irrigation (ITH); (iii) threshold to terminate irrigation; and iv) deficit/excess (DFI) irrigation strategy for grain sorghum production based on simulated sorghum yield, irrigation water use efficiency (IWUE), and grain water use efficiency (WUE). In addition, the effect of weather conditions on simulated strategies was elucidated by dividing the long-term (1977–2016) weather data into cold, warm, wet, dry, and normal climate variability classes based on the 33rd and 66th percentiles of growing season temperature and precipitation. The DSSAT model adequately simulated the grain sorghum and seed cotton yields during calibration (average Percent Error (PE) of 1.3% (sorghum) and 3.4% (cotton)) and evaluation (average PE of −2.2% (sorghum) and −10.5% (cotton)). The results from long-term simulations indicated that weather conditions played a key role in selecting appropriate irrigation management strategies. Under normal/cold/wet weather, ISM of 75% available water holding capacity (AWC), ITH of 50%, and DFI 85% were found to be adequate for irrigated grain sorghum production. However, in warm/dry weather, ISM of 75%, ITH 60%, and DFI at 100% reduced sorghum yield loss.

Kovaleski, A. P., & Baseggio, M. (2019). Is increased corn yield really the silver lining of climate change? *Proceedings of the National Academy of Sciences of the United States of America, 116*(21), 10206-10208. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066128040&doi=10.1073%2fpnas.1904487116&partnerID=40&md5=0ac03a81890bffd5c3af3c8abfb0a458. doi:10.1073/pnas.1904487116

Research Tags:

Incomplete Abstract: *Although it is possible that warming while temperature maxima decreased (1) contributed to increasing yields, a much more careful analysis is warranted before making potentially harmful statements such as "better weather experienced by US maize accounts for 28% of yield trends since 1981," as Butler et al. (2) state in PNAS. To effectively measure contributions of climate changes to yield, two alternatives are possible (but unequal in strength of results): (i) a dataset containing the same varieties grown from 1981 to 2017 with minimal changes to management practices (empirical approach) or (ii) including periods when shifts in temperature trends were not following those in the period studied, along with many more variables to explicitly account for changes in cultural practices and ...*

Kovaleski, A. P., & Londo, J. P. (2019). Tempo of gene regulation in wild and cultivated Vitis species shows coordination between cold deacclimation and budbreak. *Plant Science, 287*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068138594&doi=10.1016%2fj.plantsci.2019.110178&partnerID=40&md5=60ff8f0653a51adca480ea10b4de6a35. doi:10.1016/j.plantsci.2019.110178

Research Tags: Crops, Weather

Abstract: *Dormancy release, loss of cold hardiness and budbreak are critical aspects of the annual cycle of deciduous perennial plants. Molecular control of these processes is not fully understood, and genotypic variation may be important for climate adaptation. To gain greater understanding of these processes, single-node cuttings from wild (Vitis amurensis, V. riparia) and cultivated Vitis genotypes (V. vinifera 'Cabernet Sauvignon', 'Riesling') were collected from the vineyard during winter and placed under forcing conditions. Cold hardiness was measured daily, and buds were collected for gene expression analysis until budbreak. Wild Vitis genotypes had faster deacclimation and budbreak than V. vinifera. Temperature-sensing related genes were quickly and synchronously differentially expressed in all genotypes. Significant changes in the pattern of expression changes for eight major metabolic and hormone related pathways were seen across all genotypes. Downregulation of ABA synthesis appears to play an important role in loss of cold hardiness and budbreak in all genotypes. This role was validated through an observed halt in cold hardiness loss of 'Riesling' buds treated with exogenous ABA. The gene expression cascade that occurs during deacclimation and budbreak phenology of fast (wild) and slow (cultivated) grapevines appears coordinated and temporally conserved within these phenotypes.*

Kovaleski, A. P., Reisch, B. I., & Londo, J. P. (2018). Deacclimation kinetics as a quantitative phenotype for delineating the dormancy transition and thermal efficiency for budbreak in Vitis species. *AoB PLANTS, 10*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057247391&doi=10.1093%2faobpla%2fply066&partnerID=40&md5=9937a7f1460015a4bcaa58af4cff1b3f. doi:10.1093/aobpla/ply066

Research Tags: Crops, Weather

Abstract: *Bud dormancy and cold hardiness are critical adaptations for surviving winter cold stress for temperate perennial plant species. In grapevine, acquisition of cold hardiness requires dormancy induction in the early winter and careful maintenance of dormancy state throughout winter. With sufficient exposure to low, non-freezing temperatures (chilling requirement), grapevine buds transition between early (endodormant) and late winter (ecodormant) states. The objective of this study was to uncover the relationship between fulfilment of the chilling requirement and the effects of various temperatures on loss of cold hardiness (deacclimation). The relationship between chilling requirement and temperature as it affects the rate of deacclimation (kdeacc) was examined for dormant cuttings of Vitis vinifera, V. aestivalis, V. amurensis and V. riparia. The effect of temperature on kdeacc was exponential at low and logarithmic at high temperatures. Deacclimation rates also increased in magnitude as chilling accumulated demonstrating a change in deacclimation potential (Ψdeacc), following a logarithmic response. The combination of Ψdeacc and kdeacc indicates genotype-specific thermal efficiency for deacclimation and growth in Vitis that may be overlooked by simple growing degree-day computations. The Ψdeacc and kdeacc parameters are genotype-specific and will greatly increase the refinement of models predicting effects of climate change on phenology. Deacclimation rates represent a quantitative determinant of dormancy transition and budbreak in grapevine and will assist researchers in selecting germplasm for differences in chilling requirement and thermal efficiency.*

Kraatz, S., Jacobs, J. M., Schröder, R., Cho, E., Cosh, M., Seyfried, M., . . . Livingston, S. (2018). Evaluation of SMAP freeze/thaw retrieval accuracy at core validation sites in the contiguous United States. *Remote Sensing, 10*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053639427&doi=10.3390%2frs10091483&partnerID=40&md5=c5cd297946e250af14f702e421e85617. doi:10.3390/rs10091483

Research Tags: Research, Weather

Abstract: *Seasonal freeze-thaw (FT) impacts much of the northern hemisphere and is an important control on its water, energy, and carbon cycle. Although FT in natural environments extends south of 45°N, FT studies using the L-band have so far been restricted to boreal or greater latitudes. This study addresses this gap by applying a seasonal threshold algorithm to Soil Moisture Active Passive (SMAP) data (L3_SM_P) to obtain a FT product south of 45°N ('SMAP FT'), which is then evaluated at SMAP core validation sites (CVS) located in the contiguous United States (CONUS). SMAP landscape FT retrievals are usually in good agreement with 0–5 cm soil temperature at SMAP grids containing CVS stations (>70%). The accuracy could be further improved by taking into account specific overpass time (PM), the grid-specific seasonal scaling factor, the data aggregation method, and the sampling error. Annual SMAP FT extent maps compared to modeled soil temperatures derived from the Goddard Earth Observing System Model Version 5 (GEOS-5) show that seasonal FT in CONUS extends to latitudes of about 35–40°N, and that FT varies substantially in space and by year. In general, spatial and temporal trends between SMAP and modeled FT were similar.*

Krapek, J., Hennon, P. E., D'Amore, D. V., & Buma, B. (2017). Despite available habitat at range edge, yellow-cedar migration is punctuated with a past pulse tied to colder conditions. *Diversity and Distributions, 23*(12), 1381-1392. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029225780&doi=10.1111%2fddi.12630&partnerID=40&md5=c3d6153bd32015e7f84b5519a14e4294. doi:10.1111/ddi.12630

Research Tags: Weather, Forestry

Abstract: *Aim*

To explore the recent (past ~1,000 year) migration history of yellow-cedar (Callitropsis nootkatensis), a climate-threatened tree, which appears to lag behind its potential climatic niche at a leading northern range edge, and infer its continued migration potential under changing climate.

Location

Southeast Alaska, USA.
Methods
We located 11 leading range edge yellow-cedar stands near Juneau, Alaska, determined their proportional occupancy of modelled habitat and estimated stand ages to determine approximate time of establishment. We used future climate projections to determine the potential vulnerability of these leading edge populations using a well-established risk factor for yellow-cedar mortality in the region.
Results
Despite abundant potential habitat, and having existed in the study area > 675 years, yellow-cedar has only occupied a small proportion (<0.8%) of suitable habitat. Yellow-cedar appears to have undergone a past pulse of successful regeneration and establishment during the Little Ice Age climate period, with little expansion in recent decades. Under high emissions future climate scenarios, nine of 11 stands (82%) may become exposed to climate conditions that predispose yellow-cedar to root freezing injury by 2070.
Main conclusions
We show that yellow-cedar's migration near a northern range edge is episodic, with a past pulse of establishment during the Little Ice Age. When planning for the conservation and management of this culturally and economically valuable tree, forest managers should consider yellow-cedar's currently limited migration at the leading edge, mortality emerging farther north in recent decades and potential vulnerability of range edge stands by 2070. The range of intense, climatic driven yellow-cedar mortality is expanding northward and rapidly approaching the species' leading edge in southeast Alaska. Yellow-cedar's episodic migration demonstrates that species may not respond linearly to a warming climate and that other factors controlling dispersal to suitable habitat must be considered for accurate range predictions.

Krebs, J., Pontius, J., & Schaberg, P. G. (2017). Modeling the impacts of hemlock woolly adelgid infestation and presalvage harvesting on carbon stocks in northern hemlock forests. *Canadian Journal of Forest Research, 47*(6), 727-734. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020061427&doi=10.1139%2fcjfr-2016-0291&partnerID=40&md5=fa3350e6c51b0c0f44d8a81f127ced1b. doi:10.1139/cjfr-2016-0291
Research Tags: Forestry, Wildlife
Abstract: *To better understand the potential impact of the invasive hemlock woolly adelgid (HWA, Adelges tsugae Annand) and presalvage activities on carbon (C) dynamics in northern stands of eastern hemlock (Tsuga canadensis (L.) Carr.), we used the Forest Vegetation Simulator and Forest Inventory and Analysis data to model C storage and successional pathways under four scenarios: presalvage harvesting; HWA-induced mortality; presalvage harvesting plus HWA-induced mortality; and no disturbance (control). Our simulation showed that all treatments differed in total C storage in the short term, with HWA-induced mortality providing the highest total C storage due to regeneration and ingrowth of replacement species combined with retention of standing and downed deadwood. At the end of the 150-year simulation, all disturbance scenarios had significantly lower total C than the control. The cumulative net C gain was lower for the two presalvage scenarios than for the HWA scenario, indicating that allowing HWA to progress naturally through a stand may result in the least impact to long-term C sequestration and net C storage. While differences were not significant on low hemlock density stands, impacts to the estimated 267 000 ha of northeastern forests where hemlock is dominant could result in conversion to red maple (Acer rubrum L.) and a net loss of over 4 million metric tons of potentially sequestered C over the next 150 years.*

Krehbiel, B. C., Thomas, M. G., Wilson, C. S., Speidel, S. E., Enns, R. M., Paiva, S. R., & Blackburn, H. D. (2019). Evaluation of genetic structure across U.S. climate zones using prominent AI sires of Red Angus cattle. *Livestock Science, 225*, 26-31. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065464165&doi=10.1016%2fj.livsci.2019.04.012&partnerID=40&md5=ad83fa0926addc8d9b44dfadf172016d. doi:10.1016/j.livsci.2019.04.012
Research Tags: Livestock, Weather
Abstract: *Climate variability can influence cattle performance. Therefore, the objective of this research was to determine fine-scale genetic diversity in Red Angus cattle in relation to climate zones. One hundred and seventy-five prominent Red Angus artificial insemination (AI) sires were sampled from five conterminous U.S. climate regions (Cool Arid, Cool Humid, Transition Zone, Warm Arid, and Warm Humid). Quantitative and*

molecular genetic approaches were used to evaluate genetic diversity for the cattle. The first method utilized neutral SNP to determine the genetic structure of the population. The second method used 66 SNP associated with traits potentially influenced by climate (body weight, heat stress, milk yield, heifer conception rate, and early embryonic survival) to detect loci under selection in each zone. Using 13,961 SNP, the genetic structure analysis revealed that there were eight sub-populations present within Red Angus. Furthermore, 23 of the 66 SNP were not in Hardy-Weinberg Equilibrium and loci under selection tests (P < 0.05). Chi-square tests revealed 7 of the 23 SNP to differ (P < 0.008) among climate zones. In conclusion, fine genetic substructure observed in Red Angus corresponded to U.S. climate zones. By identifying the genetic diversity within a prominent Bos taurus beef breed in relation to climate, management strategies can be implemented to utilize the genetic diversity of this breed to adapt to changing climates.

Krichels, A., DeLucia, E. H., Sanford, R., Chee-Sanford, J., & Yang, W. H. (2019). Historical soil drainage mediates the response of soil greenhouse gas emissions to intense precipitation events. *Biogeochemistry, 142*(3), 425-442. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060974642&doi=10.1007%2fs10533-019-00544-x&partnerID=40&md5=e9966e1530eea00ddf39d8bb3ca3e3f1. doi:10.1007/s10533-019-00544-x
Research Tags: Soil, Emissions, Weather
Abstract: *Precipitation events are increasing in intensity in the Midwestern US due to climate change. This is resulting in flooding of poorly-drained upland soils, which can feed back on climate change by altering greenhouse gas (GHG) emissions, including nitrous oxide (N2O) and carbon dioxide (CO2). The objective of this study was to determine if soil drainage history affects the response of soil GHG emissions to rain events. To do this, we measured N2O and CO2 fluxes from poorly-drained (PD) and well-drained (WD) soils in an agricultural field in Urbana, Illinois before and after large rain events. We also performed a lab experiment to separate effects of soil drainage history from contemporary effects of ponding. Finally, we utilized stable isotope techniques to measure gross N2O dynamics and to determine the contributions of nitrifiers and denitrifiers to net N2O fluxes. We found that ponding of WD soils led to pulses of net N2O efflux caused by stimulation of gross N2O production by denitrifiers. In contrast, PD soils had high net N2O effluxes only between large rain events, and gross N2O production was inhibited following ponding. Soil CO2 efflux was greater from PD soils under lab conditions, but autotrophic respiration obscured this trend in the field. Soil GHG emissions were a result of different contemporary ponding status as well as historical soil drainage, suggesting that historical soil redox regimes regulate soil GHG dynamics in response to precipitation. These soil drainage legacy effects are likely important in predicting soil GHG feedback effects on climate change.*

Krinner, G., Derksen, C., Essery, R., Flanner, M., Hagemann, S., Clark, M., . . . Zhu, D. (2018). ESM-SnowMIP: Assessing snow models and quantifying snow-related climate feedbacks. *Geoscientific Model Development, 11*(12), 5027-5049. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058438078&doi=10.5194%2fgmd-11-5027-2018&partnerID=40&md5=e4fa9f3be608649b7d7c94e527abe973. doi:10.5194/gmd-11-5027-2018
Research Tags: Research
Abstract: *This paper describes ESM-SnowMIP, an international coordinated modelling effort to evaluate current snow schemes, including snow schemes that are included in Earth system models, in a wide variety of settings against local and global observations. The project aims to identify crucial processes and characteristics that need to be improved in snow models in the context of local- and global-scale modelling. A further objective of ESM-SnowMIP is to better quantify snow-related feedbacks in the Earth system. Although it is not part of the sixth phase of the Coupled Model Intercomparison Project (CMIP6), ESM-SnowMIP is tightly linked to the CMIP6-endorsed Land Surface, Snow and Soil Moisture Model Intercomparison (LS3MIP).*

Krofcheck, D. J., Hurteau, M. D., Scheller, R. M., & Loudermilk, E. L. (2017). Restoring surface fire stabilizes forest carbon under extreme fire weather in the Sierra Nevada. *Ecosphere, 8*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85010006278&doi=10.1002%2fecs2.1663&partnerID=40&md5=0b2cea391effaae7eb3eb2a80cd1ae0b. doi:10.1002/ecs2.1663
Research Tags: Forestry, Weather
Abstract: *Climate change in the western United States has increased the frequency of extreme fire weather*

events and is projected to increase the area burned by wildfire in the coming decades. This changing fire regime, coupled with increased high-severity fire risk from a legacy of fire exclusion, could destabilize forest carbon (C), decrease net ecosystem exchange (NEE), and consequently reduce the ability of forests to regulate climate through C sequestration. While management options for minimizing the risk of high-severity fire exist, little is known about the longer-term carbon consequences of these actions in the context of continued extreme fire weather events. Our goal was to compare the impacts of extreme wildfire events on carbon stocks and fluxes in a watershed in the Sierra National Forest. We ran simulations to model wildfire under contemporary and extreme fire weather conditions, and test how three management scenarios (no-management, thin-only, thin and maintenance burning) influence fire severity, forest C stocks and fluxes, and wildfire C emissions. We found that the effects of treatment on wildfire under contemporary fire weather were minimal, and management conferred neither significant reduction in fire severity nor increases in C stocks. However, under extreme fire weather, the thin and maintenance burning scenario decreased mean fire severity by 25%, showed significantly greater C stability, and unlike the no-management and thin-only management options, the thin and maintenance burning scenario showed no decrease in NEE relative to the contemporary fire weather scenarios. Further, under extreme fire weather conditions, wildfire C emissions were lowest in the thin and maintenance burning scenario, (reduction of 13.7 Mg C/ha over the simulation period) even when taking into account the C costs associated with prescribed burning. Including prescribed burning in thinning operations may be critical to maintaining C stocks and reducing C emissions in the future where extreme fire weather events are more frequent.

Krofcheck, D. J., Hurteau, M. D., Scheller, R. M., & Loudermilk, E. L. (2018). Prioritizing forest fuels treatments based on the probability of high-severity fire restores adaptive capacity in Sierran forests. *Global Change Biology, 24*(2), 729-737. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041283434&doi=10.1111%2fgcb.13913&partnerID=40&md5=084dc602d37e175af234bb0f8310525d. doi:10.1111/gcb.13913
Research Tags: Forestry, Weather
Abstract: *In frequent fire forests of the western United States, a legacy of fire suppression coupled with increases in fire weather severity have altered fire regimes and vegetation dynamics. When coupled with projected climate change, these conditions have the potential to lead to vegetation type change and altered carbon (C) dynamics. In the Sierra Nevada, fuels reduction approaches that include mechanical thinning followed by regular prescribed fire are one approach to restore the ability of the ecosystem to tolerate episodic fire and still sequester C. Yet, the spatial extent of the area requiring treatment makes widespread treatment implementation unlikely. We sought to determine if a priori knowledge of where uncharacteristic wildfire is most probable could be used to optimize the placement of fuels treatments in a Sierra Nevada watershed. We developed two treatment placement strategies: the naive strategy, based on treating all operationally available area and the optimized strategy, which only treated areas where crown-killing fires were most probable. We ran forecast simulations using projected climate data through 2,100 to determine how the treatments differed in terms of C sequestration, fire severity, and C emissions relative to a no-management scenario. We found that in both the short (20 years) and long (100 years) term, both management scenarios increased C stability, reduced burn severity, and consequently emitted less C as a result of wildfires than no-management. Across all metrics, both scenarios performed the same, but the optimized treatment required significantly less C removal (naive=0.42 Tg C, optimized=0.25 Tg C) to achieve the same treatment efficacy. Given the extent of western forests in need of fire restoration, efficiently allocating treatments is a critical task if we are going to restore adaptive capacity in frequent-fire forests.*

Kumar, S., Moglen, G. E., Godrej, A. N., Grizzard, T. J., & Post, H. E. (2018). Trends in water yield under climate change and urbanization in the US Mid-Atlantic region. *Journal of Water Resources Planning and Management, 144*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047250023&doi=10.1061%2f%28ASCE%29WR.1943-5452.0000937&partnerID=40&md5=cc00ca7cc70351492cfec0147ffad8e6. doi:10.1061/(ASCE)WR.1943-5452.0000937
Research Tags: Water
Abstract: *Changes in climate and land use are two primary drivers of hydrologic adjustment. This study*

analyzes 40 years of water resources data for 10 watersheds in the Washington, DC metropolitan area to quantify the impact of climate change and urbanization on water yield. The watersheds investigated have experienced varying degrees of land-use change, from relatively little change to rapid and extensive urbanization. Comparing the data trends for different watersheds allows the separation of effects that are due largely to climate change from those due to land-use change. Predominantly rural watersheds show a steady decline in annual water yield, whereas predominantly urban watersheds do not show any similar trend with time. Separating the year into growing versus nongrowing seasons reveals that limited evapotranspiration from urban surfaces during the growing season or the general effects of a leaking water distribution network may mask the reductions in water yield in urban watersheds from changing climate. These analyses provide hydrological evidence for generally enhanced evapotranspiration and complex interactions between concurrent climate change and urbanization within the study area.

Lafta, A., Turini, T., Sandoya, G. V., & Mou, B. (2017). Field evaluation of green and red leaf lettuce genotypes in the imperial, San Joaquin, and Salinas Valleys of california for heat tolerance and extension of the growing seasons. *Hortscience, 52*(1), 40-48. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019066891&doi=10.21273%2fHORTSCI10835-16&partnerID=40&md5=d7f61ae3dc604742aec5aaa2cc2ea80e. doi:10.21273/HORTSCI10835-16

Research Tags: Crops

Abstract: *Global warming poses serious threats and challenges to the production of leafy vegetables. Being a cool-season crop, lettuce is particularly vulnerable to heat stress. To adapt to climate change, this study was conducted to evaluate the performance of leaf lettuce genotypes for heat tolerance by growing them in different locations within California that differ in temperatures during the growing season. Fifteen green leaf and 21 red leaf lettuce genotypes were selected to evaluate their performance under these environments. These genotypes were planted in March and May in Five Points (San Joaquin Valley) and El Centro (Imperial Valley) and in June 2012 in Salinas (Salinas Valley). The results suggest that lettuce planting can be extended from January to March beyond the normal growing seasons in San Joaquin and Imperial Valleys, where yield may be higher than in the Salinas Valley. The further delay in planting date from March to May in Five Points and El Centro resulted in reduction of yield and an increase in susceptibility to bolting and heat-related disorders such as tipburn and leaf desiccation in most genotypes. The susceptibility to these disorders depends on the genotype and the temperature during lettuce growth and maturation. However, heat-tolerant leaf lettuce genotypes adapted to these regions were identified. Results of this research should be useful for the development of heat-tolerant lettuce cultivars and for extending the growing season in warmer but lower land cost areas to reduce production costs.*

Lagomasino, D., Fatoyinbo, T., Lee, S., Feliciano, E., Trettin, C., Shapiro, A., & Mangora, M. M. (2019). Measuring mangrove carbon loss and gain in deltas. *Environmental Research Letters, 14*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063984532&doi=10.1088%2f1748-9326%2faaf0de&partnerID=40&md5=469a53b231a6826d9e9413842ac098fa. doi:10.1088/1748-9326/aaf0de

Research Tags: Water, Forestry

Abstract: *Demand for mangrove forest resources has led to a steady decline in mangrove area over the past century. Land conversions in the form of agriculture, aquaculture and urbanization account for much of the deforestation of mangrove wetlands. However, natural processes at the transition zone between land and ocean can also rapidly change mangrove spread. In this study, we applied a robust field-based carbon inventory and new structural and temporal remote sensing techniques to quantify the magnitude and change of mangrove carbon stocks in major deltas across Africa and Asia. From 2000–2016, approximately 1.6% (12 270 ha) of the total mangrove area within these deltas disappeared, primarily through erosion and conversion to agriculture. However, the rapid expansion of mangroves in some regions during this same period resulted in new forests that were taller and more carbon-dense than the deforested areas. Because of the rapid vertical growth rates and horizontal expansion, new mangrove forests were able to offset the total carbon losses of 5 332 843 Mg C by 44%. Each hectare of new mangrove forest accounted for ~84% to ~160% of the aboveground carbon for each hectare of mangrove forest lost, regardless of the net change in mangrove area. Our study highlights the significance of the natural dynamics of erosion and sedimentation on carbon loss and sequestration potential for mangroves over time. Areas of naturally regenerating mangroves will have a much larger carbon* *sequestration potential if the rate of mangrove deforestation of taller forests is curbed.*

Lai, R., Kimble, J., & Follett, R. F. (2018). Pedospheric processes and the carbon cycle. In *Soil Processes and the Carbon Cycle* (pp. 1-8).
Research Tags: Soil
Abstract: *The pedosphere supports all biotic activity within the terrestrial ecosystems and interacts with the atmosphere, lithosphere, biosphere, and hydrosphere. The pedosphere has played a significant role in influencing the gaseous composition of the atmosphere, especially since 1850. Interactive processes that play a major role in the global carbon cycle are those between the pedosphere, the atmosphere, and the biosphere. There are two types of carbon pools in the pedosphere, e.g., soil organic carbon (SOC) and soil inorganic carbon (SIC). An increase in SOC, through C sequestration into the pedosphere, has two notable positive effects. First is the enhancement of soil quality, and second is the improvements in the soil's environmental regulatory capacity. Three principal processes of C sequestration in the pedosphere are humification, aggregation, and sedimentation. Each of these processes and their relations to each other need to be clearly understood as do the effects of SOC and SIC leaching and the chemical transformations of dissolved carbon.*

Laird, D. A., Novak, J. M., Collins, H. P., Ippolito, J. A., Karlen, D. L., Lentz, R. D., . . . Van Pelt, R. S. (2017). Multi-year and multi-location soil quality and crop biomass yield responses to hardwood fast pyrolysis biochar. *Geoderma, 289*, 46-53. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84998655258&doi=10.1016%2fj.geoderma.2016.11.025&partnerID=40&md5=a07c994a3449b39db4eaa9d9fac065cd. doi:10.1016/j.geoderma.2016.11.025
Research Tags:
Abstract: *Biochar can remediate degraded soils and maintain or improve soil health, but specific and predictable effects on soil properties and crop productivity are unknown because of complex interactions associated with climate patterns, inherent soil characteristics, site-specific crop and soil management practices, and the source, production characteristics, and amount of biochar applied. This multi-location field study was designed and conducted to determine if consistent response patterns could be elucidated by controlling the type and amount of biochar applied, depth of incorporation, and soil/crop management practices as much as possible for six U.S. locations. When averaged for five reporting locations, biochar or biochar plus manure (bio + man) treatments significantly ($P < 0.001$) increased surface (0–15 cm) soil organic carbon (SOC) levels by 48 or 47%, respectively, relative to control treatments. The SOC levels for the manure only treatment were not significantly different from the control. No other measured soil properties showed significant biochar or biochar × manure interactions, even though applying manure significantly increased extractable K, Mg, Na, and P levels. Analysis of three or four years of pooled biomass yield data from the six locations showed a significant location effect ($P < 0.001$), but treatment effects were not significant. However, dividing annual plot yields by the average for all control plots at each location created a dataset of relative yields that showed a significant location × treatment interaction and higher normalized yields (36%) due to biochar ($P = 0.017$) at one of the six locations. Overall, we conclude that hardwood biochar produced by fast pyrolysis can be an effective soil amendment for increasing SOC levels within a broad range of temperate soils, but crop yield responses should be anticipated only when specific soil quality problems limit productivity.*

Lal, R., Kimble, J. M., Follett, R. F., & Stewart, B. A. (2018). *Soil processes and the carbon cycle*.
Research Tags: Soil
No Abstract (Book):

Lal, R., & Stewart, B. A. (2017). *Urban soils*.
Research Tags: Soil
No Abstract (Book):

Lamb, M. C., Sorensen, R. B., & Butts, C. L. (2018). Crop response to biochar under differing irrigation levels in the southeastern USA. *Journal of Crop Improvement, 32*(3), 305-317. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041095272&doi=10.1080%2f15427528.2018.1425791&partnerID=40&md5=aa2f1b0422ba07d5a62bffb77e3b9b1e. doi:10.1080/15427528.2018.1425791

Research Tags: Crops, Soil
Abstract: *Application of biochar to soils is hypothesized to increase crop yield. Crop productivity impacts of biochar application in southeastern cropping systems consisting of peanut (Arachis hypogaea L.), corn (Zea mays L.), and cotton (Gossypium hirsutum L.) produced under varying rates of irrigation have not been addressed. This research incorporated biochar at two different rates into a long-term irrigation and cropping systems study to compare yield and quality response of peanut, corn, and cotton. Biochar was incorporated into soil once at the beginning of the 4-year project at rates of 22.4 and 44.8 Mg ha−1. Peanut, corn, and cotton were produced under three sprinkler irrigation levels (100%, 66%, and 33%), shallow surface drip irrigation (100%), and a nonirrigated control. Crop input management followed best management practices. Sprinkler irrigation was scheduled by Irrigator Pro for Peanuts, Corn, and Cotton at the 100% level and the 66% and 33% levels were applied at the same time as the 100% level. Significant year, irrigation, and year × irrigation effects for corn, cotton, and peanut yield resulted (p < 0.001). No differences resulted for biochar in corn (p = 0.930) or cotton (p = 0.678). Peanut yield showed a significant response to biochar comparing the 44.8 Mg ha−1 rate to the untreated control in nonirrigated production at the p = 0.05 level and in the 33% irrigated treatment at the p = 0.10 level. No negative effects resulted from biochar opening opportunities for biochar application in southeastern U.S. cropping systems for purposes related to carbon sequestration without compromising productivity of producers and related agricultural sectors.*

Landguth, E. L., Holden, Z. A., Mahalovich, M. F., & Cushman, S. A. (2017). Using landscape genetics simulations for planting blister rust resistant whitebark pine in the US Northern Rocky Mountains. *Frontiers in Genetics, 8*(FEB). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014684143&doi=10.3389%2ffgene.2017.00009&partnerID=40&md5=561c5ad06a03be9460f8b5b6e8e30b11. doi:10.3389/fgene.2017.00009
Research Tags: Forestry, Wildlife
Abstract: *Recent population declines to the high elevation western North America foundation species whitebark pine, have been driven by the synergistic effects of the invasive blister rust pathogen, mountain pine beetle (MPB), fire exclusion, and climate change. This has led to consideration for listing whitebark pine (WBP) as a threatened or endangered species under the Endangered Species Act, which has intensified interest in developing management strategies for maintaining and restoring the species. An important, but poorly studied, aspect of WBP restoration is the spatial variation in adaptive genetic variation and the potential of blister rust resistant strains to maintain viable populations in the future. Here, we present a simulation modeling framework to improve understanding of the long-term genetic consequences of the blister rust pathogen, the evolution of rust resistance, and scenarios of planting rust resistant genotypes of whitebark pine. We combine climate niche modeling and eco-evolutionary landscape genetics modeling to evaluate the effects of different scenarios of planting rust-resistant genotypes and impacts of wind field direction on patterns of gene flow. Planting scenarios showed different levels for local extirpation of WBP and increased population-wide blister rust resistance, suggesting that the spatial arrangement and choice of planting locations can greatly affect survival rates of whitebark pine. This study presents a preliminary, but potentially important, framework for facilitating the conservation of whitebark pine.*

Langley, J. A., Chapman, S. K., La Pierre, K. J., Avolio, M., Bowman, W. D., Johnson, D. S., . . . Tilman, D. (2018). Ambient changes exceed treatment effects on plant species abundance in global change experiments. *Global Change Biology, 24*(12), 5668-5679. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055695631&doi=10.1111%2fgcb.14442&partnerID=40&md5=a44e353c5addd8615b4d1e26efc90359. doi:10.1111/gcb.14442
Research Tags: Weather
Abstract: *The responses of species to environmental changes will determine future community composition and ecosystem function. Many syntheses of global change experiments examine the magnitude of treatment effect sizes, but we lack an understanding of how plant responses to treatments compare to ongoing changes in the unmanipulated (ambient or background) system. We used a database of long-term global change studies manipulating CO2, nutrients, water, and temperature to answer three questions: (a) How do changes in plant species abundance in ambient plots relate to those in treated plots? (b) How does the magnitude of ambient change in species-level abundance over time relate to responsiveness to global change treatments? (c) Does the*

direction of species-level responses to global change treatments differ from the direction of ambient change? We estimated temporal trends in plant abundance for 791 plant species in ambient and treated plots across 16 long-term global change experiments yielding 2,116 experiment–species–treatment combinations. Surprisingly, for most species (57%) the magnitude of ambient change was greater than the magnitude of treatment effects. However, the direction of ambient change, whether a species was increasing or decreasing in abundance under ambient conditions, had no bearing on the direction of treatment effects. Although ambient communities are inherently dynamic, there is now widespread evidence that anthropogenic drivers are directionally altering plant communities in many ecosystems. Thus, global change treatment effects must be interpreted in the context of plant species trajectories that are likely driven by ongoing environmental changes.

Lanier, A. L., Drabik, J. R., Heikkila, T., Bolson, J., Sukop, M. C., Watkins, D. W., . . . Letson, D. (2018). Facilitating Integration in Interdisciplinary Research: Lessons from a South Florida Water, Sustainability, and Climate Project. *Environmental Management, 62*(6), 1025-1037. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053383673&doi=10.1007%2fs00267-018-1099-1&partnerID=40&md5=9765f43ac8effbd7c2c78086e1361633. doi:10.1007/s00267-018-1099-1

Research Tags: Water

Abstract: *Interdisciplinary research is increasingly called upon to find solutions to complex sustainability problems, yet co-creating usable knowledge can be challenging. This article offers broad lessons for conducting interdisciplinary science from the South Florida Water, Sustainability, and Climate Project (SFWSC), a 5-year project funded by the U.S. National Science Foundation (NSF). The goal was to develop a holistic decision-making framework to improve understanding of the complex natural–social system of South Florida water allocation and its threats from climate change, including sea level rise, using a water resources optimization model as an integration mechanism. The SFWSC project faced several challenges, including uncertainty with tasks, high task interdependence, and ensuring communication among geographically dispersed members. Our hypothesis was that adaptive techniques would help overcome these challenges and maintain scientific rigor as research evolved. By systematically evaluating the interdisciplinary management approach throughout the project, we learned that integration can be supported by a three-pronged approach: (1) Build a well-defined team and leadership structure for collaboration across geographic distance and disciplines, ensuring adequate coordination funding, encouraging cross-pollination, and allowing team structure to adapt; (2) intentionally design a process and structure for facilitating collaboration, creating mechanisms for routine analysis, and incorporating collaboration tools that foster communication; and (3) support integration within the scientific framework, by using a shared research output, and encouraging team members to adapt when facing unanticipated constraints. These lessons contribute to the international body of knowledge on interdisciplinary research and can assist teams attempting to develop sustainable solutions in complex natural–social systems.*

Lantschner, M. V., Atkinson, T. H., Corley, J. C., & Liebhold, A. M. (2017). Predicting North American Scolytinae invasions in the Southern Hemisphere. *Ecological Applications, 27*(1), 66-77. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008385972&doi=10.1002%2feap.1451&partnerID=40&md5=2a4efb398421a1bc6921c0859c894909. doi:10.1002/eap.1451

Research Tags: Forestry, Wildlife

Abstract: *Scolytinae species are recognized as one of the most important tree mortality agents in coniferous forests worldwide, and many are known invaders because they are easily transported in wood products. Nonnative trees planted in novel habitats often exhibit exceptional growth, in part because they escape herbivore (such as Scolytinae) pressure from their native range. Increasing accidental introductions of forest pest species as a consequence of international trade, however, is expected to diminish enemy release of nonnative forest trees. In this context, there is need to characterize patterns of forest herbivore species invasion risks at global scales. In this study, we analyze the establishment potential of 64 North American Scolytinae species in the Southern Hemisphere. We use climate-based ecological niche models (MaxEnt) to spatially define the potential distribution of these Scolytinae species in regions of the Southern Hemisphere were pines are planted. Our model predicts that all of the pine-growing regions of the Southern Hemisphere are capable of supporting some species of North American Scolytinae, but there are certain "hotspot" regions, southeastern Argentina, Bolivia, Chile, Peru and southwestern Australia, that appear to be suitable for a particularly large* *number of species. The species with the highest predicted risk of establishment were Dendroctonus valens, Xyleborus intrusus, Hylastes tenuis, Ips grandicollis, Gnathotrichus sulcatus, and Ips calligraphus. Given that global commerce is anticipated to continue to increase, we can expect that more Scolytinae species will continue to establish outside their range. Our results provide information useful for identifying a global list of potential invasive species in pine plantations, and may assist in the design of comprehensive strategies aimed at reducing pest establishment in Southern Hemisphere forest plantations.*

Lark, T. J., Mueller, R. M., Johnson, D. M., & Gibbs, H. K. (2017). Measuring land-use and land-cover change using the U.S. department of agriculture's cropland data layer: Cautions and recommendations. *International Journal of Applied Earth Observation and Geoinformation, 62*, 224-235. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032229600&doi=10.1016%2fj.jag.2017.06.007&partnerID=40&md5=668e0740ea86fca8ea28f95bc2969d3b. doi:10.1016/j.jag.2017.06.007
Research Tags: Research
Abstract: *Monitoring agricultural land is important for understanding and managing food production, environmental conservation efforts, and climate change. The United States Department of Agriculture's Cropland Data Layer (CDL), an annual satellite imagery-derived land cover map, has been increasingly used for this application since complete coverage of the conterminous United States became available in 2008. However, the CDL is designed and produced with the intent of mapping annual land cover rather than tracking changes over time, and as a result certain precautions are needed in multi-year change analyses to minimize error and misapplication. We highlight scenarios that require special considerations, suggest solutions to key challenges, and propose a set of recommended good practices and general guidelines for CDL-based land change estimation. We also characterize a problematic issue of crop area underestimation bias within the CDL that needs to be accounted for and corrected when calculating changes to crop and cropland areas. When used appropriately and in conjunction with related information, the CDL is a valuable and effective tool for detecting diverse trends in agriculture. By explicitly discussing the methods and techniques for post-classification measurement of land-cover and land-use change using the CDL, we aim to further stimulate the discourse and continued development of suitable methodologies. Recommendations generated here are intended specifically for the CDL but may be broadly applicable to additional remotely-sensed land cover datasets including the National Land Cover Database (NLCD), Moderate Resolution Imaging Spectroradiometer (MODIS)-based land cover products, and other regional, national, and global land cover classification maps.*

Laufenberg, J. S., Johnson, H. E., Doherty, P. F., & Breck, S. W. (2018). Compounding effects of human development and a natural food shortage on a black bear population along a human development-wildland interface. *Biological Conservation, 224*, 188-198. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048589325&doi=10.1016%2fj.biocon.2018.05.004&partnerID=40&md5=bfb90cb9d23901dbc09d6833bea78510. doi:10.1016/j.biocon.2018.05.004
Research Tags: Wildlife
Abstract: *Human development and climate change are two stressors that threaten numerous wildlife populations, and their combined effects are likely to be most pronounced along the human development-wildland interface where changes in both natural and anthropogenic conditions interact to affect wildlife. To better understand the compounding influence of these stressors, we investigated the effects of a climate-induced natural food shortage on the dynamics of a black bear population in the vicinity of Durango, Colorado. We integrated 4 years of DNA-based capture-mark-recapture data with GPS-based telemetry data to evaluate the combined effects of human development and the food shortage on the abundance, population growth rate, and spatial distribution of female black bears. We documented a 57% decline in female bear abundance immediately following the natural food shortage coinciding with an increase in human-caused bear mortality (e.g., vehicle collisions, harvest and lethal removals) primarily in developed areas. We also detected a change in the spatial distribution of female bears with fewer bears occurring near human development in years immediately following the food shortage, likely as a consequence of high mortality near human infrastructure during the food shortage. Given expected future increases in human development and climate-induced food shortages, we expect that bear dynamics may be increasingly influenced by human-caused mortality, which will be difficult to detect with current management practices. To ensure long-term sustainability of bear populations, we recommend that wildlife agencies invest in monitoring programs that can accurately track bear*

populations, incorporate non-harvest human-caused mortality into management models, and work to reduce human-caused mortality, particularly in years with natural food shortages.

Lazarus, B. E., Germino, M. J., & Richardson, B. A. (2019). Freezing resistance, safety margins, and survival vary among big sagebrush populations across the western United States. *American Journal of Botany, 106*(7), 922-934. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068766286&doi=10.1002%2fajb2.1320&partnerID=40&md5=1d8bf1f389f6bc55e82310628d54e18b. doi:10.1002/ajb2.1320
Research Tags: Grassland, Weather
Abstract: *Premise*
Physiological responses to temperature extremes are considered strong drivers of species' demographic responses to climate variability. Plants are typically classified as either avoiders or tolerators in their freezing-resistance mechanism, but a gradient of physiological-threshold freezing responses may exist among individuals of a species. Moreover, adaptive significance of physiological freezing responses is poorly characterized, particularly under warming conditions that relax selection on cold hardiness.
Methods
Freezing responses were measured in winter and again for new foliage in spring for 14 populations of Artemisia tridentata collected throughout its range and planted in a warm common garden. The relationships of the freezing responses to survival were evaluated in the warm garden and in two colder gardens.
Results
Winter and spring freezing resistance were not correlated and appeared to be under differing selection regimes, as evident in correlations with different population climate of origin variables. All populations resisted considerably lower temperatures in winter than in spring, with populations from more continental climates showing narrower freezing safety margins (difference in temperatures at which ice-nucleation occurs and 50% reduction in chlorophyll fluorescence occurs) in spring. Populations with greater winter freezing resistance had lower survivorship in the warmest garden, while populations with greater spring freezing resistance had lower survivorship in a colder garden.
Conclusions
These survivorship patterns relative to physiological thresholds suggest excess freezing resistance may incur a survival cost that likely relates to a trade-off between carbon gain and freezing resistance during critical periods of moisture availability. This cost has implications for seed moved from cooler to warmer environments and for plants growing in warming environments.

Le, P. V. V., Kumar, P., Ruiz, M. O., Mbogo, C., & Muturi, E. J. (2019). Predicting the direct and indirect impacts of climate change on malaria in coastal Kenya. *PLoS ONE, 14*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061135046&doi=10.1371%2fjournal.pone.0211258&partnerID=40&md5=4e825e50c2d7dab5c43480ce816c6a24. doi:10.1371/journal.pone.0211258
Research Tags:
Abstract: *Background*
The transmission of malaria is highly variable and depends on a range of climatic and anthropogenic factors. This study investigates the combined, i.e. direct and indirect, impacts of climate change on the dynamics of malaria through modifications in: (i) the sporogonic cycle of Plasmodium induced by air temperature increase, and (ii) the life cycle of Anopheles vector triggered by changes in natural breeding habitat arising from the altered moisture dynamics resulting from acclimation responses of vegetation under climate change. The study is performed for a rural region in Kilifi county, Kenya.
Methods and findings
We use a stochastic lattice-based malaria (SLIM) model to make predictions of changes in Anopheles vector abundance, the life cycle of Plasmodium parasites, and thus malaria transmission under projected climate change in the study region. SLIM incorporates a nonlinear temperature-dependence of malaria parasite development to estimate the extrinsic incubation period of Plasmodium. It is also linked with a spatially distributed eco-hydrologic modeling framework to capture the impacts of climate change on soil moisture dynamics, which served as a key determinant for the formation and persistence of mosquito larval habitats on the land surface. Malaria incidence data collected from 2008 to 2013 is used for SLIM model validation.

Projections of climate change and human population for the region are used to run the models for prediction scenarios.
Under elevated atmospheric CO2 concentration ([CO2]) only, modeled results reveal wetter soil moisture in the root zone due to the suppression of transpiration from vegetation acclimation, which increases the abundance of Anopheles vectors and the risk of malaria. When air temperature increases are also considered along with elevated [CO2], the life cycle of Anopheles vector and the extrinsic incubation period of Plasmodium parasites are shortened nonlinearly. However, the reduction of soil moisture resulting from higher evapotranspiration due to air temperature increase also reduces the larval habitats of the vector. Our findings show the complicated role of vegetation acclimation under elevated [CO2] on malaria dynamics and indicate an indirect but ignored impact of air temperature increase on malaria transmission through reduction in larval habitats and vector density.
Conclusions
Vegetation acclimation triggered by elevated [CO2] under climate change increases the risk of malaria. In addition, air temperature increase under climate change has opposing effects on mosquito larval habitats and the life cycles of both Anopheles vectors and Plasmodium parasites. The indirect impacts of temperature change on soil moisture dynamics are significant and should be weighed together with the direct effects of temperature change on the life cycles of mosquitoes and parasites for future malaria prediction and control.

Leach, J. A., Olson, D. H., Anderson, P. D., & Eskelson, B. N. I. (2017). Spatial and seasonal variability of forested headwater stream temperatures in western Oregon, USA. *Aquatic Sciences, 79*(2), 291-307. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84978880756&doi=10.1007%2fs00027-016-0497-9&partnerID=40&md5=30ec0ac01a2d5ecdf969e5ca0fe05bba. doi:10.1007/s00027-016-0497-9
Research Tags: Water, Forestry
Abstract: *Thermal regimes of forested headwater streams control the growth and distribution of various aquatic organisms. In a western Oregon, USA, case study we examined: (1) forested headwater stream temperature variability in space and time; (2) relationships between stream temperature patterns and weather, above-stream canopy cover, and geomorphic attributes; and (3) the predictive ability of a regional stream temperature model to account for headwater stream temperature heterogeneity. Stream temperature observations were collected at 48 sites within a 128-ha managed forest in western Oregon during 2012 and 2013. Headwater stream temperatures showed the greatest spatial variability during summer (range up to 10 ∘C) and during cold and dry winter periods (range up to 7.5 ∘C), but showed less spatial variability during spring, fall and wet winter periods (range between 2 and 5 ∘C). Distinct thermal regimes among sites were identified; however, geomorphic attributes typically used in regional stream temperature models were not good predictors of thermal variability at headwater scales. A regional stream temperature model captured the mode of mean August temperatures observed across the study area, but overpredicted temperatures for a quarter of the sites by up to 2.8 ∘C. This study indicates considerable spatial thermal variability may occur at scales not resolved by regional stream temperature models. Recognizing this sub-landscape variability may be important when predicting distributions of aquatic organisms and their habitat under climate and environment change scenarios.*

LeBrun, J. J., Schneiderman, J. E., Thompson, F. R., Dijak, W. D., Fraser, J. S., He, H. S., & Millspaugh, J. J. (2017). Bird response to future climate and forest management focused on mitigating climate change. *Landscape Ecology, 32*(7), 1433-1446. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84995752855&doi=10.1007%2fs10980-016-0463-x&partnerID=40&md5=c1a82af6de4099c81c6d6bf5ae58a78d. doi:10.1007/s10980-016-0463-x
Research Tags: Wildlife
Abstract: *Context*
Global temperatures are projected to increase and affect forests and wildlife populations. Forest management can potentially mitigate climate-induced changes through promoting carbon sequestration, forest resilience, and facilitated change.
Objectives
We modeled direct and indirect effects of climate change on avian abundance through changes in forest landscapes and assessed impacts on bird abundances of forest management strategies designed to mitigate

climate change effects.
Methods
We coupled a Bayesian hierarchical model with a spatially explicit landscape simulation model (LANDIS PRO) to predict avian relative abundance. We considered multiple climate scenarios and forest management scenarios focused on carbon sequestration, forest resilience, and facilitated change over 100 years.
Results
Management had a greater impact on avian abundance (almost 50% change under some scenarios) than climate (<3% change) and only early successional and coniferous forest showed significant change in percent cover across time. The northern bobwhite was the only species that changed in abundance due to climate-induced changes in vegetation. Northern bobwhite, prairie warbler, and blue-winged warbler generally increased in response to warming temperatures but prairie warbler exhibited a non-linear response and began to decline as summer maximum temperatures exceeded 36 °C at the end of the century.
Conclusion
Linking empirical models with process-based landscape change models can be an effective way to predict climate change and management impacts on wildlife, but time frames greater than 100 years may be required to see climate related effects. We suggest that future research carefully consider species-specific effects and interactions between management and climate.

Ledo, A., Hillier, J., Smith, P., Aguilera, E., Blagodatskiy, S., Brearley, F. Q., . . . Zerihun, A. (2019). A global, empirical, harmonised dataset of soil organic carbon changes under perennial crops. *Scientific Data, 6*(1), 57. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066270415&doi=10.1038%2fs41597-019-0062-1&partnerID=40&md5=9e5e1cb945ff46c54a277b601cb03a34. doi:10.1038/s41597-019-0062-1
Research Tags: Soil, Crops
Abstract: *A global, unified dataset on Soil Organic Carbon (SOC) changes under perennial crops has not existed till now. We present a global, harmonised database on SOC change resulting from perennial crop cultivation. It contains information about 1605 paired-comparison empirical values (some of which are aggregated data) from 180 different peer-reviewed studies, 709 sites, on 58 different perennial crop types, from 32 countries in temperate, tropical and boreal areas; including species used for food, bioenergy and bio-products. The database also contains information on climate, soil characteristics, management and topography. This is the first such global compilation and will act as a baseline for SOC changes in perennial crops. It will be key to supporting global modelling of land use and carbon cycle feedbacks, and supporting agricultural policy development.*

Lee, M. S., Hollinger, D. Y., Keenan, T. F., Ouimette, A. P., Ollinger, S. V., & Richardson, A. D. (2018). Model-based analysis of the impact of diffuse radiation on CO<inf>2</inf> exchange in a temperate deciduous forest. *Agricultural and Forest Meteorology, 249*, 377-389. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034823314&doi=10.1016%2fj.agrformet.2017.11.016&partnerID=40&md5=19560c1921a11da25918b8a9a040593c. doi:10.1016/j.agrformet.2017.11.016
Research Tags: Forestry
Abstract: *Clouds and aerosols increase the fraction of global solar irradiance that is diffuse light. This phenomenon is known to increase the photosynthetic light use efficiency (LUE) of closed-canopy vegetation by redistributing photosynthetic photon flux density (400–700 nm) from saturated, sunlit leaves at the top of the canopy, to shaded leaves deeper in the canopy. We combined a process-based carbon cycle model with 10 years of eddy covariance carbon flux measurements and other ancillary data sets to assess 1) how this LUE enhancement influences interannual variation in carbon uptake, and 2) how errors in modeling diffuse fraction affect predictions of carbon uptake. Modeled annual gross primary productivity (GPP) increased by ≈0.94% when observed levels of diffuse fraction were increased by 0.01 (holding total irradiance constant). The sensitivity of GPP to increases in diffuse fraction was highest when the diffuse fraction was low to begin with, and lowest when the diffuse fraction was already high. Diffuse fraction also explained significantly more of the interannual variability of modeled net ecosystem exchange (NEE), than did total irradiance. Two tested radiation partitioning models yielded over- and underestimates of diffuse fraction at our site, which propagated to over- and underestimates of annual NEE, respectively. Our findings highlight the importance of*

incorporating LUE enhancement under diffuse light into models of global primary production, and improving models of diffuse fraction.

Lee, S., Sadeghi, A. M., Yeo, I. Y., McCarty, G. W., & Hively, W. D. (2017). Assessing the impacts of future climate conditions on the effectiveness of winter cover crops in reducing nitrate loads into the chesapeake bay watersheds using the swat model. *Transactions of the ASABE, 60*(6), 1939-1955. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040031428&partnerID=40&md5=007dc7b83f20093cab890c3648166425.

Research Tags: Crops, Water

Abstract: *Winter cover crops (WCCs) have been widely implemented in the Coastal Plain of the Chesapeake Bay watershed (CBW) due to their high effectiveness at reducing nitrate loads. However, future climate conditions (FCCs) are expected to exacerbate water quality degradation in the CBW by increasing nitrate loads from agriculture. Accordingly, the question remains whether WCCs are sufficient to mitigate increased nutrient loads caused by FCCs. In this study, we assessed the impacts of FCCs on WCC nitrate reduction efficiency on the Coastal Plain of the CBW using Soil and Water Assessment Tool (SWAT) model. Three FCC scenarios (2085 – 2098) were prepared using General Circulation Models (GCMs), considering three Intergovernmnental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) greenhouse gas emission scenarios. We also developed six representative WCC implementation scenarios based on the most commonly used planting dates and species of WCCs in this region. Simulation results showed that WCC biomass increased by ~ 58 % under FCC scenarios, due to climate conditions conducive to the WCC growth. Prior to implementing WCCs, annual nitrate loads increased by ~ 43 % under FCC scenarios compared to the baseline scenario (2001 – 2014). When WCCs were planted, annual nitrate loads were substantially reduced by ~ 48 % and WCC nitrate reduction efficiency water ~ 5 % higher under FCC scenarios relative to the baseline. The increase rate of WCC nitrate reduction efficiency varied by FCC scenarios and WCC planting methods. As CO2 concentration was higher and winters were warmer under FCC scenarios, WCCs had greater biomass and therefore showed higher nitrate reduction efficiency. In response to FCC scenarios, the performance of less effective WCC practices (e.g., barley, wheat, and late planting) under the baseline indicated ~ 14 % higher increase rate of nitrate reduction efficiency compared to ones with better effectiveness under the baseline (e.g., rye and early planting), due to warmer temperatures. According to simulation results, WCCs were effective to mitigate nitrate loads accelerated by FCCs and therefore the role of WCCs in mitigating nitrate loads is even more important in the given FCCs.*

Lee, S., Sadeghi, A. M., Yeo, I. Y., McCarty, G. W., Hively, W. D., Lang, M. W., & Sharifi, A. (2017). *Assessing climate change impacts on winter cover crop nitrate uptake efficiency on the coastal plain of the Chesapeake Bay Watershed using SWAT model.* Paper presented at the 2017 ASABE Annual International Meeting.

Research Tags: Crops, Water

Abstract: *Climate change is expected to exacerbate water quality degradation in the Chesapeake Bay Watershed (CBW). Winter cover crops (WCCs) have been widely implemented in this region due to their high effectiveness at reducing nitrate loads. However, little is known about climate change impacts on the effectiveness of WCCs for reducing nitrate loads. The objective of this study is to assess climate change impacts on WCC nitrate uptake efficiency on the Coastal Plain of the CBW using Soil and Water Assessment Tool (SWAT) model. We prepared climate change scenarios using General Circulation Models (GCMs) under three greenhouse emission scenarios (e.g., A1B, A2, and B1). Simulation results showed that WCC biomass increased by ~ 58 % under climate change scenarios, due to climate conditions conducive to WCC growth. Prior to WCC implementation, annual nitrate loads increased by ~ 43 % (5.3 kg N·ha-1) under climate change scenarios compared to the baseline scenario. When WCCs were planted, nitrate loads were substantially reduced and WCC nitrate reduction efficiency increased by ~ 5 % under climate change scenarios relative to the baseline, due to increased WCC biomass. Therefore, the role of WCCs in mitigating nitrate loads should increase in the future given predicted climate change.*

Lee, S., Wallace, C. W., Sadeghi, A. M., McCarty, G. W., Zhong, H., & Yeo, I. Y. (2018). Impacts of Global Circulation Model (GCM) bias and WXGEN on modeling hydrologic variables. *Water (Switzerland), 10*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048416920&doi=10.3390%2fw10060764&partnerI

D=40&md5=f9b583db702f0c58f938e2a71a13f0ab. doi:10.3390/w10060764
Research Tags: Water, Weather
Abstract: *A WXGEN weather generator is commonly used to generate daily climate data for Soil and Water Assessment Tool (SWAT) model when input climate data are not fully available. Of all input data for WXGEN, precipitation is critical due to its sensitivity to the number of wet days. Since global climate model (GCM) data tend to have excessive wet days, use of GCM precipitation data for WXGEN may cause errors in the estimation of climate variables and therefore SWAT predictions. To examine such impacts of GCM data, we prepared two climate data for SWAT using WXGEN with both the original GCM data with the excessive number of wet days (EGCM) and the processed GCM data with the reasonable number of wet days (RGCM). We then compared SWAT simulations from EGCM and RGCM. Results show that because of the excessive wet days in EGCM, solar radiation generated by WXGEN was underestimated, subsequently leading to 143 mm lower ET and 0.6–0.8 m3/s greater streamflow compared to the simulations from RGCM. Simulated crop biomass under EGCM was smaller than RGCM due to less solar radiation. Although use of WXGEN is increasing in projecting climate change impacts using SWAT, potential errors from the combination of WXGEN and GCM have not well investigated. Our findings clearly demonstrate that GCM bias (excessive wet days) leads WXGEN to generate inaccurate climate data, resulting in unreasonable SWAT predictions. Thus, GCM data should be carefully processed to use them for WXGEN.*

Lee, S., Yeo, I. Y., Sadeghi, A. M., McCarty, G. W., Hively, W. D., Lang, M. W., & Sharifi, A. (2018). Comparative analyses of hydrological responses of two adjacent watersheds to climate variability and change using the SWAT model. *Hydrology and Earth System Sciences, 22*(1), 689-708. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041210992&doi=10.5194%2fhess-22-689-2018&partnerID=40&md5=ad1f9101b28399c86dddd349671df5d. doi:10.5194/hess-22-689-2018
Research Tags: Water
Abstract: *Water quality problems in the Chesapeake Bay Watershed (CBW) are expected to be exacerbated by climate variability and change. However, climate impacts on agricultural lands and resultant nutrient loads into surface water resources are largely unknown. This study evaluated the impacts of climate variability and change on two adjacent watersheds in the Coastal Plain of the CBW, using the Soil and Water Assessment Tool (SWAT) model. We prepared six climate sensitivity scenarios to assess the individual impacts of variations in CO2 concentration (590 and 850 ppm), precipitation increase (11 and 21 %), and temperature increase (2.9 and 5.0 ◦C), based on regional general circulation model (GCM) projections. Further, we considered the ensemble of five GCM projections (2085–2098) under the Representative Concentration Pathway (RCP) 8.5 scenario to evaluate simultaneous changes in CO2, precipitation, and temperature. Using SWAT model simulations from 2001 to 2014 as a baseline scenario, predicted hydrologic outputs (water and nitrate budgets) and crop growth were analyzed. Compared to the baseline scenario, a precipitation increase of 21 % and elevated CO2 concentration of 850 ppm significantly increased streamflow and nitrate loads by 50 and 52 %, respectively, while a temperature increase of 5.0 ◦C reduced streamflow and nitrate loads by 12 and 13 %, respectively. Crop biomass increased with elevated CO2 concentrations due to enhanced radiation- and water-use efficiency, while it decreased with precipitation and temperature increases. Over the GCM ensemble mean, annual streamflow and nitrate loads showed an increase of ∼70 % relative to the baseline scenario, due to elevated CO2 concentrations and precipitation increase. Different hydrological responses to climate change were observed from the two watersheds, due to contrasting land use and soil characteristics. The watershed with a larger percent of croplands demonstrated a greater increased rate of 5.2 kg N ha−1 in nitrate yield relative to the watershed with a lower percent of croplands as a result of increased export of nitrate derived from fertilizer. The watershed dominated by poorly drained soils showed increased nitrate removal due do enhanced denitrification compared to the watershed dominated by well-drained soils. Our findings suggest that increased implementation of conservation practices would be necessary for this region to mitigate increased nitrate loads associated with predicted changes in future climate.*

Lefohn, A. S., Malley, C. S., Smith, L., Wells, B., Hazucha, M., Simon, H., . . . Gerosa, G. (2018). Tropospheric ozone assessment report: Global ozone metrics for climate change, human health, and crop/ecosystem research. *Elementa, 6*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055353980&doi=10.1525%2felementa.279&partne

rID=40&md5=aa8669c10b95d228cc013a580218e02b. doi:10.1525/elementa.279
Research Tags: Emissions
Abstract: *Assessment of spatial and temporal variation in the impacts of ozone on human health, vegetation, and climate requires appropriate metrics. A key component of the Tropospheric Ozone Assessment Report (TOAR) is the consistent calculation of these metrics at thousands of monitoring sites globally. Investigating temporal trends in these metrics required that the same statistical methods be applied across these ozone monitoring sites. The nonparametric Mann-Kendall test (for significant trends) and the Theil-Sen estimator (for estimating the magnitude of trend) were selected to provide robust methods across all sites. This paper provides the scientific underpinnings necessary to better understand the implications of and rationale for selecting a specific TOAR metric for assessing spatial and temporal variation in ozone for a particular impact. The rationale and underlying research evidence that influence the derivation of specific metrics are given. The form of 25 metrics (4 for model-measurement comparison, 5 for characterization of ozone in the free troposphere, 11 for human health impacts, and 5 for vegetation impacts) are described. Finally, this study categorizes health and vegetation exposure metrics based on the extent to which they are determined only by the highest hourly ozone levels, or by a wider range of values. The magnitude of the metrics is influenced by both the distribution of hourly average ozone concentrations at a site location, and the extent to which a particular metric is determined by relatively low, moderate, and high hourly ozone levels. Hence, for the same ozone time series, changes in the distribution of ozone concentrations can result in different changes in the magnitude and direction of trends for different metrics. Thus, dissimilar conclusions about the effect of changes in the drivers of ozone variability (e.g., precursor emissions) on health and vegetation exposure can result from the selection of different metrics.*

Lei, F., Crow, W. T., Holmes, T. R. H., Hain, C., & Anderson, M. C. (2018). Global Investigation of Soil Moisture and Latent Heat Flux Coupling Strength. *Water Resources Research, 54*(10), 8196-8215. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055484925&doi=10.1029%2f2018WR023469&partnerID=40&md5=5033b82778b481a80171271577b53b6a. doi:10.1029/2018WR023469
Research Tags: Soil, Weather
Abstract: *Physical models describing land-atmosphere coupling have been developed to help better understand the impact of local-, regional-, and global-scale climate on weather and the water cycle. However, verifying the accuracy of these models is challenging over sparsely instrumented areas. Here the strength of land-atmosphere coupling between soil moisture and terrestrial evapotranspiration is examined by combining multiple global-scale remote sensing and modeling products into a unified analysis. This analysis is unique in that it can be conducted globally and is unbiased by the presence of random errors in the remote sensing products. As such it provides the first robust estimate of the degree to which soil moisture and evapotranspiration are linked. Results show strong soil moisture/evapotranspiration coupling over the western United States, the African Sahel, central Asia, and Australia. However, they also demonstrate that most existing models are still overpredicting this coupling along transitional regions between wet and dry climates (like the Central Great Plains of North America, India, and coastal Australia). This work will help improve the representation of land-atmosphere coupling in models used to obtain future climate projections.*

Lembrechts, J. J., Alexander, J. M., Cavieres, L. A., Haider, S., Lenoir, J., Kueffer, C., . . . Milbau, A. (2017). Mountain roads shift native and non-native plant species' ranges. *Ecography, 40*(3), 353-364. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84961821137&doi=10.1111%2fecog.02200&partnerID=40&md5=b8787787d4e99f9795418c25057a2912. doi:10.1111/ecog.02200
Research Tags: Forestry
Abstract: *Roads are known to act as corridors for dispersal of plant species. With their variable microclimate, role as corridors for species movement and reoccurring disturbance events, they show several characteristics that might influence range dynamics of both native and non-native species. Previous research on plant species ranges in mountains however seldom included the effects of roads. To study how ranges of native and non-native species differ between roads and adjacent vegetation, we used a global dataset of plant species composition along mountain roads. We compared average elevation and range width of species, and used generalized linear mixed models (GLMMs) to compile their range optimum and amplitude. We then explored differences between roadside and adjacent plots based on a species' origin (native vs non-native) and nitrogen

and temperature affinity. Most non-native species had on average higher elevational ranges and broader amplitudes in roadsides. Higher optima for non-native species were associated with high nitrogen and temperature affinity. While lowland native species showed patterns comparable to those in non-native species, highland native species had significantly lower elevational ranges in roadsides compared to the adjacent vegetation. We conclude that roadsides indeed change the elevational ranges of a variety of species. These changes are not limited to the expansion of non-native species along mountain roads, but also include both upward and downward changes in ranges of native species. Roadsides may thus facilitate upward range shifts, for instance related to climate change, and they could serve as corridors to facilitate migration of alpine species between adjacent high-elevation areas. We recommend including the effects of mountain roads in species distribution models to fine-tune the predictions of range changes in a warming climate.

Lenhart, C., & Smiley, P. C. (2018). *Ecological restoration in the Midwest: Past, present, and future*.
Research Tags: Grassland
Summary: *Most people do not realize it, but the Midwest has been at the forefront of ecological restoration longer than perhaps any other region in the United States, dating back to the 1930s. Because of its industrial history, agricultural productivity, and natural features such as the Great Lakes, the Midwest has always faced a unique set of ecological challenges.*
Focusing on six cutting-edge case studies that highlight thirty restoration efforts and research sites throughout the region— Iowa, Indiana, Illinois, Wisconsin, Michigan, Minnesota, and Ohio— editors Christian Lenhart and Peter "Rocky" Smiley Jr. bring together a group of scholars and practitioners to show how midwestern restoration efforts have developed, as well as where they are headed. Whether cleaning up contamination from auto plants in Ohio, or restoring native prairie grasses along the Iowa highway, the contributors uncover a vast network of interested citizens and volunteer groups committed to preserving the region's environment.

Lerman, S. B., & Contosta, A. R. (2019). Lawn mowing frequency and its effects on biogenic and anthropogenic carbon dioxide emissions. *Landscape and Urban Planning, 182*, 114-123. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056181236&doi=10.1016%2fj.landurbplan.2018.10.016&partnerID=40&md5=9f45d2069e2aa5663a3a269d9747a08d. doi:10.1016/j.landurbplan.2018.10.016
Research Tags: Emissions, Grassland
Abstract: *Decision makers in urban areas actively pursue strategies to decrease carbon dioxide (CO2) emissions and other greenhouse gases. Lawns dominate urban lands in the U.S. and require intensive management, including frequent mowing, which may influence CO2 emissions from both biogenic and anthropogenic sources. We tested whether different lawn mowing frequencies (every one, two or three weeks) affected soil respiration (i.e., biogenic CO2 emissions), by changing soil moisture and temperature, and the gasoline emissions associated with lawn maintenance via lawn mowing (i.e., anthropogenic CO2 emissions). Sixteen yards in Springfield, Massachusetts USA were assigned a mowing frequency for two seasons (2013–2014). We measured grass height, air and soil temperature, soil moisture, soil CO2 flux, lawn mower emissions, tree canopy coverage and precipitation. We used a mixed effects modeling approach to test how these variables interacted with each other and responded to mowing frequency. Lawn-mowing frequency did not influence soil temperature, moisture, or biogenic soil CO2 fluxes. Soil microclimate and soil respiration varied more with ambient climatic fluctuations and tree canopy cover. By contrast, anthropogenic emissions increased with more frequent mowing due to emissions associated with the mower. When scaled to the entire mowing season, biogenic CO2 fluxes far exceeded the anthropogenic fluxes, thus requiring consideration for accurate accounting of urban greenhouse gas emissions. The interplay between biogenic (e.g., increasing tree canopy in lawn-dominated yards) and anthropogenic (i.e., mowing less frequently) methods of reducing CO2 emissions in cities highlights the need for more rigorous accounting processes for cities to meet climate action goals.*

Lesk, C., Coffel, E., D'Amato, A. W., Dodds, K., & Horton, R. (2017). Threats to North American forests from southern pine beetle with warming winters. *Nature Climate Change, 7*(10), 713-717. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032579130&doi=10.1038%2fnclimate3375&partnerID=40&md5=828f793a40f2baec34dbaa50b74044a8. doi:10.1038/nclimate3375
Research Tags: Weather, Wildlife, Forestry

Abstract: *In coming decades, warmer winters are likely to ease range constraints on many cold-limited forest insects1,2,3,4,5. Recent unprecedented expansion of the southern pine beetle (SPB, Dendroctonus frontalis) into New Jersey, New York and Connecticut in concert with warming annual temperature minima highlights the risk that this insect pest poses to the pine forests of the northern United States and Canada under continued climate change6. Here we present projections of northward expansion in SPB-suitable climates using a statistical bioclimatic range modelling approach and current-generation general circulation model output under Representative Concentration Pathways 4.5 and 8.5. Results show that by the middle of the twenty-first century, the climate is likely to be suitable for SPB expansion into vast areas of previously unaffected forests throughout the northeastern United States and into southeastern Canada. This scenario would pose a significant economic and ecological risk to the affected regions, including disruption of local ecosystem services7, shifts in forest structure8, and threats to native biodiversity9.*

Lesmeister, D. B., Sovern, S. G., Davis, R. J., Bell, D. M., Gregory, M. J., & Vogeler, J. C. (2019). Mixed-severity wildfire and habitat of an old-forest obligate. *Ecosphere, 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065015988&doi=10.1002%2fecs2.2696&partnerID=40&md5=2e45bc2cf1cc30b017c2725c0204a078. doi:10.1002/ecs2.2696

Research Tags: Forestry, Weather

Abstract: *The frequency, extent, and severity of wildfire strongly influence the structure and function of ecosystems. Mixed-severity fire regimes are the most complex and least understood fire regimes, and variability of fire severity can occur at fine spatial and temporal scales, depending on previous disturbance history, topography, fuel continuity, vegetation type, and weather. During high fire weather in 2013, a complex of mixed-severity wildfires burned across multiple ownerships within the Klamath-Siskiyou ecoregion of southwestern Oregon where northern spotted owl (Strix occidentalis caurina) demographics were studied since 1990. A year prior to these wildfires, high-resolution, remotely sensed forest structural information derived from light detection and ranging (lidar) data was acquired for an area that fully covered the extent of these fires. To quantify wildfire impact on northern spotted owl nesting/roosting habitat, we fit a relative habitat suitability model based on pre-fire locations used for nesting and roosting, and forest structure variables developed from 2012 lidar data. Our pre-fire habitat suitability model predicted nesting/roosting locations well, and variable response functions followed known resource selection patterns. These forests had typical characteristics of old-growth forest, with high density of large live trees, high canopy cover, and complex structure in canopy height. We projected the pre-fire model onto lidar data collected two months post-fire to produce a post-fire suitability map, which indicated that >93% of pre-fire habitat that burned at high severity was no longer suitable forest for nesting and roosting. We also quantified the probability that pre-fire nesting/roosting habitat would burn at each severity class (unburned/low, low, moderate, high). Pre-fire nesting/roosting habitat had lower probability of burning at moderate or high severity compared to other forest types under high burning conditions. Our results indicate that northern spotted owl habitat can buffer the negative effects of climate change by enhancing biodiversity and resistance to high-severity fires, which are predicted to increase in frequency and extent with climate change. Within this region, protecting large blocks of old forests could be an integral component of management plans that successfully maintain variability of forests in this mixed-ownership and mixed-severity fire regime landscape and enhance conservation of many species.*

Levy-Booth, D. J., Giesbrecht, I. J. W., Kellogg, C. T. E., Heger, T. J., D'Amore, D. V., Keeling, P. J., . . . Mohn, W. W. (2019). Seasonal and ecohydrological regulation of active microbial populations involved in DOC, CO <inf>2</inf> , and CH <inf>4</inf> fluxes in temperate rainforest soil. *ISME Journal, 13*(4), 950-963. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058240932&doi=10.1038%2fs41396-018-0334-3&partnerID=40&md5=99a6afdcf0a06aa99ed6ce0108255902. doi:10.1038/s41396-018-0334-3

Research Tags: Water, Soil

Abstract: *The Pacific coastal temperate rainforest (PCTR) is a global hot-spot for carbon cycling and export. Yet the influence of microorganisms on carbon cycling processes in PCTR soil is poorly characterized. We developed and tested a conceptual model of seasonal microbial carbon cycling in PCTR soil through integration of geochemistry, micro-meteorology, and eukaryotic and prokaryotic ribosomal amplicon (rRNA) sequencing from 216 soil DNA and RNA libraries. Soil moisture and pH increased during the wet season, with significant correlation to net CO_2 flux in peat bog and net CH_4 flux in bog forest soil. Fungal succession in these sites was*

characterized by the apparent turnover of Archaeorhizomycetes phylotypes accounting for 41% of ITS libraries. Anaerobic prokaryotes, including Syntrophobacteraceae and Methanomicrobia increased in rRNA libraries during the wet season. Putatively active populations of these phylotypes and their biogeochemical marker genes for sulfate and CH4 cycling, respectively, were positively correlated following rRNA and metatranscriptomic network analysis. The latter phylotype was positively correlated to CH4 fluxes ($r = 0.46$, $p < 0.0001$). Phylotype functional assignments were supported by metatranscriptomic analysis. We propose that active microbial populations respond primarily to changes in hydrology, pH, and nutrient availability. The increased microbial carbon export observed over winter may have ramifications for climate–soil feedbacks in the PCTR.

Lewin, H. A., Robinson, G. E., Kress, W. J., Baker, W. J., Coddington, J., Crandall, K. A., . . . Zhang, G. (2018). Earth BioGenome Project: Sequencing life for the future of life. *Proceedings of the National Academy of Sciences of the United States of America, 115*(17), 4325-4333. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046353202&doi=10.1073%2fpnas.1720115115&partnerID=40&md5=7ba870627a2d744f08674ba5cc94a519. doi:10.1073/pnas.1720115115

Research Tags: Research

Abstract: *Increasing our understanding of Earth's biodiversity and responsibly stewarding its resources are among the most crucial scientific and social challenges of the new millennium. These challenges require fundamental new knowledge of the organization, evolution, functions, and interactions among millions of the planet's organisms. Herein, we present a perspective on the Earth BioGenome Project (EBP), a moonshot for biology that aims to sequence, catalog, and characterize the genomes of all of Earth's eukaryotic biodiversity over a period of 10 years. The outcomes of the EBP will inform a broad range of major issues facing humanity, such as the impact of climate change on biodiversity, the conservation of endangered species and ecosystems, and the preservation and enhancement of ecosystem services. We describe hurdles that the project faces, including data-sharing policies that ensure a permanent, freely available resource for future scientific discovery while respecting access and benefit sharing guidelines of the Nagoya Protocol. We also describe scientific and organizational challenges in executing such an ambitious project, and the structure proposed to achieve the project's goals. The far-reaching potential benefits of creating an open digital repository of genomic information for life on Earth can be realized only by a coordinated international effort.*

Leytem, A. B., Dungan, R. S., & Bjorneberg, D. L. (2017). Spatial and temporal variation in physicochemical properties of dairy lagoons in south-central Idaho. *Transactions of the ASABE, 60*(2), 439-447. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019990854&doi=10.13031%2ftrans.11991&partnerID=40&md5=94635f4d700d533b07a1d5dd0ff0852e. doi:10.13031/trans.11991

Research Tags: Livestock, Water

Abstract: *Large quantities of wastewater are generated on dairies in south-central Idaho, which can be a source of valuable nutrients as well as contribute to air quality and climate change issues via ammonia (NH3) and greenhouse gas (GHG) emissions. The objective of this study was to examine the range of lagoon water properties among dairies in the region and to determine how they varied spatially and temporally. Twenty-seven lagoons were sampled twice in a nutrient survey to determine physicochemical characteristics, while six lagoons were sampled (3 to 27 times) over a longer period to determine how these characteristics changed with space and time. Lagoon properties measured consisted of total solids (TS), volatile solids (VS), chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN), total ammoniacal nitrogen (TAN), total phosphorus (P), total potassium (K), temperature, pH, dissolved oxygen (DO), and specific conductivity. Results indicate that all lagoon characteristics varied greatly between dairies and with sampling date. Seasonal trends indicated that N decreased from spring to fall, while specific conductivity, total P, total K, and in some instances TS and VS increased over the same period. There was an effect of housing type on these properties, with freestall dairies having higher concentrations of TS, VS, COD, TKN, TAN, and specific conductivity than dry-lot dairies. There was little effect of dairy size on the physicochemical characteristics measured. These results suggest that it is important to account for the nutrients applied with lagoon water in nutrient budgets in order to prevent over-application of N and K, which could lead to N leaching and forage quality issues. In addition, capturing the temporal variation in lagoon properties is important to accurately model seasonal variations in NH3 and GHG emissions.*

Leytem, A. B., Moore, A. D., & Dungan, R. S. (2019). Greenhouse gas emissions from an irrigated crop rotation utilizing dairy manure. *Soil Science Society of America Journal, 83*(1), 137-152. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062174539&doi=10.2136%2fsssaj2018.06.0216&partnerID=40&md5=968bb8f437fd64d33b80bc678245392e. doi:10.2136/sssaj2018.06.0216

Research Tags: Crops, Emissions

Abstract: *Information on greenhouse gas (GHG) emissions from manure application in cropping systems of the irrigated mountain west region is needed. The objectives of this study were to (i) determine the effect of manure application rate and frequency (annual vs. biennial) on GHG losses compared to synthetic fertilizer, (ii) determine the effect of irrigation on GHG losses and (iii) determine the overall global warming potential (GWP) of using manure vs. synthetic fertilizer. Treatments included dry manure rates of 18 or 52 Mg ha−1 applied annually or 36 Mg ha−1 applied biennially as well as synthetic fertilizer and control treatments. Cumulative losses of N2O-N over the rotation ranged from 1.4 to 8.4 kg ha−1 with the 52 Mg ha−1 manure application losing the greatest amount of N2O-N. Emission factors for the growing season indicated that 0.13 to 0.24% of total N applied was lost as N2O-N. Cumulative CO2–C losses were greatest in the manure treatments, with approximately 7% of carbon added lost as CO2–C. Maximum N2O-N fluxes occurred at soil moisture contents of 0.3 to 0.4 m3 m−3 and temperature near 25°C, while CO2–C emissions occurred over broader soil moisture and temperature conditions. The overall GWP associated with manure application indicated a net negative GWP for manure treatments while the synthetic fertilizer treatment was near neutral. Including manure in cropping system rotations can lead to enhanced GHG emission, however the benefits of enhanced SOC can outweigh these losses leading to lower GWP than use of synthetic fertilizer alone.*

Li, C., Fultz, L. M., Moore-Kucera, J., Acosta-Martínez, V., Horita, J., Strauss, R., . . . Weindorf, D. (2017). Corrigendum to "Soil carbon sequestration potential in semi-arid grasslands in the Conservation Reserve Program" [Geoderma 297 (2017) 80–90] (S0016706117301465) (10.1016/j.geoderma.2017.01.032). *Geoderma, 301*, 81. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018724559&doi=10.1016%2fj.geoderma.2017.04.014&partnerID=40&md5=2582e82955e8224923206e09b7b5d1b3. doi:10.1016/j.geoderma.2017.04.014

Research Tags: Soil, Grassland

No Abstract:

Li, C., Fultz, L. M., Moore-Kucera, J., Acosta-Martínez, V., Horita, J., Strauss, R., . . . Weindorf, D. (2017). Soil carbon sequestration potential in semi-arid grasslands in the Conservation Reserve Program. *Geoderma, 294*, 80-90. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013177525&doi=10.1016%2fj.geoderma.2017.01.032&partnerID=40&md5=a78921af91129e7deefe82e46071d074. doi:10.1016/j.geoderma.2017.01.032

Research Tags: Soil, Grassland, Economics

Abstract: *The Conservation Reserve Program (CRP) in the USA plays a major role in carbon (C) sequestration to help mitigate rising CO2 levels and climate change. The Southern High Plains (SHP) region contains > 900.000 ha enrolled in CRP, but a regionally specific C sequestration rate has not been studied, and identification of the C pools and processes important in controlling C sequestration rates remain unresolved. We aimed to address these gaps by utilizing a CRP chronosequence with historical rangeland as a reference ecosystem. Soil samples (0–10 and 10–30 cm) were collected in 2012 and 2014 from a total of 26 fields across seven counties within the SHP and included seven croplands (0 y in CRP), 16 CRP fields that ranged from 6 to 26 y (as of 2012), plus three rangelands. Multiple regression analysis was conducted to gauge the rate of C sequestration under CRP within C pools: soil organic C (SOC), particulate organic matter C (POM-C), and microbial biomass C (MBC), with two additional predictors (soil clay + silt content and precipitation). Despite attempts to control for soil texture by targeting a dominant soil series (Amarillo fine sandy loam), the percent of clay + silt (15.2–48.7%) significantly influenced C accrual. The C sources (C3 from previous cropping systems or C4 from CRP grasses) in SOC and POM-C were assessed using stable C isotope signatures. Additionally, the role of soil microbes in C sequestration was evaluated by investigating the relationship between MBC and CO2 flux and C sequestration. SOC increased at a rate of 69.82 and 132.87 kg C ha− 1 y− 1 and would take approximately 74 and 77 y to reach the rangeland C stocks at 0–10 and 0–30 cm, respectively. The C4-C*

primarily from the introduced grasses was the main source of C sequestration. SOC gains were essentially due to increases in POM-C and MBC, accounting for 50.04 and 15.64% of SOC sequestration at 0–30 cm, respectively. The highest semi-partial correlation coefficients between the increasing years under CRP restoration and MBC indicated CRP had the strongest effect on MBC compared to other C pools. In addition, increasing soil CO2 flux and MBC:SOC ratio with years of CRP restoration indicated MBC played a critical role in the C sequestration process. Conservation of CRP lands and efforts to sustain perennial systems in this highly erodible landscape should be a high priority of conservation programs. In doing so, significant offsets to increasing atmospheric CO2 levels may be achieved in addition to erosion control and improved wildlife habitat.

Li, D., Monahan, W. B., & Baiser, B. (2018). Species richness and phylogenetic diversity of native and non-native species respond differently to area and environmental factors. *Diversity and Distributions, 24*(6), 853-864. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042522101&doi=10.1111%2fddi.12731&partnerID=40&md5=8022995a98ba9cdde60148c22e9285c6. doi:10.1111/ddi.12731

Research Tags: Research

Abstract: *Aim*

To test whether native and non-native species have similar diversity–area relationships (species–area relationships [SARs] and phylogenetic diversity–area relationships [PDARs]) and whether they respond similarly to environmental variables.

Location

United States.

Methods

Using lists of native and non-native species as well as environmental variables for >250 US national parks, we compared SARs and PDARs of native and non-native species to test whether they respond similarly to environmental conditions. We then used multiple regressions involving climate, land cover and anthropogenic variables to further explore underlying predictors of diversity for plants and birds in US national parks.

Results

Native and non-native species had different slopes for SARs and PDARs, with significantly higher slopes for native species. Corroborating this pattern, multiple regressions showed that native and non-native diversity of plants and birds responded differently to a greater number of environmental variables than expected by chance. For native species richness, park area and longitude were the most important variables while the number of park visitors, temperature and the percentage of natural area were among the most important ones for non-native species richness. Interestingly, the most important predictor of native and non-native plant phylogenetic diversity, temperature, had positive effects on non-native plants but negative effects on natives.

Main conclusions

SARs, PDARs and multiple regressions all suggest that native and non-native plants and birds responded differently to environmental factors that influence their diversity. The agreement between diversity–area relationships and multiple regressions with environmental variables suggests that SARs and PDARs can be both used as quick proxies of overall responses of species to environmental conditions. However, more importantly, our results suggest that global change will have different effects on native and non-native species, making it inappropriate to apply the large body of knowledge on native species to understand patterns of community assembly of non-native species.

Li, G., Zhang, F., Jing, Y., Liu, Y., & Sun, G. (2017). Response of evapotranspiration to changes in land use and land cover and climate in China during 2001–2013. *Science of the Total Environment, 596-597*, 256-265. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018465111&doi=10.1016%2fj.scitotenv.2017.04.080&partnerID=40&md5=775d73133699261292d59ab4963f37e1. doi:10.1016/j.scitotenv.2017.04.080

Research Tags: Weather

Abstract: *Land surface evapotranspiration (ET) is a central component of the Earth's global energy balance and water cycle. Understanding ET is important in quantifying the impacts of human influences on the hydrological cycle and thus helps improving water use efficiency and strengthening water use planning and* *watershed management. China has experienced tremendous land use and land cover changes (LUCC) as a result of urbanization and ecological restoration under a broad background of climate change. This study used MODIS data products to analyze how LUCC and climate change affected ET in China in the period 2001–2013. We examined the separate contribution to the estimated ET changes by combining LUCC and climate data. Results showed that the average annual ET in China decreased at a rate of − 0.6 mm/yr from 2001 to 2013. Areas in which ET decreased significantly were mainly distributed in the northwest China, the central of southwest China, and most regions of south central and east China. The trends of four climatic factors including air temperature, wind speed, sunshine duration, and relative humidity were determined, while the contributions of these four factors to ET were quantified by combining the ET and climate datasets. Among the four climatic factors, sunshine duration and wind speed had the greatest influence on ET. LUCC data from 2001 to 2013 showed that forests, grasslands and croplands in China mutually replaced each other. The reduction of forests had much greater effects on ET than change by other land cover types. Finally, through quantitative separation of the distinct effects of climate change and LUCC on ET, we conclude that climate change was the more significant than LULC change in influencing ET in China during the period 2001–2013. Effective water resource management and vegetation-based ecological restoration efforts in China must consider the effects of climate change on ET and water availability.*

Li, J., Ren, L., Bai, Y., Lecain, D., Blumenthal, D., & Morgan, J. (2018). Seed traits and germination of native grasses and invasive forbs are largely insensitive to parental temperature and CO<inf>2</inf> concentration. *Seed Science Research, 28*(4), 303-311. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052696667&doi=10.1017%2fS0960258518000314&partnerID=40&md5=84575bc8fe575c2340820eee00a7eae7. doi:10.1017/S0960258518000314
Research Tags: Grassland
Abstract: *The structure and function of grassland ecosystems can be altered by a changing climate, including higher temperature and elevated atmospheric CO2 concentration. Previous studies suggest that there is no consistent trend in seed germination and seedling recruitment as affected by these conditions. We collected seeds of two native and two invasive species over 6 years from a field study with elevated CO2 (600 p.p.m.) and temperature (1.5/3.0°C day/night) on the mixed-grass prairie of Wyoming, USA. Seed fill, viability and mass were evaluated and germination tests were conducted under alternating temperatures in growth chambers. Thermal time requirements to reach 50% germination (θ50) and base temperatures (Tb) for germination were determined using thermal time models. Climate change conditions had limited effects on seed fill, viability and mass. The combination of CO2 enrichment and warming increased germination of Bouteloua gracilis. Centaurea diffusa and Linaria dalmatica, two invasive species in this study, had the lowest θ50 and Tb required for germination among all the species studied. Although final germination percentages of these invasive species were not affected by treatments, previous studies reported increased seed production under future climate conditions, indicating that they could be more invasive at the regeneration stage in the future. We conclude that projected future temperature increases will have little effect on seed reproductive traits of native species. In addition, the distribution and abundance of B. gracilis and invasive species may be favoured by global climate change due to enhanced germination or seed production traits caused by elevated parental CO2 and temperature conditions.*

Li, L., Zheng, Z., Biederman, J. A., Xu, C., Xu, Z., Che, R., . . . Hao, Y. (2019). Ecological responses to heavy rainfall depend on seasonal timing and multi-year recurrence. *New Phytologist, 223*(2), 647-660. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065396958&doi=10.1111%2fnph.15832&partnerID=40&md5=8b909eddad99a59161196772b2243826. doi:10.1111/nph.15832
Research Tags: Weather
Abstract: *Heavy rainfall events are expected to increase in frequency and severity in the future. However, their effects on natural ecosystems are largely unknown, in particular with different seasonal timing of the events and recurrence over multiple years.*
We conducted a 4 yr manipulative experiment to explore grassland response to heavy rainfall imposed in either the middle of, or late in, the growing season in Inner Mongolia, China. We measured hierarchical responses at individual, community and ecosystem levels.
Surprisingly, above-ground biomass remained stable in the face of heavy rainfall, regardless of seasonal timing,

whereas heavy rainfall late in the growing season had consistent negative impacts on below-ground and total biomass. However, such negative biomass effects were not significant for heavy rainfall in the middle of the growing season. By contrast, heavy rainfall in the middle of the growing season had greater positive effects on ecosystem CO2 exchanges, mainly reflected in the latter 2 yr of the 4 yr experiment. This two-stage response of CO2 fluxes was regulated by increased community-level leaf area and leaf-level photosynthesis and interannual variability of natural precipitation.
Overall, our study demonstrates that ecosystem impacts of heavy rainfall events crucially depend on the seasonal timing and multiannual recurrence. Plant physiological and morphological adjustment appeared to improve the capacity of the ecosystem to respond positively to heavy rainfall.

Li, S., Gitau, M., Engel, B. A., Zhang, L., Du, Y., Wallace, C., & Flanagan, D. C. (2017). Development of a distributed hydrological model to facilitate watershed management. *Hydrological Sciences Journal, 62*(11), 1755-1771. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85025120596&doi=10.1080%2f02626667.2017.1351029&partnerID=40&md5=fc35a416ad32cda3fe1d22867fb3b57f. doi:10.1080/02626667.2017.1351029
Research Tags: Water
Abstract: *To facilitate precise and cost-effective watershed management, a simple yet spatially and temporally distributed hydrological model (DHM-WM) was developed. The DHM-WM is based on the Mishra-Singh version of the curve number method, with several modifications: The spatial distribution of soil moisture was considered in moisture updating; the travel time of surface runoff was calculated on a grid cell basis for routing; a simple tile flow module was included as an option. The DHM-WM was tested on a tile-drained agricultural watershed in Indiana, USA. The model with the tile flow module performed well in the study area, providing a balanced water budget and reasonable flow partitioning. The daily coefficient of determination and Nash-Sutcliffe coefficient were 0.58 and 0.56, for the calibration period, and 0.63 and 0.62 for the validation period. The DHM-WM also provides detailed information about the source areas of flow components, the travel time and pathways of surface runoff.*

Li, W., Ciais, P., Peng, S., Yue, C., Wang, Y., Thurner, M., . . . Zaehle, S. (2017). Land-use and land-cover change carbon emissions between 1901 and 2012 constrained by biomass observations. *Biogeosciences, 14*(22), 5053-5067. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034055468&doi=10.5194%2fbg-14-5053-2017&partnerID=40&md5=2c1570087902ded73088c5f7a451a467. doi:10.5194/bg-14-5053-2017
Research Tags: Research
Abstract: *The use of dynamic global vegetation models (DGVMs) to estimate CO2 emissions from land-use and land-cover change (LULCC) offers a new window to account for spatial and temporal details of emissions and for ecosystem processes affected by LULCC. One drawback of LULCC emissions from DGVMs, however, is lack of observation constraint. Here, we propose a new method of using satellite- and inventory-based biomass observations to constrain historical cumulative LULCC emissions (ELUCc) from an ensemble of nine DGVMs based on emerging relationships between simulated vegetation biomass and ELUCc. This method is applicable on the global and regional scale. The original DGVM estimates of ELUCc range from 94 to 273 PgC during 1901–2012. After constraining by current biomass observations, we derive a best estimate of 155 ± 50 PgC (1σ Gaussian error). The constrained LULCC emissions are higher than prior DGVM values in tropical regions but significantly lower in North America. Our emergent constraint approach independently verifies the median model estimate by biomass observations, giving support to the use of this estimate in carbon budget assessments. The uncertainty in the constrained ELUCc is still relatively large because of the uncertainty in the biomass observations, and thus reduced uncertainty in addition to increased accuracy in biomass observations in the future will help improve the constraint. This constraint method can also be applied to evaluate the impact of land-based mitigation activities.*

Li, X., Xiao, J., He, B., Altaf Arain, M., Beringer, J., Desai, A. R., . . . Varlagin, A. (2018). Solar-induced chlorophyll fluorescence is strongly correlated with terrestrial photosynthesis for a wide variety of biomes: First global analysis based on OCO-2 and flux tower observations. *Global Change Biology, 24*(9), 3990-4008. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051463887&doi=10.1111%2fgcb.14297&partnerID=40&md5=e1f8509b0c3c72d006e40de7ea17e536. doi:10.1111/gcb.14297
Research Tags: Research
Abstract: *Solar-induced chlorophyll fluorescence (SIF) has been increasingly used as a proxy for terrestrial gross primary productivity (GPP). Previous work mainly evaluated the relationship between satellite-observed SIF and gridded GPP products both based on coarse spatial resolutions. Finer resolution SIF (1.3 km × 2.25 km) measured from the Orbiting Carbon Observatory-2 (OCO-2) provides the first opportunity to examine the SIF–GPP relationship at the ecosystem scale using flux tower GPP data. However, it remains unclear how strong the relationship is for each biome and whether a robust, universal relationship exists across a variety of biomes. Here we conducted the first global analysis of the relationship between OCO-2 SIF and tower GPP for a total of 64 flux sites across the globe encompassing eight major biomes. OCO-2 SIF showed strong correlations with tower GPP at both midday and daily timescales, with the strongest relationship observed for daily SIF at the 757 nm (R2 = 0.72, p < 0.0001). Strong linear relationships between SIF and GPP were consistently found for all biomes (R2 = 0.57–0.79, p < 0.0001) except evergreen broadleaf forests (R2 = 0.16, p < 0.05) at the daily timescale. A higher slope was found for C4 grasslands and croplands than for C3 ecosystems. The generally consistent slope of the relationship among biomes suggests a nearly universal rather than biome-specific SIF–GPP relationship, and this finding is an important distinction and simplification compared to previous results. SIF was mainly driven by absorbed photosynthetically active radiation and was also influenced by environmental stresses (temperature and water stresses) that determine photosynthetic light use efficiency. OCO-2 SIF generally had a better performance for predicting GPP than satellite-derived vegetation indices and a light use efficiency model. The universal SIF–GPP relationship can potentially lead to more accurate GPP estimates regionally or globally. Our findings revealed the remarkable ability of finer resolution SIF observations from OCO-2 and other new or future missions (e.g., TROPOMI, FLEX) for estimating terrestrial photosynthesis across a wide variety of biomes and identified their potential and limitations for ecosystem functioning and carbon cycle studies.*

Liang, S., Gu, H., & Bergman, R. D. (2017). Life cycle assessment of cellulosic ethanol and biomethane production from forest residues. *BioResources, 12*(4), 7873-7883. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032662406&doi=10.15376%2fbiores.12.4.7873-7883&partnerID=40&md5=fdf5e7d1ed0d1ec31aeada38a5e96996. doi:10.15376/biores.12.4.7873-7883
Research Tags: Energy, Forestry
Abstract: *There is a strong need to manage low-value forest residues generated from the management practices associated with wildfire, pest, and disease control strategies to improve both the environmental and economic sustainability of forestlands. The conversion of this woody biomass into value-added products provides a great opportunity to benefit both the environment and economy. This study aimed to assess the environmental impacts of converting forest residues into two renewable fuels, cellulosic ethanol and biomethane, by different biochemical conversion pathways. The energy balances and environmental impacts, including acidification, eutrophication, global warming, and photochemical ozone formation, of the two biorefinery approaches were addressed. This work illustrated the advantages of converting forest residues into biomethane from energy and environmental perspectives. The tradeoff between the economic benefits and potential environmental issues need to be carefully considered.*

Liang, X. Z., Wu, Y., Chambers, R. G., Schmoldt, D. L., Gao, W., Liu, C., . . . Kennedy, J. A. (2017). Determining climate effects on US total agricultural productivity. *Proceedings of the National Academy of Sciences of the United States of America, 114*(12), E2285-E2292. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016097981&doi=10.1073%2fpnas.1615922114&partnerID=40&md5=27b487af332c567553f075c8c25958b5. doi:10.1073/pnas.1615922114
Research Tags: Crops
Abstract: *The sensitivity of agricultural productivity to climate has not been sufficiently quantified. The total factor productivity (TFP) of the US agricultural economy has grown continuously for over half a century, with most of the growth typically attributed to technical change. Many studies have examined the effects of local climate on partial productivity measures such as crop yields and economic returns, but these measures cannot account for national-level impacts. Quantifying the relationships between TFP and climate is critical to*

understanding whether current US agricultural productivity growth will continue into the future. We analyze correlations between regional climate variations and national TFP changes, identify key climate indices, and build a multivariate regression model predicting the growth of agricultural TFP based on a physical understanding of its historical relationship with climate. We show that temperature and precipitation in distinct agricultural regions and seasons explain ~70% of variations in TFP growth during 1981–2010. To date, the aggregate effects of these regional climate trends on TFP have been outweighed by improvements in technology. Should these relationships continue, however, the projected climate changes could cause TFP to drop by an average 2.84 to 4.34% per year under medium to high emissions scenarios. As a result, TFP could fall to pre-1980 levels by 2050 even when accounting for present rates of innovation. Our analysis provides an empirical foundation for integrated assessment by linking regional climate effects to national economic outcomes, offering a more objective resource for policy making.

Liang, Y., Duveneck, M. J., Gustafson, E. J., Serra-Diaz, J. M., & Thompson, J. R. (2018). How disturbance, competition, and dispersal interact to prevent tree range boundaries from keeping pace with climate change. *Global Change Biology*, *24*(1), e335-e351. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031408957&doi=10.1111%2fgcb.13847&partnerID=40&md5=1644814428cfd74a018336043c30339f. doi:10.1111/gcb.13847

Research Tags: Forestry

Abstract: *Climate change is expected to cause geographic shifts in tree species' ranges, but such shifts may not keep pace with climate changes because seed dispersal distances are often limited and competition-induced changes in community composition can be relatively slow. Disturbances may speed changes in community composition, but the interactions among climate change, disturbance and competitive interactions to produce range shifts are poorly understood. We used a physiologically based mechanistic landscape model to study these interactions in the northeastern United States. We designed a series of disturbance scenarios to represent varied disturbance regimes in terms of both disturbance extent and intensity. We simulated forest succession by incorporating climate change under a high-emissions future, disturbances, seed dispersal, and competition using the landscape model parameterized with forest inventory data. Tree species range boundary shifts in the next century were quantified as the change in the location of the 5th (the trailing edge) and 95th (the leading edge) percentiles of the spatial distribution of simulated species. Simulated tree species range boundary shifts in New England over the next century were far below (usually <20 km) that required to track the velocity of temperature change (usually more than 110 km over 100 years) under a high-emissions scenario. Simulated species` ranges shifted northward at both the leading edge (northern boundary) and trailing edge (southern boundary). Disturbances may expedite species' recruitment into new sites, but they had little effect on the velocity of simulated range boundary shifts. Range shifts at the trailing edge tended to be associated with photosynthetic capacity, competitive ability for light and seed dispersal ability, whereas shifts at the leading edge were associated only with photosynthetic capacity and competition for light. This study underscores the importance of understanding the role of interspecific competition and disturbance when studying tree range shifts.*

Liebhold, A. M., Yamanaka, T., Roques, A., Augustin, S., Chown, S. L., Brockerhoff, E. G., & Pyšek, P. (2018). Plant diversity drives global patterns of insect invasions. *Scientific Reports*, *8*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053405980&doi=10.1038%2fs41598-018-30605-4&partnerID=40&md5=2a3a1b789d05edb3d07352f4bfc6b66c. doi:10.1038/s41598-018-30605-4

Research Tags: Wildlife

Abstract: *During the last two centuries, thousands of insect species have been transported (largely inadvertently) and established outside of their native ranges worldwide, some with catastrophic ecological and economic impacts. Global variation in numbers of invading species depends on geographic variation in propagule pressure and heterogeneity of environmental resistance to invasions. Elton's diversity-invasibility hypothesis, proposed over sixty years ago, has been widely explored for plants but little is known on how biodiversity affects insect invasions. Here we use species inventories from 44 land areas, ranging from small oceanic islands to entire continents in various world regions, to show that numbers of established insect species are primarily driven by diversity of plants, with both native and non-native plant species richness being the strongest predictor of insect invasions. We find that at large spatial scales, plant diversity directly explains* *variation in non-native insect species richness among world regions, while geographic factors such as land area, climate and insularity largely affect insect invasions indirectly via their effects on local plant richness.*

Liebig, M. A., & Toledo, D. (2019). Hold Your Ground: Threats to Soil Function in Northern Great Plains Grazing Lands. *Rangelands, 41*(1), 17-22. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058793302&doi=10.1016%2fj.rala.2018.11.003&partnerID=40&md5=0a798f421924c51bcb6095dd70e1dc4d. doi:10.1016/j.rala.2018.11.003
Research Tags: Grassland, Soil
Abstract:

Liles, G. C., Maxwell, T. M., Silva, L. C. R., Zhang, J. W., & Horwath, W. R. (2019). Two Decades of Experimental Manipulation Reveal Potential for Enhanced Biomass Accumulation and Water Use Efficiency in Ponderosa Pine Plantations Across Climate Gradients. *Journal of Geophysical Research: Biogeosciences*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070253105&doi=10.1029%2f2019JG005183&partnerID=40&md5=b55166f086c4bcf83e883033e4e08fee. doi:10.1029/2019JG005183
Research Tags:
Abstract:*Many soils throughout the northern Great Plains (NGP) of North America possess attributes that support the successful delivery of multiple ecosystem services from grazing lands.*
Anticipated changes in climate and land use in the region, however, suggest delivery of these services could be compromised in the future because of an increase in threats to soil function. These threats include soil organic matter decline, reduced physical stability, soil erosion, compaction, localized nutrient accumulation, acidification, and salinization.
Adaptive management to conserve existing soil functions in grazing lands is necessary and includes: 1) judicious management of forage resources, 2) strategic application of management to modify vegetation composition or soil conditions, and 3) use of restoration and conservation practices known to maintain vegetation cover and protect soil.
Management approaches to conserve soil functions in NGP grazing lands will likely require considerable adaptive capacity by land managers. Successful application of management will require timely information about soil and vegetation conditions to guide land-use decisions.

Lillie, K. M., Gese, E. M., Atwood, T. C., & Sonsthagen, S. A. (2018). Development of on-shore behavior among polar bears (Ursus maritimus) in the southern Beaufort Sea: Inherited or learned? *International Journal of Business Innovation and Research, 17*(3), 7790-7799. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054812266&doi=10.1002%2fece3.4233&partnerID=40&md5=3db8ad0f2b9f4caba2614779dcbbffe6. doi:10.1002/ece3.4233
Research Tags: Wildlife
Abstract: *Polar bears (Ursus maritimus) are experiencing rapid and substantial changes to their environment due to global climate change. Polar bears of the southern Beaufort Sea (SB) have historically spent most of the year on the sea ice. However, recent reports from Alaska indicate that the proportion of the SB subpopulation observed on-shore during late summer and early fall has increased. Our objective was to investigate whether this on-shore behavior has developed through genetic inheritance, asocial learning, or through social learning. From 2010 to 2013, genetic data were collected from SB polar bears in the fall via hair snags and remote biopsy darting on-shore and in the spring from captures and remote biopsy darting on the sea ice. Bears were categorized as either on-shore or off-shore individuals based on their presence on-shore during the fall. Levels of genetic relatedness, first-order relatives, mother–offspring pairs, and father–offspring pairs were determined and compared within and between the two categories: on-shore versus off-shore. Results suggested transmission of on-shore behavior through either genetic inheritance or social learning as there was a higher than expected number of first-order relatives exhibiting on-shore behavior. Genetic relatedness and parentage data analyses were in concurrence with this finding, but further revealed mother–offspring social learning as the primary mechanism responsible for the development of on-shore behavior. Recognizing that on-shore behavior among polar bears was predominantly transmitted via social learning from mothers to their offspring has implications for future management and conservation as sea ice continues to decline.*

Lin, L., Di, L., Yu, E. G., Tang, J., Shrestha, R., Rahman, M. S., . . . Yang, Z. (2017). *Extract flood duration from Dartmouth Flood Observatory flood product.* Paper presented at the 2017 6th International Conference on Agro-Geoinformatics, Agro-Geoinformatics 2017.

Research Tags: Water

Abstract: *Climate change has become a hot topic in recent years. Flood is one of the most common natural hazards caused from extreme climate change. Scientists have spent a lot of money and time on monitoring flood in past decades. The development of Remote Sensing and Geographic Information System (GIS) brings new ways for scientists to analyze, monitor, and predict floods. Remote Sensing provides an alternative method to traditional flood survey with very fine temporal resolution data with much lower cost. Scientists have been utilizing data from MODIS satellite to detect flood in a lot of research. In this paper, flood duration layers are generated with utilizing Remote Sensing based flood data from Dartmouth Flood Observatory. The flood event layers provide detail view of flood events at pixel level. Flood data is currently processed and managed by RFCLASS website which developed by Center for Spatial Information Science and Systems. Few experiments have been designed to explore the possibility of minimizing cloud impact. Result indicated that there is a huge decrease in total events. Flood data generated in this research is ready to serve further research such as crop loss from flood. However, flood data is not fully accurate due to the similarity of spectral pattern between shadow and water surface. Further study is needed in order to remove error caused by shadow.*

Lin, W., Li, Y., Yang, Z., Giardina, C. P., Xie, J., Chen, S., . . . Yang, Y. (2018). Warming exerts greater impacts on subsoil than topsoil CO<inf>2</inf> efflux in a subtropical forest. *Agricultural and Forest Meteorology, 263*, 137-146. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052304418&doi=10.1016%2fj.agrformet.2018.08.014&partnerID=40&md5=f56d07436c02b8b618c41f48ea5ea2a9. doi:10.1016/j.agrformet.2018.08.014

Research Tags: Soil

Abstract: *How warming affects the magnitude of CO2 fluxes within the soil profile remains an important question, with implications for modeling the response of ecosystem carbon balance to changing climate. Information on belowground responses to warming is especially limited for the tropics and subtropics because the majority of manipulative studies have been conducted in temperate and boreal regions. We examined how artificial warming affected CO2 gas production and exchange across soil profiles in a replicated mesocosms experiment relying on heavily weathered subtropical soils and planted with Chinese fir (Cunninghamia lanceolata). Half of 2 × 2 m mesocosms (5 replications) was heated with cables buried at a 10 cm depth, which increased temperature in the whole soil profile by 4.5, 3.6 and 2.5 °C at 15, 30 and 60 cm soil depths, respectively. Using a combination of chamber-based and concentration gradient method (CGM) approaches, we found that warming increased soil CO2 efflux across the whole profile by 40%. Changes were unevenly distributed across soil depth: mean CO2 production rate decreased from 0.74 to 0.67 μmol CO2 m−2 s−1 in topsoils (0–15 cm depth) whereas it increased from 0.26 to 0.73 μmol CO2 m−2 s−1 in subsoils (15–60 cm depth). Warming reduced moisture more strongly in subsurface than surface soils and increased subsoil soluble N concentrations as well as fine root turnover, in line with previous temperate and boreal warming studies. This consistency indicates that overall responses of subtropical forests to warming may be similar to forests in higher latitudes.*

Lind, B. M., North, M. P., Maloney, P. E., & Eckert, A. J. (2019). Effect of fire and thinning on fine-scale genetic structure and gene flow in fire-suppressed populations of sugar pine (Pinus lambertiana Dougl.). *Forest Ecology and Management, 447*, 115-129. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066270923&doi=10.1016%2fj.foreco.2019.04.033&partnerID=40&md5=540bc63655bc57aedc3c98bd9a0e7beb. doi:10.1016/j.foreco.2019.04.033

Research Tags: Forestry, Weather

Abstract: *Historically, frequent, low-severity fires in dry western North American forests were a major driver of ecological patterns and processes, creating resilient ecosystems dominated by widely-spaced pine species. However, a century of fire-suppression has caused overcrowding, altering forest composition to shade-tolerant species, while increasing competition and leaving trees stressed and susceptible to pathogens, insects, and high-severity fire. Exacerbating the issue, fire incidence is expected to increase with changing climate, while fire season has been observed to begin earlier and last longer than historic trends. Forest thinning and prescribed*

fire have been identified as important management tools to mitigate these risks. Yet little is known of how thinning, fire, or their interaction affect contemporary evolutionary processes of constituent pine species that influence fitness and play an important role in the opportunity for selection and population persistence. We assessed the impact of widely used fuel reduction treatments on fine-scale gene flow on an ecologically important and historically dominant shade-intolerant pine species of the Sierra Nevada, Pinus lambertiana Dougl. Treatment prescription (no-thin-no-fire, thin-no-fire, and fire-and-thin) was found to differentially affect both fine-scale spatial and genetic structure as well as effective gene flow in this species. Specifically, the thin-no-fire prescription increases genetic structure (spatial autocorrelation of relatives) between adults and seedlings, while seed and pollen dispersal increase and decrease, respectively, as a function of increasing disturbance intensity. While these results may be specific to the stands at our study site, they indicate how assumptions relating to genetic effects based on spatial structure can be misleading (for instance, in many stands the presence or absence of spatial structure was not indicative the presence or absence of genetic structure). It is likely that these disequilibrated systems will continue to evolve on unknown evolutionary trajectories. The long-term impacts of management practices on reduced fitness from inbreeding depression should be continually monitored to ensure resilience to increasingly frequent and severe fire, drought, and pest stresses.

Linquist, B. A., Marcos, M., Arlene Adviento-Borbe, M., Anders, M., Harrell, D., Linscombe, S., . . . Thomson, A. (2018). Greenhouse gas emissions and management practices that affect emissions in US rice systems. *Journal of Environmental Quality, 47*(3), 395-409. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046758409&doi=10.2134%2fjeq2017.11.0445&partnerID=40&md5=3b2a984745a5a7797dbc7fde83564f07. doi:10.2134/jeq2017.11.0445

Research Tags: Crops, Emissions

Abstract: *Previous reviews have quantified factors affecting greenhouse gas (GHG) emissions from Asian rice (Oryza sativa L.) systems, but not from rice systems typical for the United States, which often vary considerably particularly in practices (i.e., water and carbon management) that affect emissions. Using meta-analytic and regression approaches, existing data from the United States were examined to quantify GHG emissions and major practices affecting emissions. Due to different production practices, major rice production regions were defined as the mid-South (Arkansas, Texas, Louisiana, Mississippi, and Missouri) and California, with emissions being evaluated separately. Average growing season CH4 emissions for the mid-South and California were 194 (95% confidence interval [CI] = 129–260) and 218 kg CH4 ha−1 season−1 (95% CI = 153–284), respectively. Growing season N2O emissions were similar between regions (0.14 kg N2O ha−1 season−1). Ratoon cropping (allowing an additional harvestable crop to grow from stubble after the initial harvest), common along the Gulf Coast of the mid-South, had average CH4 emissions of 540 kg CH4 ha−1 season−1 (95% CI = 465–614). Water and residue management practices such as alternate wetting and drying, and stand establishment method (water vs. dry seeding), and the amount of residue from the previous crop had the largest effect on growing season CH4 emissions. However, soil texture, sulfate additions, and cultivar selection also affected growing season CH4 emissions. This analysis can be used for the development of tools to estimate and mitigate GHG emissions from US rice systems and other similarly mechanized systems in temperate regions.*

Littell, J. S., McAfee, S. A., & Hayward, G. D. (2018). Alaska snowpack response to climate change: Statewide snowfall equivalent and snowpack water scenarios. *Water (Switzerland), 10*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047250551&doi=10.3390%2fw10050668&partnerID=40&md5=6267f3f2602ef49d5d136206da9832dc. doi:10.3390/w10050668

Research Tags: Water, Weather

Abstract: *Climatically driven changes in snow characteristics (snowfall, snowpack, and snowmelt) will affect hydrologic and ecological systems in Alaska over the coming century, yet there exist no projections of downscaled future snow pack metrics for the state of Alaska. We updated historical and projected snow day fraction (PSF, the fraction of days with precipitation falling as snow) from McAfee et al. We developed modeled snowfall equivalent (SFE) derived from the product of snow-day fraction (PSF) and existing gridded precipitation for Alaska from Scenarios Network for Alaska and Arctic Planning (SNAP). We validated the assumption that modeled SFE approximates historical decadally averaged snow water equivalent (SWE) observations from snowcourse and Snow Telemetry (SNOTEL) sites. We present analyses of future downscaled PSF and two new* *products, October–March SFE and ratio of snow fall equivalent to precipitation (SFE:P) based on bias-corrected statistically downscaled projections of Coupled Model Intercomparison Project 5 (CMIP5) Global Climate Model (GCM) temperature and precipitation for the state of Alaska. We analyzed mid-century (2040–2069) and late-century (2070–2099) changes in PSF, SFE, and SFE:P relative to historical (1970–1999) mean temperature and present results for Alaska climate divisions and 12-digit Hydrologic Unit Code (HUC12) watersheds. Overall, estimated historical the SFE is reasonably well related to the observed SWE, with correlations over 0.75 in all decades, and correlations exceeding 0.9 in the 1960s and 1970s. In absolute terms, SFE is generally biased low compared to the observed SWE. PSF and SFE:P decrease universally across Alaska under both Representative Concentration Pathway (RCP) 4.5 and RCP 8.5 emissions scenarios, with the smallest changes for RCP 4.5 in 2040–2069 and the largest for RCP 8.5 in 2070–2099. The timing and magnitude of maximum decreases in PSF vary considerably with regional average temperature, with the largest changes in months at the beginning and end of the snow season. Mean SFE changes vary widely among climate divisions, ranging from decreases between −17 and −58% for late twenty-first century in southeast, southcentral, west coast and southwest Alaska to increases up to 21% on the North Slope. SFE increases most at highest elevations and latitudes and decreases most in coastal southern Alaska. SFE:P ratios indicate a broad switch from snow-dominated to transitional annual hydrology across most of southern Alaska by mid-century, and from transitional to rain-dominated watersheds in low elevation parts of southeast Alaska by the late twenty-first century.*

Littell, J. S., McKenzie, D., Wan, H. Y., & Cushman, S. A. (2018). Climate Change and Future Wildfire in the Western United States: An Ecological Approach to Nonstationarity. *Earth's Future, 6*(8), 1097-1111. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052653866&doi=10.1029%2f2018EF000878&partnerID=40&md5=0288110542ec827b423a46281f221cfa. doi:10.1029/2018EF000878

Research Tags: Weather

Abstract: *Most people, including many familiar with fire ecology and future climate, assume that the area burned by wildfire will increase in a warmer climate. This depends a lot on what kind of ecosystem we mean. In all ecosystems, fuels must be available to fire for fires to get very big, but the climate controls on those fuels vary widely with vegetation. In wetter forests, it takes an abnormally warm, dry year to make normally wet fuels available. But in many drier ecosystems, fuels are dry enough to burn most years—whether fires get big depends also on whether there is sufficient fuel available to carry fires over large areas. In this kind of vegetation, abnormally wet years in the year prior to fire can create larger or more connected fuels that then lead to larger fires. In this study, we use this concept to investigate how future area burned might be affected by climate change. We found that some ecosystems will burn much more, just as expected. But some will actually burn less. We characterized these futures for 70 different ecosystems around the West. The similarities and differences illustrate the range of futures that might be expected under climate change.*

Liu, B., Wagner, L. E., Ning, D., & Qu, J. (2017). Estimation of wind erosion from construction of a railway in arid Northwest China. *International Soil and Water Conservation Research, 5*(2), 102-108. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020694409&doi=10.1016%2fj.iswcr.2017.04.005&partnerID=40&md5=945886a5826d9bfcb0be53bad9428f01. doi:10.1016/j.iswcr.2017.04.005

Research Tags: Soil, Research

Abstract: *A state-of-the-art wind erosion simulation model, the Wind Erosion Prediction System and the United States Environmental Protection Agency's AP 42 emission factors formula, were combined together to evaluate wind-blown dust emissions from various construction units from a railway construction project in the dry Gobi land in Northwest China. The influence of the climatic factors: temperature, precipitation, wind speed and direction, soil condition, protective measures, and construction disturbance were taken into account. Driven by daily and sub-daily climate data and using specific detailed management files, the process-based WEPS model was able to express the beginning, active, and ending phases of construction, as well as the degree of disturbance for the entire scope of a construction project. The Lanzhou-Xinjiang High-speed Railway was selected as a representative study because of the diversities of different climates, soil, and working schedule conditions that could be analyzed. Wind erosion from different working units included the building of roadbeds, bridges, plants, temporary houses, earth spoil and barrow pit areas, and vehicle transportation were calculated. The total wind erosion emissions, 7406 t, for the first construction area of section LXS-15 with a 14.877 km* *length was obtained for quantitative analysis. The method used is applicable for evaluating wind erosion from other complex surface disturbance projects.*

Liu, C., Sun, G., McNulty, S. G., Noormets, A., & Fang, Y. (2017). Environmental controls on seasonal ecosystem evapotranspiration/potential evapotranspiration ratio as determined by the global eddy flux measurements. *Hydrology and Earth System Sciences, 21*(1), 311-322. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009966199&doi=10.5194%2fhess-21-311-2017&partnerID=40&md5=62decb4e54f9912035d3ce58ea752da5. doi:10.5194/hess-21-311-2017

Research Tags: Weather, Crop

Abstract: *The evapotranspiration/potential evapotranspiration (AET/PET) ratio is traditionally termed as the crop coefficient (Kc) and has been generally used as ecosystem evaporative stress index. In the current hydrology literature, Kc has been widely used as a parameter to estimate crop water demand by water managers but has not been well examined for other types of ecosystems such as forests and other perennial vegetation. Understanding the seasonal dynamics of this variable for all ecosystems is important for projecting the ecohydrological responses to climate change and accurately quantifying water use at watershed to global scales. This study aimed at deriving monthly Kc for multiple vegetation cover types and understanding its environmental controls by analyzing the accumulated global eddy flux (FLUXNET) data. We examined monthly Kc data for seven vegetation covers, including open shrubland (OS), cropland (CRO), grassland (GRA), deciduous broad leaf forest (DBF), evergreen needle leaf forest (ENF), evergreen broad leaf forest (EBF), and mixed forest (MF), across 81 sites. We found that, except for evergreen forests (EBF and ENF), Kc values had large seasonal variation across all land covers. The spatial variability of Kc was well explained by latitude, suggesting site factors are a major control on Kc. Seasonally, Kc increased significantly with precipitation in the summer months, except in EBF. Moreover, leaf area index (LAI) significantly influenced monthly Kc in all land covers, except in EBF. During the peak growing season, forests had the highest Kc values, while croplands (CRO) had the lowest. We developed a series of multivariate linear monthly regression models for Kc by land cover type and season using LAI, site latitude, and monthly precipitation as independent variables. The Kc models are useful for understanding water stress in different ecosystems under climate change and variability as well as for estimating seasonal ET for large areas with mixed land covers.*

Liu, J., Baulch, H. M., Macrae, M. L., Wilson, H. F., Elliott, J. A., Bergström, L., . . . Vadas, P. A. (2019). Agricultural water quality in cold climates: Processes, drivers, management options, and research needs. *Journal of Environmental Quality, 48*(4), 792-802. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069508868&doi=10.2134%2fjeq2019.05.0220&partnerID=40&md5=d721f72388eeec78b539a4df4693c9b8. doi:10.2134/jeq2019.05.0220

Research Tags: Water

Abstract: *Cold agricultural regions are important sites of global food production. This has contributed to widespread water quality degradation influenced by processes and hydrologic pathways that differ from warm region analogues. In cold regions, snowmelt is often a dominant period of nutrient loss. Freeze–thaw processes contribute to nutrient mobilization. Frozen ground can limit infiltration and interaction with soils, and minimal nutrient uptake during the nongrowing season may govern nutrient export from agricultural catchments. This paper reviews agronomic, biogeochemical, and hydrological characteristics of cold agricultural regions and synthesizes findings of 23 studies that are published in this special section, which provide new insights into nutrient cycling and hydrochemical processes, model developments, and the efficacy of different potentially beneficial management practices (BMPs) across varied cold regions. Growing evidence suggests the need to redefine optimum soil phosphorus levels and input regimes in cold regions to allow achievement of water quality targets while still supporting strong agricultural productivity. Practices should be considered through a regional and site-specific lens, due to potential interactions between climate, hydrology, vegetation, and soils, which influence the efficacy of nutrient, crop, water, and riparian buffer management. This leads to differing suitability of BMPs across varied cold agricultural regions. We propose a systematic approach ("CUPCAKE"), to achieve water quality objectives in variable and changing climates, which combines nutrient transport process Conceptualization, Understanding BMP functions, Predicting effects of variability and change, Consideration of producer input and agronomic and environmental tradeoffs, practice Adaptation, Knowledge mobilization, and Evaluation of water quality improvement.*

Liu, J. J., Schoettle, A. W., Sniezko, R. A., Yao, F., Zamany, A., Williams, H., & Rancourt, B. (2019). Limber pine (Pinus flexilis James) genetic map constructed by exome-seq provides insight into the evolution of disease resistance and a genomic resource for genomics-based breeding. *Plant Journal, 98*(4), 745-758. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062541296&doi=10.1111%2ftpj.14270&partnerID=40&md5=dab4b2b1ddbed9d2aa0915b22c5628f6. doi:10.1111/tpj.14270

Research Tags: Forestry

Abstract: *Limber pine (Pinus flexilis) is a keystone species of high-elevation forest ecosystems of western North America, but some parts of the geographic range have high infection and mortality from the non-native white pine blister rust caused byCronartium ribicola. Genetic maps can provide essential knowledge for understanding genetic disease resistance as well as local adaptation to changing climates. Exome-seq was performed to construct high-density genetic maps in two seed families. Composite maps positioned 9612 unigenes across 12 linkage groups (LGs). Syntenic analysis of genome structure revealed that the majority of orthologs were positional orthologous genes (POGs) with localization on homologousLGs among conifer species. Gene ontology (GO) enrichment analysis showed relatively fewer constraints forPOGs with putative roles in adaptation to environments and relatively more conservation forPOGs with roles in basic cell function and maintenance. The mapped genes included 639 nucleotide-binding site leucine-rich repeat genes (NBS-LRRs), 290 receptor-like protein kinase genes (RLKs), and 1014 genes with potential roles in the defense response and induced systemic resistance to attack by pathogens. Orthologous loci for resistance to rust pathogens were identified and were co-positioned with multiple members of theR gene family, revealing the evolutionary pressure acting upon them. This high-density genetic map provides a genomic resource and practical tool for breeding and genetic conservation programs, with applications in genome-wide association studies (GWASs), the characterization of functional genes underlying complex traits, and the sequencing and assembly of the full-length genomes of limber pine and relatedPinus species.*

Liu, N., Shaikh, M. A., Kala, J., Harper, R. J., Dell, B., Liu, S., & Sun, G. (2018). Parallelization of a distributed ecohydrological model. *Environmental Modelling and Software, 101*, 51-63. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039148795&doi=10.1016%2fj.envsoft.2017.11.033&partnerID=40&md5=96032834b398fa0ed976df5b52a6c4bf. doi:10.1016/j.envsoft.2017.11.033

Research Tags: Water, Research

Abstract: *WaSSI-C is an ecohydrological model which couples water and carbon cycles with water use efficiency (WUE) derived from global eddy flux observations. However, a significant limitation of the WaSSI-C model is that it only runs serially. High resolution simulations at a large scale are therefore computationally expensive and cause a run-time memory burden. Using distributed (MPI) and shared (OpenMP) memory parallelism techniques, we revised the original model as dWaSSI-C. We showed that using MPI was effective in reducing the computational run-time and memory use. Two experiments were carried out to simulate water and carbon fluxes over the Australian continent to test the sensitivity of the parallelized model to input data-sets of different spatial resolutions, as well as to WUE parameters for different vegetation types. These simulations were completed within minutes using dWaSSI-C, whereas they would not have been possible with the serial version. The dWaSSI-C model was able to simulate the seasonal dynamics of gross ecosystem productivity (GEP) reasonably well when compared to observations at four eddy flux sites. Sensitivity analysis showed that simulated GEP was more sensitive to WUE during the summer compared to winter in Australia, and woody savannas and grasslands showed higher sensitivity than evergreen broadleaf forests and shrublands. Although our results are model-specific, the parallelization approach can be adopted in other similar ecosystem models for large scale applications.*

Liu, P., Hao, L., Pan, C., Zhou, D., Liu, Y., & Sun, G. (2017). Combined effects of climate and land management on watershed vegetation dynamics in an arid environment. *Science of the Total Environment, 589*, 73-88. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014408227&doi=10.1016%2fj.scitotenv.2017.02.210&partnerID=40&md5=206eb43309799aa2d796d17e6d41301e. doi:10.1016/j.scitotenv.2017.02.210

Research Tags: Weather, Research

Abstract: *Leaf area index (LAI) is a key parameter to characterize vegetation dynamics and ecosystem structure that determines the ecosystem functions and services such as clean water supply and carbon sequestration in a watershed. However, linking LAI dynamics and environmental controls (i.e., coupling biosphere, atmosphere, and anthroposphere) remains challenging and such type of studies have rarely been done at a watershed scale due to data availability. The present study examined the spatial and temporal variations of LAI for five ecosystem types within a watershed with a complex topography in the Upper Heihe River Basin, a major inland river in the arid and semi-arid western China. We integrated remote sensing-based GLASS (Global Land Surface Satellite) LAI products, interpolated climate data, watershed characteristics, and land management records for the period of 2001–2012. We determined the relationships among LAI, topography, air temperature and precipitation, and grazing history by five ecosystem types using several advanced statistical methods. We show that long-term mean LAI distribution had an obvious vertical pattern as controlled by precipitation and temperature in a hilly watershed. Overall, watershed-wide mean LAI had an increasing trend overtime for all ecosystem types during 2001–2012, presumably as a result of global warming and a wetting climate. However, the fluctuations of observed LAI at a pixel scale (1 km) varied greatly across the watershed. We classified the vegetation changes within the watershed as 'Improved', 'Stabilized', and 'Degraded' according their respective LAI changes. We found that climate was not the only driver for temporal vegetation changes for all land cover types. Grazing partially contributed to the decline of LAI in some areas and masked the positive climate warming effects in other areas. Extreme weathers such as cold spells and droughts could substantially affect inter-annual variability of LAI dynamics. We concluded that temporal and spatial LAI dynamics were rather complex and were affected by both climate variations and human disturbances in the study basin. Future monitoring studies should focus on the functional interactions among vegetation dynamics, climate variations, land management, and human disturbances.*

Liu, S., Bond-Lamberty, B., Boysen, L. R., Ford, J. D., Fox, A., Gallo, K., . . . Zhao, S. (2017). Grand challenges in understanding the interplay of climate and land changes. *Earth Interactions, 21*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019067005&doi=10.1175%2fEI-D-16-0012.1&partnerID=40&md5=a9c9f86fda54f8ac94fa0cdf6b7db760. doi:10.1175/EI-D-16-0012.1

Research Tags: Weather

Abstract: *Half of Earth's land surface has been altered by human activities, creating various consequences on the climate and weather systems at local to global scales, which in turn affect a myriad of land surface processes and the adaptation behaviors. This study reviews the status and major knowledge gaps in the interactions of land and atmospheric changes and present 11 grand challenge areas for the scientific research and adaptation community in the coming decade. These land-cover and land-use change (LCLUC)-related areas include 1) impacts on weather and climate, 2) carbon and other biogeochemical cycles, 3) biospheric emissions, 4) the water cycle, 5) agriculture, 6) urbanization, 7) acclimation of biogeochemical processes to climate change, 8) plant migration, 9) land-use projections, 10) model and data uncertainties, and, finally, 11) adaptation strategies. Numerous studies have demonstrated the effects of LCLUC on local to global climate and weather systems, but these putative effects vary greatly in magnitude and even sign across space, time, and scale and thus remain highly uncertain. At the same time, many challenges exist toward improved understanding of the consequences of atmospheric and climate change on land process dynamics and services. Future effort must improve the understanding of the scale-dependent, multifaceted perturbations and feedbacks between land and climate changes in both reality and models. To this end, one critical cross-disciplinary need is to systematically quantify and better understand measurement and model uncertainties. Finally, LCLUC mitigation and adaptation assessments must be strengthened to identify implementation barriers, evaluate and prioritize opportunities, and examine how decision-making processes work in specific contexts.*

Liu, W. J., Li, L. F., Biederman, J. A., Hao, Y. B., Zhang, H., Kang, X. M., . . . Xu, C. Y. (2017). Repackaging precipitation into fewer, larger storms reduces ecosystem exchanges of CO <inf>2</inf> and H <inf>2</inf> O in a semiarid steppe. *Agricultural and Forest Meteorology, 247*, 356-364. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028370830&doi=10.1016%2fj.agrformet.2017.08.029&partnerID=40&md5=d46ea564cd39690b1b68e23950f1b29b. doi:10.1016/j.agrformet.2017.08.029

Research Tags: Grassland, Weather

Abstract: *General circulation models predict that precipitation will become more extreme, i.e. rainfall events of larger size but reduced frequency. Studies in North American grasslands have shown that such repackaging of precipitation into fewer, larger events enhanced above ground net primary productivity (ANPP), likely due to deeper soil moisture infiltration favoring plant water use over evaporation. However, ANPP responses in other regions remain poorly understood, and responses of carbon and water exchanges with the atmosphere remain unknown. Here we manipulated rainfall in a steppe ecosystem of northern China over 4 years to investigate how temporal packaging of precipitation impacts ANPP, evapotranspiration (ET), net ecosystem CO2 exchange (NEE) and the component fluxes gross primary productivity (GPP) and ecosystem respiration (RE). Experimental plots received precipitation equivalent to the 60-year growing-season average of 240 mm, variously packaged into 6, 10, 16, or 24 events representing extreme (P6) to historical average (P24) rainfall frequency. Extraordinarily extreme frequency (6 large events) reduced NEE, GPP, RE, ET and water use efficiency (WUE = |NEE|/ET). The average NEE, GPP and RE declined 35%, 45% and 48% respectively in the P6 treatment as compared to P16, which showed maximum ET and CO2 exchange. After peaking in the 16-event treatment, GPP and WUE in P24 were not distinguishable from P6. These peaks suggest that P16 was optimal for photosynthesis, with sufficiently frequent rain to maintain unregulated plants and adequately deep soil moisture infiltration to favour transpiration, with associated carbon uptake, over evaporation. Path analysis indicated the lower CO2 fluxes were influenced by reduced soil water content and leaf area index and higher soil temperature, with ET regulating the effects of these microclimatic drivers. ANPP showed a monotonic but non-significant decline with decreasing precipitation frequency, consistent with reduced CO2 fluxes*. *We found an increase in ANPP of xerophyte plants partially compensated for the ANPP decline in the dominant eurytopic xerophyte plants. Our results suggest that extreme temporal repackaging of precipitation into few events with correspondingly long dry intervals may reduce the capacity of steppe ecosystems to assimilate atmospheric CO2, although community diversity may moderate impacts.*

Liu, X., Sun, G., Mitra, B., Noormets, A., Gavazzi, M. J., Domec, J. C., . . . McNulty, S. G. (2018). Drought and thinning have limited impacts on evapotranspiration in a managed pine plantation on the southeastern United States coastal plain. *Agricultural and Forest Meteorology, 262*, 14-23. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049354873&doi=10.1016%2fj.agrformet.2018.06.025&partnerID=40&md5=af142ab015666df0522ecc3d591258ef. doi:10.1016/j.agrformet.2018.06.025
Research Tags: Weather, Forestry
Abstract: *Managed and natural coastal plain forests in the humid southeastern United States exchange large amounts of water and energy with the atmosphere through the evapotranspiration (ET) process. ET plays an important role in controlling regional hydrology, climate, and ecosystem productivity. However, long-term studies on the impacts of forest management and climatic variability on forest ET are rare, and our understanding of both external and internal drivers on seasonal and interannual ET variability is incomplete. Using techniques centered on an eddy covariance method, the present study measured year-round ET flux and associated hydrometeorological variables in a drained loblolly pine (Pinus taeda L.) plantation on the lower coastal plain of North Carolina, U.S. We found that annual ET was relatively stable (1076 ± 104 mm) in comparison to precipitation (P) (1168 ± 216 mm) during the 10-year study period when the site experienced extreme climate (2007–2008) and forest thinning (2009). At the seasonal time scale, mean ET/P varied between 0.41 and 1.51, with a mean value of 1.12 ± 0.23 and 0.72 ± 0.16 for the growing and dormant seasons, respectively. The extreme drought during 2007–2008 (mean annual P, 854 mm) only resulted in a slight decrease (~8%) in annual ET owing to the shallow groundwater common to the study area. Although changes in leaf area index and canopy structure were large after the stand was 50% thinned in the fall of 2009, mean annual ET was similar and averaged 1055 mm and 1104 mm before (2005, 2006 and 2009) and after (2010–2015) thinning, respectively. Data suggested that annual ET recovered within two years of the thinning as a result of rapid canopy closure and growth of understory. Further analysis indicated that available energy was the key driver of ET: approximately 69% and 61% of the monthly variations in ET were explained by net radiation during the dormant and growing seasons, respectively. Overall, we concluded that drought and forest thinning had limited impacts on seasonal and annual ET in this energy limited forest ecosystem with shallow groundwater. The results from this study help to better understand regional ecohydrological processes and projecting potential effects of forest management and extreme climate on water and carbon cycles.*

Liu, X., Yang, Z., Lin, C., Giardina, C. P., Xiong, D., Lin, W., . . . Yang, Y. (2017). Will nitrogen deposition mitigate warming-increased soil respiration in a young subtropical plantation? *Agricultural and Forest Meteorology, 246*, 78-85. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020879355&doi=10.1016%2fj.agrformet.2017.06.010&partnerID=40&md5=9db04247b4a1817227abbbd4ab938dad. doi:10.1016/j.agrformet.2017.06.010

Research Tags: Soil

Abstract: *Global change such as climate warming and nitrogen (N) deposition is likely to alter terrestrial carbon (C) cycling, including soil respiration (Rs), the largest CO2 source from soils to the atmosphere. To examine the effects of warming, N addition and their interactions on Rs, we conducted a two-way factorial soil warming (control, 5 °C warming) and N addition (control, 40 and 80 kg N ha−1 yr−1) mesocosm experiment in subtropical China. We measured Rs and nutrient availability. We found warming alone increased Rs by 15%, but warming plus high N addition treatment appeared to have offsetting effects as these plots were not significantly different from unheated and unfertilized controls. Warming alone increased soil available phosphorus (P) but availability declined in response to warming plus N additions. N additions alone had no effect on Rs in this study. Our results suggest that future increases in N deposition could mitigate warming-increased Rs in P-limited and relatively N-saturated subtropical forest ecosystems.*

Liu, X., Zeng, X., Zou, X., Lodge, D. J., Stankavich, S., González, G., & Cantrell, S. A. (2018). Responses of soil labile organic carbon to a simulated hurricane disturbance in a tropical wet forest. *Forests, 9*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050192415&doi=10.3390%2ff9070420&partnerID=40&md5=e3738c7fb31c045bf854dc9b7a995381. doi:10.3390/f9070420

Research Tags: Weather, Soil

Abstract: *Hurricanes are an important disturbance in the tropics that can alter forest ecosystem properties and processes. To understand the immediate influence of hurricane disturbance on carbon cycling, we examined soil labile organic carbon (LOC) in a Canopy Trimming Experiment (CTE) located in the Luquillo Experimental Forest of Puerto Rico. We trimmed tree canopy and deposited debris (CTDD) on the forest ground of the treatment plots in December 2014, and collected floor mass samples and 0–10 cm soil samples three weeks before the treatment, as well as at scheduled intervals for 120 weeks after the treatment. Within the first week following the CTDD treatment, the mean soil microbial biomass carbon (MBC) and soil LOC in the CTDD plots were significantly greater than in the control plots (soil MBC: 2.56 g/kg versus 1.98 g/kg, soil LOC: 9.16 g/kg versus 6.44 g/kg, respectively), and the mean turnover rates of soil LOC in the CTDD plots were significantly faster than in the control plots. The measured indices fluctuated temporally more in the CTDD plots than in the control plots, especially between the 12th and 84th week after the CTDD treatment. The treatment effect on soil LOC and its turnover rate gradually disappeared after the 84th week following the treatment, while higher levels of soil MBC in the CTDD plots than in the control plots remained high, even at the 120th week. Our data suggest that hurricane disturbance can accelerate the cycling of soil LOC on a short temporal scale of less than two years, but might have a longer lasting effect on soil MBC in a tropical wet forest.*

Liu, Y. (2017). Responses of dead forest fuel moisture to climate change. *Ecohydrology, 10*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84983628526&doi=10.1002%2feco.1760&partnerID=40&md5=0d147ba6418322244b1b9e90240dd4ce. doi:10.1002/eco.1760

Research Tags: Forestry

Abstract: *Forest fuel moisture is an important factor for wildland fire behavior. Predicting future wildfire trends and controlled burned conditions is essential to effective natural resource management, but the associated effects of forest fuel moisture remain uncertain. This study investigates the responses of dead forest fuel moisture to climate change in the continental United States, one of the global regions with frequent wildfire and controlled burning activities. Moisture content was calculated for dead fuels with 1- and 1000-hr lags (MC1 and MC1000) using the algorithms from the U.S. National Fire Danger Rating System. A set of dynamically downscaled regional climate change scenarios provided by the North American Regional Climate Change Assessment Program was used. The present fuel moisture shows large seasonal variations peaked in winter and spatial variability with dominant meridional change in winter and zonal change in summer. Fuel moisture is projected to decrease overwhelmingly across the United States, mainly caused by temperature increases. The largest MC1 decrease of over 1% mainly occurs in the southwestern United States in spring and southeastern*

United States in summer, while the largest MC1000 decrease of over 1.5% occurs in the southwestern United States in spring and in the southern Plains and eastern United States in summer. The spatial patterns and seasonal variations of future fuel moisture trends, however, vary considerably with regional climate change scenarios. The drying fuel trends suggest that frequency, size, and intensity of wildfires would increase and prescribed burning windows would decrease in the future in the Southwest and the inter-mountains during spring and the Rocky Mountains during summer if other fuel conditions remain the same. These results highlight the general vulnerability of semiarid forests to drying fuels trends.

Liu, Y. (2018). New development and application needs for Earth system modeling of fire-climate-ecosystem interactions. *Environmental Research Letters, 13*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043792525&doi=10.1088%2f1748-9326%2faaa347&partnerID=40&md5=24c3505b9050031a3abc19333a8ed6f6. doi:10.1088/1748-9326/aaa347
Research Tags: Weather
No Abstract:

Loehman, R., Flatley, W., Holsinger, L., & Thode, A. (2018). Can land management buffer impacts of climate changes and altered fire regimes on ecosystems of the Southwestern United States? *Forests, 9*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045108617&doi=10.3390%2ff9040192&partnerID=40&md5=c94b98400f4bc02a2779aa03668c65e1. doi:10.3390/f9040192
Research Tags: Weather
Abstract: *Climate changes and associated shifts in ecosystems and fire regimes present enormous challenges for the management of landscapes in the Southwestern US. A central question is whether management strategies can maintain or promote desired ecological conditions under projected future climates. We modeled wildfire and forest responses to climate changes and management activities using two ecosystem process models: FireBGCv2, simulated for the Jemez Mountains, New Mexico, and LANDIS-II, simulated for the Kaibab Plateau, Arizona. We modeled contemporary and two future climates—"Warm-Dry" (CCSM4 RCP 4.5) and "Hot-Arid" (HadGEM2ES RCP 8.5)—and four levels of management including fire suppression alone, a current treatment strategy, and two intensified treatment strategies. We found that Hot-Arid future climate resulted in a fundamental, persistent reorganization of ecosystems in both study areas, including biomass reduction, compositional shifts, and altered forest structure. Climate changes increased the potential for high-severity fire in the Jemez study area, but did not impact fire regime characteristics in the Kaibab. Intensified management treatments somewhat reduced wildfire frequency and severity; however, management strategies did not prevent the reorganization of forest ecosystems in either landscape. Our results suggest that novel approaches may be required to manage future forests for desired conditions.*

Loehman, R. A., Bentz, B. J., DeNitto, G. A., Keane, R. E., Manning, M. E., Duncan, J. P., . . . Zambino, P. J. (2018) Effects of Climate Change on Ecological Disturbance in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 115-141).
Research Tags: Forestry
Abstract: *This chapter describes the ecology of important disturbance regimes in the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and the Greater Yellowstone Area, hereafter called the Northern Rockies region, and potential shifts in these regimes as a consequence of observed and projected climate change. The term disturbance regime describes the general temporal and spatial characteristics of a disturbance agent - insect, disease, fire, weather, even human activity - and the effects of that agent on the landscape (table 8.1). More specifically, a disturbance regime is the cumulative effect of multiple disturbance events over space and time (Keane 2013). Disturbances disrupt an ecosystem, community, or population structure and change elements of the biological environment, physical environment, or both (White and Pickett 1985). The resulting shifting mosaic of diverse ecological patterns and structures in turn affects future patterns of disturbance, in a reciprocal, linked relationship that shapes the fundamental character of landscapes and ecosystems. Disturbance creates and maintains biological diversity in the form of shifting, heterogeneous mosaics of diverse communities and habitats across a landscape (McKinney and Drake 1998), and biodiversity is generally highest when disturbance is neither too rare nor too frequent on the landscape (Grime 1973).*

Loehman, R. A., Keane, R. E., Holsinger, L. M., & Wu, Z. (2017). Interactions of landscape disturbances and climate change dictate ecological pattern and process: spatial modeling of wildfire, insect, and disease dynamics under future climates. *Landscape Ecology, 32*(7), 1447-1459. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84978096851&doi=10.1007%2fs10980-016-0414-6&partnerID=40&md5=f3178ee63cc8167cc382a72fddb0bf88. doi:10.1007/s10980-016-0414-6

Research Tags: Forestry, Wildlife, Weather

Abstract: *Context*

Interactions among disturbances, climate, and vegetation influence landscape patterns and ecosystem processes. Climate changes, exotic invasions, beetle outbreaks, altered fire regimes, and human activities may interact to produce landscapes that appear and function beyond historical analogs.

Objectives

We used the mechanistic ecosystem-fire process model FireBGCv2 to model interactions of wildland fire, mountain pine beetle (Dendroctonus ponderosae), and white pine blister rust (Cronartium ribicola) under current and future climates, across three diverse study areas.

Methods

We assessed changes in tree basal area as a measure of landscape response over a 300-year simulation period for the Crown of the Continent in north-central Montana, East Fork of the Bitterroot River in western Montana, and Yellowstone Central Plateau in western Wyoming, USA.

Results

Interacting disturbances reduced overall basal area via increased tree mortality of host species. Wildfire decreased basal area more than beetles or rust, and disturbance interactions modeled under future climate significantly altered landscape basal area as compared with no-disturbance and current climate scenarios. Responses varied among landscapes depending on species composition, sensitivity to fire, and pathogen and beetle suitability and susceptibility.

Conclusions

Understanding disturbance interactions is critical for managing landscapes because forest responses to wildfires, pathogens, and beetle attacks may offset or exacerbate climate influences, with consequences for wildlife, carbon, and biodiversity.

Loladze, I., Nolan, J. M., Ziska, L. H., & Knobbe, A. R. (2019). Rising Atmospheric CO<inf>2</inf> Lowers Concentrations of Plant Carotenoids Essential to Human Health: A Meta-Analysis. *Molecular Nutrition and Food Research, 63*(15). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069868798&doi=10.1002%2fmnfr.201801047&partnerID=40&md5=b8a2556f93975955bb3b62882d4ecc11. doi:10.1002/mnfr.201801047

Research Tags: Crops

Abstract: *Plant and human tissues (e.g., leaves, retina) share the need for carotenoids to protect against light-induced and other oxidative stresses. While plants synthesize carotenoids de novo, humans must obtain them primarily through plant-based foods. In plants, elevated levels of atmospheric carbon dioxide (eCO2) decrease the concentrations of essential minerals, including magnesium and zinc (essential for brain and eye health), but the overall effect of globally rising CO2 levels on carotenoids is unknown. Here, investigation is sought on how eCO2 affects carotenoids in plants. A meta-analysis of 1026 experimental observations from 37 studies shows that eCO2 decreases plant carotenoid concentrations by 15% (95% CI: −26% to −6%). The meta-analysis of available gene expression data for Arabidopsis thaliana points to a potential CO2-induced downregulation of carotenoid biosynthesis (Log2 fold-change −13%, 95% CI: −17% to −9%). Some other stoichiometric and biochemical mechanisms related to CO2-induced changes in carotenoids are also highlighted. While overall eCO2 decreases carotenoid concentrations, individual CO2 studies report variable responses, including increases in carotenoid levels, especially in abiotically stressed plants. The initial assessment raises a novel question about the potential effects of rising CO2 on human health through its global effect on plant carotenoids.*

Lombardo, J. A., Weed, A. S., Aoki, C. F., Sullivan, B. T., & Ayres, M. P. (2018). Temperature affects phenological synchrony in a tree-killing bark beetle. *Oecologia, 188*(1), 117-127. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051698932&doi=10.1007%2fs00442-018-4164-9&

partnerID=40&md5=c6c2a5c19515fb0aeb3201939c271fec. doi:10.1007/s00442-018-4164-9
Research Tags: Wildlife, Forestry
Abstract: *Phenological synchrony can promote population growth in species with positive density dependence. Variation among life stages in the thermal thresholds for development can foster phenological synchrony under thermal regimes that include frequent occurrence of temperatures between developmental thresholds. The southern pine beetle is an insect with positive density dependence that has recently undergone important shifts in population abundance at the northern extremes of their distribution. We evaluated the hypothesis that cooler winter temperatures in their northern range cause a convergence of the population life stage structure that leads to synchrony in spring flight phenology. We used a combination of approaches. First, in situ laboratory experiments demonstrated a threshold temperature for pupation that was greater than was required for larval development; rearing larvae at lower temperatures increased the pooling of individuals at the end stage of larval development and synchrony in adult emergence. Second, a development rate model showed a similar convergence of the majority of the population at the end stage of larval development when brood experienced the cooler temperatures of the northern region, but not with temperatures from the southern region, or as a null model. Finally, field trapping of wild beetles showed greater synchrony in the pine forests of New Jersey than in the warmer, historically occupied forests of Georgia and Mississippi. Given these results, pine-dominated forests in the northern edge of the southern pine beetle's range may experience more frequent occurrence of outbreaks, due to the positive feedbacks associated with a synchronous spring emergence of this insect.*

Londo, J. P., & Kovaleski, A. P. (2019). Deconstructing cold hardiness: variation in supercooling ability and chilling requirements in the wild grapevine Vitis riparia. *Australian Journal of Grape and Wine Research, 25*(3), 276-285. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063080471&doi=10.1111%2fajgw.12389&partnerID=40&md5=6b039fee147fd9d6e925f2fad0fd29d8. doi:10.1111/ajgw.12389
Research Tags: Crops, Weather
Abstract: *Background and Aims*
Grapevine production in cool climates is limited by aspects of winter survival and frost risk. Cold hardiness-related traits are key to future viticultural sustainability as climate variations, including acute cold events and frost, are predicted to increase even in traditional cultivation regions. This study examines the variation in dormant bud cold hardiness (supercooling) and dormancy (chilling requirement) in 43 different genotypes of the wild grapevine species Vitis riparia, the dominant wild species used to incorporate cold hardiness traits into new hybrid grapevine cultivars.
Methods and Results
Cold hardiness was evaluated bi-weekly in 2 years using measures of low temperature exotherms. Whole winter responses were modelled to determine significant factors affecting cold hardiness and determine genotypic differences. Results demonstrate significant differences in supercooling ability and deacclimation rate (loss of cold hardiness) between genotypes.
Conclusions
This study determined that genotypic differences contribute to initial differences in cold hardiness. However, data modelling suggests that midwinter cold hardiness changes are driven by environment as all Vitis riparia tested in this study respond to temperature in the same manner during the endodormant period of winter. In contrast, responses to warming temperature during ecodormancy are significantly different by genotype.
Significance of the Study
This study has demonstrated that these two traits interact to determine differences in early versus late winter cold hardiness and help identify breeding germplasm with delayed loss of cold hardiness.

Long, R. W., Bush, S. E., Grady, K. C., Smith, D. S., Potts, D. L., D'Antonio, C. M., . . . Hultine, K. R. (2017). Can local adaptation explain varying patterns of herbivory tolerance in a recently introduced woody plant in North America? *Conservation Physiology, 5*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017263440&doi=10.1093%2fconphys%2fcox016&partnerID=40&md5=1c087577758790d093efcb2842e1f544. doi:10.1093/conphys/cox016
Research Tags: Forestry, Wildlife

Abstract: *Patterns of woody-plant mortality have been linked to global-scale environmental changes, such as extreme drought, heat stress, more frequent and intense fires, and episodic outbreaks of insects and pathogens. Although many studies have focussed on survival and mortality in response to specific physiological stresses, little attention has been paid to the role of genetic heritability of traits and local adaptation in influencing patterns of plant mortality, especially in non-native species. Tamarix spp. is a dominant, non-native riparian tree in western North America that is experiencing dieback in some areas of its range due to episodic herbivory by the recently introduced northern tamarisk leaf beetle (Diorhabda carinulata). We propose that genotype × environment interactions largely underpin current and future patterns of Tamarix mortality. We anticipate that (i) despite its recent introduction, and the potential for significant gene flow, Tamarix in western North America is generally adapted to local environmental conditions across its current range in part due to hybridization of two species; (ii) local adaptation to specific climate, soil and resource availability will yield predictable responses to episodic herbivory; and (iii) the ability to cope with a combination of episodic herbivory and increased aridity associated with climate change will be largely based on functional tradeoffs in resource allocation. This review focusses on the potential heritability of plant carbon allocation patterns in Tamarix, focussing on the relative contribution of acquired carbon to non-structural carbohydrate (NSC) pools versus other sinks as the basis for surviving episodic disturbance. Where high aridity and/or poor edaphic position lead to chronic stress, NSC pools may fall below a minimum threshold because of an imbalance between the supply of carbon and its demand by various sinks. Identifying patterns of local adaptation of traits related to resource allocation will improve forecasting of Tamarix population susceptibility to episodic herbivory.*

Longman, R. J., Giambelluca, T. W., Nullet, M. A., Frazier, A. G., Kodama, K., Crausbay, S. D., . . . Arnold, J. R. (2018). Data Descriptor: Compilation of climate data from heterogeneous networks across the Hawaiian Islands. *Scientific Data, 5*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042046788&doi=10.1038%2fsdata.2018.12&partnerID=40&md5=4bdd1c181002fc62b98b4d543b0d4296. doi:10.1038/sdata.2018.12
Research Tags: Weather
Abstract: *Long-term, accurate observations of atmospheric phenomena are essential for a myriad of applications, including historic and future climate assessments, resource management, and infrastructure planning. In Hawai'i, climate data are available from individual researchers, local, State, and Federal agencies, and from large electronic repositories such as the National Centers for Environmental Information (NCEI). Researchers attempting to make use of available data are faced with a series of challenges that include: (1) identifying potential data sources; (2) acquiring data; (3) establishing data quality assurance and quality control (QA/QC) protocols; and (4) implementing robust gap filling techniques. This paper addresses these challenges by providing: (1) a summary of the available climate data in Hawai'i including a detailed description of the various meteorological observation networks and data accessibility, and (2) a quality controlled meteorological dataset across the Hawaiian Islands for the 25-year period 1990-2014. The dataset draws on observations from 471 climate stations and includes rainfall, maximum and minimum surface air temperature, relative humidity, wind speed, downward shortwave and longwave radiation data.*

Looney, C. E., D'Amato, A. W., Palik, B. J., & Slesak, R. A. (2017). Canopy treatment influences growth of replacement tree species in Fraxinus nigra forests threatened by the emerald ash borer in Minnesota, USA. *Canadian Journal of Forest Research, 47*(2), 183-192. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011115956&doi=10.1139%2fcjfr-2016-0369&partnerID=40&md5=179db9e409eec0255db47bfc59b93fec. doi:10.1139/cjfr-2016-0369
Research Tags: Forestry, Wildlife
Abstract: *Fraxinus nigra Marsh. (black ash), a dominant tree species of wetland forests in northern Minnesota, USA, is imperiled by the invasive insect emerald ash borer (EAB; Agrilus planipennis Fairmaire, 1888). Regeneration of associated tree species is generally low in F. nigra forests and could be impacted further by climate change. Proactive management may be critical to maintaining tree cover and ecosystem function following EAB invasion. We investigated the mean height and diameter relative growth rate (RGR) of seedlings of 10 potential replacement tree species, including two from the next southern climate zone projected to be adapted to the future northern Minnesota climate. Seedlings were planted in F. nigra wetlands under four canopy treatments: unharvested control, clearcut, girdling F. nigra to emulate EAB-induced mortality, and*

group selection. Mean height and diameter RGR was fastest overall in the clearcut treatment, followed by the girdling, group selection, and control treatments. Depending on species, treatment significantly influenced RGR. Several species projected to be adapted to the future northern Minnesota climate had moderate to rapid mean RGR, including one from the next southern climate zone. Our results suggest that seedling plantings and overstory treatment represent an effective strategy for establishing F. nigra replacement tree species as EAB approaches, while reducing future risk from climate change.

López-Ballesteros, A., Serrano-Ortiz, P., Kowalski, A. S., Sánchez-Cañete, E. P., Scott, R. L., & Domingo, F. (2017). Subterranean ventilation of allochthonous CO<inf>2</inf> governs net CO<inf>2</inf> exchange in a semiarid Mediterranean grassland. *Agricultural and Forest Meteorology, 234-235*, 115-126. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007530417&doi=10.1016%2fj.agrformet.2016.12.021&partnerID=40&md5=843be032a9147bf17f770874b5f5d9ab. doi:10.1016/j.agrformet.2016.12.021

Research Tags: Grassland, Emissions

Abstract: *Recent research highlights the important role of (semi-)arid ecosystems in the global carbon (C) cycle. However, detailed process based investigations are still necessary in order to fully understand how drylands behave and to determine the main factors currently affecting their C balance with the aim of predicting how climate change will affect their structure and functions. Here, we explore the potential biological and non-biological processes that may compose net CO2 exchange in a semiarid grassland in southeast Spain by means of eddy covariance measurements registered over six hydrological years (2009–2015). Results point out the great importance of subterranean ventilation, an advective transport process causing net CO2 release, especially during drought periods and under high-turbulence conditions. Accordingly, extreme CO2 release, far exceeding that found in the literature, was measured over the whole study period (2009–2015) averaging 230 g C m−2 year−1; this occurred mostly during the dry season and was very unlikely to correspond to concurrent biological activity and variations of in situ organic C pools. Underground CO2 concentrations corroborate this finding. In this regard, the potential origins of the released CO2 could be geological degassing and/or subterranean translocation of CO2 in both gaseous and aqueous phases. However, future research is needed in order to understand how CO2 transport and production processes interact and modulate drylands' terrestrial C balance. Overall, the present study exposes how subterranean ventilation and hydrogeochemistry can complicate the interpretation of the terrestrial C cycle.*

Loudermilk, E. L., Scheller, R. M., Weisberg, P. J., & Kretchun, A. (2017). Bending the carbon curve: fire management for carbon resilience under climate change. *Landscape Ecology, 32*(7), 1461-1472. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84989956098&doi=10.1007%2fs10980-016-0447-x&partnerID=40&md5=a40f9ea381161776e5c11d2b53b43d81. doi:10.1007/s10980-016-0447-x

Research Tags: Weather, Forestry

Abstract: *Context*

Forest landscapes are increasingly managed for fire resilience, particularly in the western US which has recently experienced drought and widespread, high-severity wildfires. Fuel reduction treatments have been effective where fires coincide with treated areas. Fuel treatments also have the potential to reduce drought-mortality if tree density is uncharacteristically high, and to increase long-term carbon storage by reducing high-severity fire probability.

Objective

Assess whether fuel treatments reduce fire intensity and spread and increase carbon storage under climate change.

Methods

We used a simulation modeling approach that couples a landscape model of forest disturbance and succession with an ecosystem model of carbon dynamics (Century), to quantify the interacting effects of climate change, fuel treatments and wildfire for carbon storage potential in a mixed-conifer forest in the western USA.

Results

Our results suggest that fuel treatments have the potential to 'bend the C curve', maintaining carbon resilience despite climate change and climate-related changes to the fire regime. Simulated fuel treatments resulted in reduced fire spread and severity. There was partial compensation of C lost during fuel treatments with increased growth of residual stock due to greater available soil water, as well as a shift in species composition

to more drought- and fire-tolerant Pinus jeffreyi at the expense of shade-tolerant, fire-susceptible Abies concolor.
Conclusions
Forest resilience to global change can be achieved through management that reduces drought stress and supports the establishment and dominance of tree species that are more fire- and drought-resistant, however, achieving a net C gain from fuel treatments may take decades.

Lozano, O. M., Salis, M., Ager, A. A., Arca, B., Alcasena, F. J., Monteiro, A. T., . . . Spano, D. (2017). Assessing Climate Change Impacts on Wildfire Exposure in Mediterranean Areas. *Risk Analysis, 37*(10), 1898-1916. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007083639&doi=10.1111%2frisa.12739&partnerID=40&md5=2de65847c2a2a5bf1c4b818bf066693c. doi:10.1111/risa.12739
Research Tags: Weather
Abstract: *We used simulation modeling to assess potential climate change impacts on wildfire exposure in Italy and Corsica (France). Weather data were obtained from a regional climate model for the period 1981–2070 using the IPCC A1B emissions scenario. Wildfire simulations were performed with the minimum travel time fire spread algorithm using predicted fuel moisture, wind speed, and wind direction to simulate expected changes in weather for three climatic periods (1981–2010, 2011–2040, and 2041–2070). Overall, the wildfire simulations showed very slight changes in flame length, while other outputs such as burn probability and fire size increased significantly in the second future period (2041–2070), especially in the southern portion of the study area. The projected changes fuel moisture could result in a lengthening of the fire season for the entire study area. This work represents the first application in Europe of a methodology based on high resolution (250 m) landscape wildfire modeling to assess potential impacts of climate changes on wildfire exposure at a national scale. The findings can provide information and support in wildfire management planning and fire risk mitigation activities.*

Lu, C., Yu, Z., Tian, H., Hennessy, D. A., Feng, H., Al-Kaisi, M., . . . Arritt, R. (2018). Increasing carbon footprint of grain crop production in the US Western Corn Belt. *Environmental Research Letters, 13*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060134082&doi=10.1088%2f1748-9326%2faae9fe&partnerID=40&md5=fa0f7462a030b79294603d370b20f213. doi:10.1088/1748-9326/aae9fe
Research Tags: Crops, Soil
Abstract: *Global agriculture is challenged to increase soil carbon sequestration and reduce greenhouse gas emissions while providing products for an increasing population. Growing crop production could be achieved through higher yield per hectare (i.e. intensive farming) or more hectares (extensive farming), which however, have different ecological and environmental consequences. Multiple lines of evidence indicate that expanding cropland for additional production may lead to loss of vegetation and soil carbon, and threaten the survival of wildlife. New concerns about the impacts of extensive farming have been raised for the US Corn Belt, one of the world's most productive regions, as cropland has rapidly expanded northwestward unto grasslands and wetlands in recent years. Here we used a process-based ecosystem model to distinguish and quantify how natural drivers as well as intensive and extensive farming practices have altered grain production, soil carbon storage, and agricultural carbon footprint in the US Western Corn Belt since 1980. Compared to the period 1980–2005, we found that cropland expansion more than tripled in the most recent decade (2006–2016), becoming a significant factor contributing to growing grain production. Land use change in this period led to a soil carbon loss of 90.8 ± 14.7 Tg (1 Tg = 1012 g). As a result, grain production in this region shifted from carbon neutral to a carbon loss of 2.3 kg C kg−1 grain produced. The enlarging negative carbon footprint (ΔC/ΔP) indicates the major role that cropland expansion has had on the carbon cost of grain production in this region. Therefore, we should be more cautious to pursue high crop production through agricultural cropland conversion, particularly in those carbon-rich soils.*

Lu, H., Wu, Y., Li, Y., & Liu, Y. (2017). Effects of meteorological droughts on agricultural water resources in southern China. *Journal of Hydrology, 548*, 419-435. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015392501&doi=10.1016%2fj.jhydrol.2017.03.021&partnerID=40&md5=7ee079ff85a7aa9e3f4eb2c3bdda9326. doi:10.1016/j.jhydrol.2017.03.021

Research Tags: Weather, Crops
Abstract: *With the global warming, frequencies of drought are rising in the humid area of southern China. In this study, the effects of meteorological drought on the agricultural water resource based on the agricultural water resource carrying capacity (AWRCC) in southern China were investigated. The entire study area was divided into three regions based on the distributions of climate and agriculture. The concept of the maximum available water resources for crops was used to calculate AWRCC. Meanwhile, an agricultural drought intensity index (ADI), which was suitable for rice planting areas, was proposed based on the difference between crop water requirements and precipitation. The actual drought area and crop yield in drought years from 1961 to 2010 were analyzed. The results showed that ADI and AWRCC were significantly correlated with the actual drought occurrence area and food yield in the study area, which indicated ADI and AWRCC could be used in drought-related studies. The effects of seasonal droughts on AWRCC strongly depended on both the crop growth season and planting structure. The influence of meteorological drought on agricultural water resources was pronounced in regions with abundant water resources, especially in Southwest China, which was the most vulnerable to droughts. In Southwest China, which has dry and wet seasons, reducing the planting area of dry season crops and rice could improve AWRCC during drought years. Likewise, reducing the planting area of double-season rice could improve AWRCC during drought years in regions with a double-season rice cropping system. Our findings highlight the importance of adjusting the proportions of crop planting to improve the utilization efficiency of agricultural water resources and alleviate drought hazards in some humid areas.*

Lucash, M. S., Scheller, R. M., J. Gustafson, E., & R. Sturtevant, B. (2017). Spatial resilience of forested landscapes under climate change and management. *Landscape Ecology, 32*(5), 953-969. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015775844&doi=10.1007%2fs10980-017-0501-3&partnerID=40&md5=0858504c43526539483556b159250162. doi:10.1007/s10980-017-0501-3
Research Tags: Forestry
Abstract: *Context*
Resilience, the ability to recover from disturbance, has risen to the forefront of scientific policy, but is difficult to quantify, particularly in large, forested landscapes subject to disturbances, management, and climate change.
Objectives
Our objective was to determine which spatial drivers will control landscape resilience over the next century, given a range of plausible climate projections across north-central Minnesota.
Methods
Using a simulation modelling approach, we simulated wind disturbance in a 4.3 million ha forested landscape in north-central Minnesota for 100 years under historic climate and five climate change scenarios, combined with four management scenarios: business as usual (BAU), maximizing economic returns ('EcoGoods'), maximizing carbon storage ('EcoServices'), and climate change adaption ('CCAdapt'). To estimate resilience, we examined sites where simulated windstorms removed >70% of the biomass and measured the difference in biomass and species composition after 50 years.
Results
Climate change lowered resilience, though there was wide variation among climate change scenarios. Resilience was explained more by spatial variation in soils than climate. We found that BAU, EcoGoods and EcoServices harvest scenarios were very similar; CCAdapt was the only scenario that demonstrated consistently higher resilience under climate change. Although we expected spatial patterns of resilience to follow ownership patterns, it was contingent upon whether lands were actively managed.
Conclusions
Our results demonstrate that resilience may be lower under climate change and that the effects of climate change could overwhelm current management practices. Only a substantial shift in simulated forest practices was successful in promoting resilience.

Lucash, M. S., Scheller, R. M., Sturtevant, B. R., Gustafson, E. J., Kretchun, A. M., & Foster, J. R. (2018). More than the sum of its parts: how disturbance interactions shape forest dynamics under climate change. *Ecosphere, 9*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050733204&doi=10.1002%2fecs2.2293&partnerID=40&md5=17050dd661e6ca6b54b3b5a530d3e10e. doi:10.1002/ecs2.2293

Research Tags: Forestry, Weather, Wildlife
Abstract: *Interactions among disturbances are seldom quantified, and how they will be affected by climate change is even more uncertain. In this study, we sought to better understand how interactions among disturbances shift under climate change by applying a process-based landscape disturbance and succession model (LANDIS-II) to project disturbance regimes under climate change in north-central Minnesota, USA. Specifically, we (1) contrasted mortality rates and the extent of disturbance for four individual (single) disturbance regimes (fire, insects, wind, or forest management) vs. all four disturbance regimes operating simultaneously (concurrent) under multiple climate change scenarios and (2) determined how climate change interacts with single and concurrent disturbance regimes to affect carbon stocks and forest composition. Under single disturbance regimes, we found that climate change amplifies mortality, but did not substantially change the overall extent of disturbances. Tree mortality under the concurrent disturbance regime scenario was less than the sum of all single disturbance regimes, providing evidence of significant negative feedbacks among disturbances, particularly under climate change. Finally, we found that climate change was the most critical driver of area harvested (via shifts in species composition), soil carbon, species composition, and diversity, while the disturbance regime (i.e., single or concurrent) had a larger influence on aboveground carbon and the relative dominance of conifers vs. hardwoods. In conclusion, our simulations suggest that disturbance interactions will be strongly mediated by climate change and will produce increasingly negative feedbacks, preventing worst-case disturbance outcomes. Our results underscore the importance of running simulations with multiple disturbances on the landscape concurrently rather than focusing on any one or two disturbances.*

Luce, C. H. (2018) Effects of Climate Change on Snowpack, Glaciers, and Water Resources in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 25-36).
Research Tags: Water, Weather
Abstract: *Water is critical to life, and the effects of climate change on ecosystems are mediated through changes in hydrology. Changes in how snow accumulates and melts are one of the more consistently noted climate-induced changes to water in the western United States (Barnett et al. 2005; Service 2004), and these changes affect when water will be available for forests and fish alike. Changes in summer atmospheric circulation patterns may alter the ability of summer precipitation to allow midsummer respite from seasonal drought and dampening of wildfire spread (Intergovernmental Panel on Climate Change [IPCC] 2013; see chapter 8). Fish will be affected by both lower low flows with earlier snowmelt and higher midwinter floods caused by rain-on-snow events. Declining summer water supplies will likewise challenge municipal and agricultural water supplies. All of these meaningful effects can be traced to interactions between temperature and precipitation changes projected for the future and described in chapter 3. In this chapter, we describe mechanisms of hydrologic change, and provide maps illustrating variations in effects across the Forest Service, U.S. Department of Agriculture Northern Region and the Greater Yellowstone Area, hereafter called the Northern Rockies region. We also discuss some uncertainties relevant to these effects. Climate change effects on stream temperature in the region are discussed in chapter 5.*

Lucero, S. A., & Tamez, S. (2017). Working together to implement the tribal forest protection act of 2004: Partnerships for today and tomorrow. *Journal of Forestry, 115*(5), 468-472. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029142447&doi=10.5849%2fjof.2016-096R2&partnerID=40&md5=578aa3ef7f7d6df515f9caf8fa613dbc. doi:10.5849/jof.2016-096R2
Research Tags: Forestry, Economics
Abstract: *The Tribal Forest Protection Act of 2004, PL 108-278 (TFPA), was passed in response to fires that swept the West in 2002 and 2003, devastating many tribal forest resources and communities. TFPA was heralded as a critical authority to protect tribal communities, trust resources, and lands. However, TFPA was rarely used, despite its utility to address landscape issues across tribal and nontribal forest ownerships. This article discusses the background of TFPA and the partnership between the Intertribal Timber Council, US Department of Agriculture Forest Service, and Bureau of Indian Affairs to promote TFPA through surveys, webinars, and three workshops. The TFPA workshops present a lens to examine approaches that are transferable to other collaborative forest management actions across boundaries with additional partners. This article discusses their efficacy to create more resilient forests that can withstand environmental challenges stemming from climate change and other issues.*

Management and Policy Implications The Intertribal Timber Council (ITC) study (ITC 2013) and subsequent Tribal Forest Protection Act (TFPA) workshops revealed and subsequent Tribal Forest Protection Act (TFPA) workshops had four implications for forest managers and policymakers. First, the law recognizes that tribal rights and interests are greatly affected by federal forest management decisions and policy regarding adjacent, off-reservation forests. These federal agencies also have a fiduciary trust responsibility to protect tribal assets. Second, TFPA and tribal participation bring the legislative authority of federally reserved rights, consultation requirements, and government-to-government relationships to the table. Third, long-term, place-based experience enables tribal communities to accumulate traditional environmental knowledge over multiple generations. Fourth, many tribes have expertise and resources to contribute to forest management across boundaries (Tamez 2012a). These implications are vital to increasing the capacity for tribes, land management agencies, and other parties to forge long-term partnerships to sustain productive forests on the landscape. Many of the lessons learned and tools developed through TFPA training and the Template are transferable to other collaborative efforts. Employing TFPA and related tools, finding mutual interests, and providing unique knowledge and resources to shared goals must gain currency for the future of our forests. Resilient, healthy forests spanning jurisdictions require collective, unified efforts using all the tools we have.

Ludwig, J. A., Wondzell, S. M., Muldavin, E. H., Blanche, K. R., & Chauvin, Y. (2017). Native desert grassland plant species declines and accelerated erosion in the Paint Gap Hills of southwest Texas. *Southwestern Naturalist, 62*(1), 53-61. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019603069&doi=10.1894%2f0038-4909-62.1.53&partnerID=40&md5=17d7d29f3796fa60fb579a42a1ce0e25. doi:10.1894/0038-4909-62.1.53

Research Tags: Grassland, Soil, Weather

Abstract: *Due to the hotter droughts occurring with climate change, grasslands of southwestern deserts and southern plains in the United States are predicted to increasingly lose cover of native plant species, be invaded by nonnative species, and have accelerated soil erosion. We evaluated these predictions for desert grasslands in the Paint Gap Hills of Big Bend National Park, Texas. We used data from 10 monitoring transects established in 1981 and surveyed vegetation composition, canopy cover, and soil surface elevations in 1981, 1983, 1995, and 2014. Four longer and hotter droughts occurred between 1985 and 2014. We found that by 2014 canopy covers of two dominant native warm-season perennial grasses, Bouteloua curtipendula and Bouteloua ramosa, were reduced to near zero, and the cover of many native shrubs and subshrubs had notably declined. By 2014 two nonnative perennial grasses, Eragrostis lehmanniana and Pennisetum ciliare, had invaded, and their expansion could have long-term ecological consequences. Soil surfaces changed from accumulating sediments at a rate of 0.7 mm/year for 1983–1995 to eroding at −1.6 mm/year for 1995–2014. These soil and vegetation changes support predictions of major declines in native desert grasslands and emphasize their vulnerability to climate change.*

Luo, T., Liu, X., Zhang, L., Li, X., Pan, Y., & Wright, I. J. (2018). Summer solstice marks a seasonal shift in temperature sensitivity of stem growth and nitrogen-use efficiency in cold-limited forests. *Agricultural and Forest Meteorology, 248*, 469-478. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032726549&doi=10.1016%2fj.agrformet.2017.10.029&partnerID=40&md5=c9174c6b63574656a0736e7a301becfd. doi:10.1016/j.agrformet.2017.10.029

Research Tags: Forestrt, Weather

Abstract: *In boreal forests and alpine treelines, it is debatable how the temperature sensitivity of tree-ring growth should vary with changes in climate over time and the extent to which seasonal stem increments are controlled by leaf physiology. We aim to test the hypothesis that, in cold-limited forests, maximizing stem growth rate around summer solstice is closely related to foliage turnover, which generally results in high sensitivity of stem growth and less sensitivity of nitrogen-use efficiency (NUE) to early-season temperatures. Our analysis was based on repeat-census observations of stem radial increment (2008–2013; made with dendrometers) and monthly litterfall (2007–2015) as well as the measurements of tree-ring width series (1960–2015; made with tree-ring cores) in two Tibetan treeline forests. NUE was estimated as the inverse of leaf-litter nitrogen concentration. We further examined a global dataset of tree-ring chronologies (1931–1990) from 139 sites across temperate and boreal coniferous forests in the northern high-latitude region. Weekly stem increments across species and years synchronously peaked around summer solstice, with more than half of*

annual increment produced in the first 28–35 days of the growing season when air and soil temperatures were still low. Monthly stem increments were positively related to previous-month litterfall, and higher litterfall generally resulted in higher NUE. NUE was insensitive or less sensitive to soil temperature in the early growing season. Among years, pre-peak increments were positively correlated with pre-solstice temperatures while post-peak increments varied little. The annual increment was dominated by and coherent with the pre-peak increment and well correlated with the ring-width measurements of monitored trees during 2008–2013. Variations in tree-ring width chronologies from the two Tibetan treelines and the global 139 forest sites mainly reflected the change of early summer temperatures. The findings suggest a day-length control on the linkage between seasonal stem growth and nitrogen cycling in a cold-limited forest ecosystem, and provide the basic for predicting responses of tree-ring growth and NUE to climatic warming.

Lute, A. C., & Luce, C. H. (2017). Are Model Transferability And Complexity Antithetical? Insights From Validation of a Variable-Complexity Empirical Snow Model in Space and Time. *Water Resources Research, 53*(11), 8825-8850. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038946839&doi=10.1002%2f2017WR020752&partnerID=40&md5=99f83f4ff5b24580ec65322ceb0bcd14. doi:10.1002/2017WR020752

Research Tags: Water

Abstract: *The related challenges of predictions in ungauged basins and predictions in ungauged climates point to the need to develop environmental models that are transferable across both space and time. Hydrologic modeling has historically focused on modelling one or only a few basins using highly parameterized conceptual or physically based models. However, model parameters and structures have been shown to change significantly when calibrated to new basins or time periods, suggesting that model complexity and model transferability may be antithetical. Empirical space-for-time models provide a framework within which to assess model transferability and any tradeoff with model complexity. Using 497 SNOTEL sites in the western U.S., we develop space-for-time models of April 1 SWE and Snow Residence Time based on mean winter temperature and cumulative winter precipitation. The transferability of the models to new conditions (in both space and time) is assessed using non-random cross-validation tests with consideration of the influence of model complexity on transferability. As others have noted, the algorithmic empirical models transfer best when minimal extrapolation in input variables is required. Temporal split-sample validations use pseudoreplicated samples, resulting in the selection of overly complex models, which has implications for the design of hydrologic model validation tests. Finally, we show that low to moderate complexity models transfer most successfully to new conditions in space and time, providing empirical confirmation of the parsimony principal.*

Lutz, J. A., Furniss, T. J., Johnson, D. J., Davies, S. J., Allen, D., Alonso, A., . . . Zimmerman, J. K. (2018). Global importance of large-diameter trees. *Global Ecology and Biogeography, 27*(7), 849-864. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046535962&doi=10.1111%2fgeb.12747&partnerID=40&md5=0c90988e066261cd24cca7e8530f58a2. doi:10.1111/geb.12747

Research Tags: Forestry

Abstract: *Aim*

To examine the contribution of large-diameter trees to biomass, stand structure, and species richness across forest biomes.

Location

Global.

Time period

Early 21st century.

Major taxa studied

Woody plants.

Methods

We examined the contribution of large trees to forest density, richness and biomass using a global network of 48 large (from 2 to 60 ha) forest plots representing 5,601,473 stems across 9,298 species and 210 plant families. This contribution was assessed using three metrics: the largest 1% of trees ≥ 1 cm diameter at breast height (DBH), all trees ≥ 60 cm DBH, and those rank-ordered largest trees that cumulatively comprise 50% of forest biomass.

Results
Averaged across these 48 forest plots, the largest 1% of trees ≥ 1 cm DBH comprised 50% of aboveground live biomass, with hectare-scale standard deviation of 26%. Trees ≥ 60 cm DBH comprised 41% of aboveground live tree biomass. The size of the largest trees correlated with total forest biomass (r2 = .62, p < .001). Large-diameter trees in high biomass forests represented far fewer species relative to overall forest richness (r2 = .45, p < .001). Forests with more diverse large-diameter tree communities were comprised of smaller trees (r2 = .33, p < .001). Lower large-diameter richness was associated with large-diameter trees being individuals of more common species (r2 = .17, p = .002). The concentration of biomass in the largest 1% of trees declined with increasing absolute latitude (r2 = .46, p < .001), as did forest density (r2 = .31, p < .001). Forest structural complexity increased with increasing absolute latitude (r2 = .26, p < .001).
Main conclusions
Because large-diameter trees constitute roughly half of the mature forest biomass worldwide, their dynamics and sensitivities to environmental change represent potentially large controls on global forest carbon cycling. We recommend managing forests for conservation of existing large-diameter trees or those that can soon reach large diameters as a simple way to conserve and potentially enhance ecosystem services.

Lutz, J. A., Matchett, J. R., Tarnay, L. W., Smith, D. F., Becker, K. M. L., Furniss, T. J., & Brooks, M. L. (2017). Fire and the distribution and uncertainty of carbon sequestered as aboveground tree biomass in Yosemite and Sequoia & Kings Canyon National Parks. *Land, 6*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019221494&doi=10.3390%2fland6010010&partnerID=40&md5=ea48987e7658cc94308d103fa6a18a7b. doi:10.3390/land6010010

Research Tags: Weather, Forestry

Abstract: *Fire is one of the principal agents changing forest carbon stocks and landscape level distributions of carbon, but few studies have addressed how accurate carbon accounting of fire-killed trees is or can be. We used a large number of forested plots (1646), detailed selection of species-specific and location-specific allometric equations, vegetation type maps with high levels of accuracy, and Monte Carlo simulation to model the amount and uncertainty of aboveground tree carbon present in tree species (hereafter, carbon) within Yosemite and Sequoia & Kings Canyon National Parks. We estimated aboveground carbon in trees within Yosemite National Park to be 25 Tg of carbon (C) (confidence interval (CI): 23–27 Tg C), and in Sequoia & Kings Canyon National Park to be 20 Tg C (CI: 18–21 Tg C). Low-severity and moderate-severity fire had little or no effect on the amount of carbon sequestered in trees at the landscape scale, and high-severity fire did not immediately consume much carbon. Although many of our data inputs were more accurate than those used in similar studies in other locations, the total uncertainty of carbon estimates was still greater than ±10%, mostly due to potential uncertainties in landscape-scale vegetation type mismatches and trees larger than the ranges of existing allometric equations. If carbon inventories are to be meaningfully used in policy, there is an urgent need for more accurate landscape classification methods, improvement in allometric equations for tree species, and better understanding of the uncertainties inherent in existing carbon accounting methods.*

Ly, D., Huet, S., Gauffreteau, A., Rincent, R., Touzy, G., Mini, A., . . . Charmet, G. (2018). Whole-genome prediction of reaction norms to environmental stress in bread wheat (Triticum aestivum L.) by genomic random regression. *Field Crops Research, 216*, 32-41. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033469128&doi=10.1016%2fj.fcr.2017.08.020&partnerID=40&md5=293ed1bfc256ce55ed07f6f7d9defd8f. doi:10.1016/j.fcr.2017.08.020

Research Tags: Weather, Crops

Abstract: *Plant breeding has always sought to develop crops able to withstand environmental stresses, but this is all the more urgent now as climate change is affecting the agricultural regions of the world. It is currently difficult to screen genetic material to determine how well a crop will tolerate various stresses. Multi-environment trials (MET) which include a particular stress condition could be used to train a genomic selection model thanks to molecular marker information that is now readily available. Our study focuses on understanding how and predicting whether a plant is adapted to a particular environmental stress. We propose a way to use genomic random regression, an extension of factorial regression, to model the reaction norms of a genotype to an environmental stress: the factorial regression genomic best linear unbiased predictor (FR-gBLUP). Twenty-eight wheat trials in France (3 years, 12 locations, nitrogen or water stress treatments)*

were split into two METs where different stresses limited grain number and yield. In MET1, drought at flowering was responsible for 46.7% of the genotype-by-environment (G × E) interactions for yield while in MET2, heat stress during booting was identified as the main factor responsible for G × E interactions, but that explained less of the interaction variance (33.6%).
Since drought at flowering explained a fairly large variance in G × E in MET1, the FR-gBLUP model was more accurate than the additive gBLUP across all types of cross validation. Accuracy gains varied from 2.4% to 12.9% for the genomic regression to drought. In MET2 accuracy gains were modest, varying from −5.7% to 2.4%. When a major stress influencing G × E is identified, the FR-gBLUP strategy makes it possible to predict the level of adaptation of genotyped individuals to varying stress intensities, and thus to select them in silico. Our study demonstrates how genome-wide selection can facilitate breeding for adaptation.

Lydersen, J. M., Collins, B. M., Brooks, M. L., Matchett, J. R., Shive, K. L., Povak, N. A., . . . Smith, D. F. (2017). Evidence of fuels management and fire weather influencing fire severity in an extreme fire event. *Ecological Applications, 27*(7), 2013-2030. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030152934&doi=10.1002%2feap.1586&partnerID=40&md5=861be2edd9a9b24808e0d2a6250ae5ec. doi:10.1002/eap.1586
Research Tags: Weather, Forestry
Abstract: *Following changes in vegetation structure and pattern, along with a changing climate, large wildfire incidence has increased in forests throughout the western United States. Given this increase, there is great interest in whether fuels treatments and previous wildfire can alter fire severity patterns in large wildfires. We assessed the relative influence of previous fuels treatments (including wildfire), fire weather, vegetation, and water balance on fire-severity in the Rim Fire of 2013. We did this at three different spatial scales to investigate whether the influences on fire severity changed across scales. Both fuels treatments and previous low to moderate-severity wildfire reduced the prevalence of high-severity fire. In general, areas without recent fuels treatments and areas that previously burned at high severity tended to have a greater proportion of high-severity fire in the Rim Fire. Areas treated with prescribed fire, especially when combined with thinning, had the lowest proportions of high severity. The proportion of the landscape burned at high severity was most strongly influenced by fire weather and proportional area previously treated for fuels or burned by low to moderate severity wildfire. The proportion treated needed to effectively reduce the amount of high severity fire varied by spatial scale of analysis, with smaller spatial scales requiring a greater proportion treated to see an effect on fire severity. When moderate and high-severity fire encountered a previously treated area, fire severity was significantly reduced in the treated area relative to the adjacent untreated area. Our results show that fuels treatments and low to moderate-severity wildfire can reduce fire severity in a subsequent wildfire, even when burning under fire growth conditions. These results serve as further evidence that both fuels treatments and lower severity wildfire can increase forest resilience.*

Lydersen, J. M., Collins, B. M., & Hunsaker, C. T. (2019). Implementation constraints limit benefits of restoration treatments in mixed-conifer forests. *International Journal of Wildland Fire, 28*(7), 495-511. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065984109&doi=10.1071%2fWF18141&partnerID=40&md5=6cba5ed94be5023c77177291c2d35c70. doi:10.1071/WF18141
Research Tags: Forestry
Abstract: *Forest restoration treatments seek to increase resilience to wildfire and a changing climate while avoiding negative impacts to the ecosystem. The extent and intensity of treatments are often constrained by operational considerations and concerns over uncertainty in the trade-offs of addressing different management goals. The recent (2012–15) extreme drought in California, USA, resulted in widespread tree mortality, particularly in the southern Sierra Nevada, and provided an opportunity to assess the effects of restoration treatments on forest resilience to drought. We assessed changes in mixed-conifer forest structure following thinning and understorey burning at the Kings River Experimental Watersheds in the southern Sierra Nevada, and how treatments, topography and forest structure related to tree mortality in the recent drought. Treatments had negligible effect on basal area, tree density and canopy cover. Following the recent drought, average basal area mortality within the watersheds ranged from 5 to 26% across riparian areas and 12 to 44% across upland areas, with a range of 0 to 95% across all plots. Tree mortality was not significantly influenced by restoration treatments or topography. Our results suggest that the constraints common to many restoration*

treatments may limit their ability to mitigate the impacts of severe drought.

Lytle, D. A., Merritt, D. M., Tonkin, J. D., Olden, J. D., & Reynolds, L. V. (2017). Linking river flow regimes to riparian plant guilds: A community-wide modeling approach. *Ecological Applications, 27*(4), 1338-1350. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020237036&doi=10.1002%2feap.1528&partnerID=40&md5=3a07e1c565fb6d07fc778c1bd0c06fc5. doi:10.1002/eap.1528
Research Tags: Water
Abstract: *Modeling riparian plant dynamics along rivers is complicated by the fact that plants have different edaphic and hydrologic requirements at different life stages. With intensifying human demands for water and continued human alteration of rivers, there is a growing need for predicting responses of vegetation to flow alteration, including responses related to climate change and river flow management. We developed a coupled structured population model that combines stage-specific responses of plant guilds with specific attributes of river hydrologic regime. The model uses information on the vital rates of guilds as they relate to different hydrologic conditions (flood, drought, and baseflow), but deliberately omits biotic interactions from the structure (interaction neutral). Our intent was to (1) consolidate key vital rates concerning plant population dynamics and to incorporate these data into a quantitative framework, (2) determine whether complex plant stand dynamics, including biotic interactions, can be predicted from basic vital rates and river hydrology, and (3) project how altered flow regimes might affect riparian communities. We illustrated the approach using five flow-response guilds that encompass much of the river floodplain community: hydroriparian tree, xeroriparian shrub, hydroriparian shrub, mesoriparian meadow, and desert shrub. We also developed novel network-based tools for predicting community-wide effects of climate-driven shifts and deliberately altered flow regimes. The model recovered known patterns of hydroriparian tree vs. xeroriparian shrub dominance, including the relative proportion of these two guilds as a function of river flow modification. By simulating flow alteration scenarios ranging from increased drought to shifts in flood timing, the model predicted that mature hydroriparian forest should be most abundant near the observed natural flow regime. Multiguild sensitivity analysis identified substantial network connectivity (many connected nodes) and biotic linkage (strong pairwise connections between nodes) under natural flow regime conditions. Both connectivity and linkage were substantially reduced under drought and other flow-alteration scenarios, suggesting that community structure is destabilized under such conditions. This structured population modeling approach provides a useful tool for understanding the community-wide effects of altered flow regimes due to climate change and management actions that influence river flow regime.*

Lyu, M., Xie, J., Giardina, C. P., Vadeboncoeur, M. A., Feng, X., Wang, M., . . . Yang, Y. (2019). Understory ferns alter soil carbon chemistry and increase carbon storage during reforestation with native pine on previously degraded sites. *Soil Biology and Biochemistry, 132*, 80-92. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061667072&doi=10.1016%2fj.soilbio.2019.02.004&partnerID=40&md5=f8013673c15818f0fd69a7154ea22c15. doi:10.1016/j.soilbio.2019.02.004
Research Tags: Forestry, Soil
Abstract: *Reforestation with native species and resulting understory succession can exert important influences on soil organic matter (SOM) storage and chemistry, but a mechanistic understanding of these effects is lacking. We studied different aged Masson pine (Pinus massoniana L.) plantations with and without the understory fern, Dicranopteris dichotoma (Thunb.) Berhn., in subtropical China to assess how SOM over a 30 year sequence of pine growth and fern expansion. To do this, we measured total SOM, lignin-derived phenols, soil carbon (total C and 13C), soil nitrogen (total N and 15N), and soil microbial community composition via phospholipid fatty acid (PLFA) analyses. We found that the accumulation of newly-formed SOM outweighed decomposition of old SOM, with the majority of this increase being derived from fern detrital inputs. Where ferns were present, ferns contributed 54–61% of total soil C storage in surface (0–10 cm depth) soils, which was 62–91% higher than pre-reforestation soil C storage. We found that the abundance of lignin-derived compounds was lower in fern dominated soils, perhaps because soils under ferns supported more soil fungi, the primary decomposers of the lignin in soil. Fern soils also showed higher ratios of syringyls to vanillyls and decreased δ13C values, an indicator that ferns altered the composition of SOM at the molecular level while contributing significantly to SOM accumulation. Reforestation especially when accompanied by fern expansion*

also improved soil N and phosphorus (P) status, with observed declines in soil δ15N in fern dominated soils aligning with increased nutrient retention and observed increases in soil C storage. Our study highlights the potentially important role of understory ferns in mediating SOM chemistry and soil C storage during ecosystem recovery.

Lyu, Z., Genet, H., He, Y., Zhuang, Q., McGuire, A. D., Bennett, A., . . . Zhu, Z. (2018). The role of environmental driving factors in historical and projected carbon dynamics of wetland ecosystems in Alaska. *Ecological Applications, 28*(6), 1377-1395. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052750201&doi=10.1002%2feap.1755&partnerID=40&md5=02903aa8c9c4d9e9ee1f3bd4dc6d6388. doi:10.1002/eap.1755
Research Tags: Water, Emissions
Abstract: *Wetlands are critical terrestrial ecosystems in Alaska, covering ~177,000 km2, an area greater than all the wetlands in the remainder of the United States. To assess the relative influence of changing climate, atmospheric carbon dioxide (CO2) concentration, and fire regime on carbon balance in wetland ecosystems of Alaska, a modeling framework that incorporates a fire disturbance model and two biogeochemical models was used. Spatially explicit simulations were conducted at 1-km resolution for the historical period (1950–2009) and future projection period (2010–2099). Simulations estimated that wetland ecosystems of Alaska lost 175 Tg carbon (C) in the historical period. Ecosystem C storage in 2009 was 5,556 Tg, with 89% of the C stored in soils. The estimated loss of C as CO2 and biogenic methane (CH4) emissions resulted in wetlands of Alaska increasing the greenhouse gas forcing of climate warming. Simulations for the projection period were conducted for six climate change scenarios constructed from two climate models forced under three CO2 emission scenarios. Ecosystem C storage averaged among climate scenarios increased 3.94 Tg C/yr by 2099, with variability among the simulations ranging from 2.02 to 4.42 Tg C/yr. These increases were driven primarily by increases in net primary production (NPP) that were greater than losses from increased decomposition and fire. The NPP increase was driven by CO2 fertilization (~5% per 100 parts per million by volume increase) and by increases in air temperature (~1% per °C increase). Increases in air temperature were estimated to be the primary cause for a projected 47.7% mean increase in biogenic CH4 emissions among the simulations (~15% per °C increase). Ecosystem CO2 sequestration offset the increase in CH4 emissions during the 21st century to decrease the greenhouse gas forcing of climate warming. However, beyond 2100, we expect that this forcing will ultimately increase as wetland ecosystems transition from being a sink to a source of atmospheric CO2 because of (1) decreasing sensitivity of NPP to increasing atmospheric CO2, (2) increasing availability of soil C for decomposition as permafrost thaws, and (3) continued positive sensitivity of biogenic CH4 emissions to increases in soil temperature.*

Ma, H., Zeng, J., Chen, N., Zhang, X., Cosh, M. H., & Wang, W. (2019). Satellite surface soil moisture from SMAP, SMOS, AMSR2 and ESA CCI: A comprehensive assessment using global ground-based observations. *Remote Sensing of Environment, 231*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066605651&doi=10.1016%2fj.rse.2019.111215&partnerID=40&md5=d1da72ce525f1c1a44425090c91eeaa1. doi:10.1016/j.rse.2019.111215
Research Tags: Soil, Weather
Abstract: *Comprehensive assessments on the reliability of remotely sensed soil moisture products are undeniably essential for their advancement and application. With the establishment of extensive dense networks across the globe, mismatches between satellite footprints and ground single-point observations can be feasibly relieved. In this study, five remotely sensed soil moisture products, namely, the Soil Moisture Active Passive (SMAP), two Soil Moisture and Ocean Salinity (SMOS) products, the Land Parameter Retrieval Model (LPRM) Advanced Microwave Scanning Radiometer 2 (AMSR2) and the European Space Agency (ESA) Climate Change Initiative (CCI), were systematically investigated by utilizing in-situ soil moisture observations from global dense and sparse networks. Distinguished from previous studies, several perturbing factors comprising the surface temperature, vegetation optical depth (VOD), surface roughness and spatial heterogeneity were taken into account in this investigation. Furthermore, products' skills under various climate regions were also evaluated.*
Through the results, the SMAP product captures temporal trends of ground soil moisture, exhibiting an averaged R of 0.729, whereas for overall accuracy, ESA CCI outperformed other products with a slightly smaller

ubRMSE of 0.041 m3 m−3 and a bias of −0.005 m3 m−3. This complementarity between SMAP and ESA CCI was further demonstrated under different climate conditions and can afford the reference of their integration for a more reliable global soil moisture product. Though some underestimations still exist, the newly developed SMOS- INRA-CESBIO (SMOS-IC) was illustrated to gain considerable upgrades with regard to R and ubRMSE compared to SMOS-L3 product, especially in dense VOD conditions achieving the highest R compared to other products.
Generally, the underestimations of the European Centre for Medium-Range-Weather Forecasts (ECMWF) surface temperature used for SMOS under moderate or high VOD, heterogeneity, and most surface roughness conditions were consistent with the underestimations of the soil moisture product and provide the directions of product promotions. As for LPRM surface temperature, the worse skills can partially explain the unsatisfactory performances for LPRM soil moisture products. In spite of relatively acceptable skills of SMAP and SMOS-IC soil moisture products concerning R under moderate or dense VOD, small surface roughness, low heterogeneity conditions and temperate and cold climate types, advances in soil moisture products under high or even slightly low VOD, high roughness or topography complexity and heterogeneity, as well as in tropical or desert regions, remain challenging. It is expected that these findings can contribute to algorithm refinements, product enhancements (e.g., fusion and disaggregation) and hydrometeorological usages.

Ma, L., Ahuja, L. R., Islam, A., Trout, T. J., Saseendran, S. A., & Malone, R. W. (2017). Modeling yield and biomass responses of maize cultivars to climate change under full and deficit irrigation. *Agricultural Water Management, 180*, 88-98. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84994613906&doi=10.1016%2fj.agwat.2016.11.007&partnerID=40&md5=701933212f854baad1a62f04ddaf3512. doi:10.1016/j.agwat.2016.11.007
Research Tags: Water, Crops
Abstract: *With as much as 4.8 °C increase in air temperature by end of 21st century, new crop cultivars are needed for adapting to the new climate. The objective of this study was to identify maize (Zea mays L.) cultivar parameters that maintain yield under projected climate for late in the 21st century under full and deficit irrigation in a semi-arid region. The Root Zone Water Quality Model (RZWQM2) was calibrated with four years of maize data from northeastern Colorado, USA, under various irrigation conditions and was then used to simulate climate change effects on maize production with current management practices. Results showed that projected climate change decreased yield by 21% and biomass by 7% late in the 21st century (2070–2091) under full irrigation, compared to yield in the current climate (1992–2013). Under deficit irrigation, the corresponding reductions were 14% and 3%, respectively. Using the cultivar parameters calibrated with RZWQM2 for southern Colorado condition did not show yield decrease under future climate, but it simulated much lower yield under current climate in northeastern Colorado. A cultivar from the DSSAT (Decision Support Systems for Agrotechnology Transfer) crop database (GL 482) produced similar yield to experimental data under current climate and increased yield by 4% at full irrigation under future climate in northeastern Colorado. Using Latin Hypercube Sampling (LHS), we also identified 70 cultivars with longer maturity duration (between silking and physiological maturity) and higher grain filling rate for mitigating climate change effects on maize production. These two identified traits can guide plant breeders in developing cultivars for the future.*

Ma, L., Derner, J. D., Harmel, R. D., Tatarko, J., Moore, A. D., Rotz, C. A., . . . Wilmer, H. (2019) Application of grazing land models in ecosystem management: Current status and next frontiers. In. *Advances in Agronomy*.
Research Tags: Grassland, Livestock
Abstract: *Grazing land models can assess the provisioning and trade-offs among ecosystem services attributable to grazing management strategies. We reviewed 12 grazing land models used for evaluating forage and animal (meat and milk) production, soil C sequestration, greenhouse gas emission, and nitrogen leaching, under both current and projected climate conditions. Given the spatial and temporal variability that characterizes most rangelands and pastures in which animal, plant, and soil interact, none of the models currently have the capability to simulate a full suite of ecosystem services provided by grazing lands at different spatial scales and across multiple locations. A large number of model applications have focused on topics such as environmental impacts of grazing land management and sustainability of ecosystems. Additional model components are needed to address the spatial and temporal dynamics of animal foraging behavior and interactions with biophysical and ecological processes on grazing lands and their impacts on animal*

performance. In addition to identified knowledge gaps in simulating biophysical processes in grazing land ecosystems, our review suggests further improvements that could increase adoption of these models as decision support tools. Grazing land models need to increase user-friendliness by utilizing available big data to minimize model parameterization so that multiple models can be used to reduce simulation uncertainty. Efforts need to reduce inconsistencies among grazing land models in simulated ecosystem services and grazing management effects by carefully examining the underlying biophysical and ecological processes and their interactions in each model. Learning experiences among modelers, experimentalists, and stakeholders need to be strengthened by co-developing modeling objectives, approaches, and interpretation of simulation results.

Ma, L., Xia, H., Sun, J., Wang, H., Feng, G., & Qin, F. (2018). Spatial-temporal variability of hydrothermal climate conditions in the Yellow River Basin from 1957 to 2015. *Atmosphere, 9*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056142285&doi=10.3390%2fatmos9110433&partnerID=40&md5=122eb3d7d75b8bb4463013f51f2f342c. doi:10.3390/atmos9110433
Research Tags: Weather, Water
Abstract: *The Yellow River Basin has been affected by global climate change. Studying the spatial–temporal variability of the hydrothermal climate conditions in the Yellow River Basin is of vital importance for the development of technologies and policies related to ecological, environmental, and agricultural adaptation in this region. This study selected temperature and precipitation data observed from 118 meteorological stations distributed in the Yellow River Basin over the period of 1957–2015, and used the Mann–Kendall, Pettitt, and Hurst indices to investigate the spatial–temporal variability of the hydrothermal climate conditions in this area. The results indicated: (1) the annual maximum, minimum, and average temperatures have increased. The seasonal maximum, minimum, and average temperatures for the spring, summer, autumn, and winter have also increased, and this trend is statistically significant ($p < 0.01$) between 1957–2015. The rate of increase in the minimum temperature exceeded that of the maximum temperature, and diurnal warming was asymmetric. Annual precipitation and the total spring, summer, and autumn precipitations declined, while the total winter precipitation increased, although the trend was non-significant ($p > 0.05$). (2) Based on the very restrictive assumption that future changes will be similar to past changes, according to the Hurst index experiment, the future trends of temperature and precipitation in the Yellow River Basin are expected to stay the same as in the past. There will be a long-term correlation between the two trends: the temperature will continue to rise, while the precipitation will continue to decline (except in the winter). However, over the late stage of the study period, the trends slowed down to some extent.*

Ma, L., Zhong, M., Zhu, Y., Yang, H., Johnson, D. A., & Rong, Y. (2018). Annual methane budgets of sheep grazing systems were regulated by grazing intensities in the temperate continental steppe: A two-year case study. *Atmospheric Environment, 174*, 66-75. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035747357&doi=10.1016%2fj.atmosenv.2017.11.024&partnerID=40&md5=2b82e7624cfb93b21d052a90060e6771. doi:10.1016/j.atmosenv.2017.11.024
Research Tags: Emissions, Grassland, Livestock
Abstract: *Methane (CH_4) emission from animal husbandry accounts for a large percentage of anthropogenic contributions to CH_4 emissions. Fully understanding of grazing management effects on the CH_4 budget is essential for mitigating CH_4 emissions in the temperate grazing steppe systems. Annual CH_4 budgets for the sheep grazed steppes at various grazing intensities, un–grazing (UG, 0 sheep $ha^{-1}year^{-1}$), defer grazing (DG, 1.0 sheep ha^{-1} $year^{-1}$), moderate grazing (MG, 1.43 sheep $ha^{-1}year^{-1}$), and heavy grazing (HG, 2.43 sheep $ha^{-1}year^{-1}$) were assessed across 2012–2014 in the agro–pastoral region of northern China. Annual soil CH_4 uptake averaged across 2012–2014 were 1.1 ± 0.1, 2.4 ± 0.2, 2.2 ± 0.2, and 1.3 ± 0.1 kg CH_4–C ha^{-1} for UG, DG (only 2013–2014), MG and HG sites. Non–growing season CH_4 uptake comprised 50.0 ± 4.3% of annual CH_4 uptake in 2012–2013 and 37.7 ± 2.0% in 2013–2014. DG and MG significantly promoted annual soil CH_4 uptake ($P < 0.05$), while there was no difference between HG and UG ($P > 0.05$). Bell–shaped relationship was presented between stocking rates and soil CH_4 uptake ($r^2 = 0.59$, $P < 0.05$). Annual soil CH_4 uptake significant linearly and positively correlated with root biomass ($r^2 = 0.30$, $P < 0.05$). Annual CH_4 budgets for the grazed grasslands were −1.1 ± 0.1, 5.7 ± 0.6, 11.5 ± 1.5 and 15.5 ± 1.3 kg CH_4–C ha^{-1} $year^{-1}$ in UG, DG (only 2013–2014), MG and HG across 2012–2014. Soil CH_4 uptake could offset 29.7 ± 5.6, 15.9 ± 4.3 and 6.8 ± 1.0% of total annual CH_4 emissions from sheep, sheepfold and faeces in DG, MG, and HG. All grazed steppes are*

sources for atmospheric CH4 and the magnitude is regulated by grazing intensities. Sheep CH4 emissions for 1–g liveweight gain were 0.21, 0.32 and 0.37 g CH4–C in DG, MG and HG, respectively. DG is the recommended grazing management in this region to achieve greater herbage mass, higher sheep performance and lower CH4 emissions simultaneously.

Ma, S., Jiang, J., Huang, Y., Shi, Z., Wilson, R. M., Ricciuto, D., . . . Luo, Y. (2017). Data-Constrained Projections of Methane Fluxes in a Northern Minnesota Peatland in Response to Elevated CO<inf>2</inf> and Warming. *Journal of Geophysical Research: Biogeosciences, 122*(11), 2841-2861. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038002503&doi=10.1002%2f2017JG003932&partnerID=40&md5=7431eccc85804ba493d1c31866ac7e70. doi:10.1002/2017JG003932
Research Tags: Emissions, Soil
Abstract: *Large uncertainties exist in predicting responses of wetland methane (CH4) fluxes to future climate change. However, sources of the uncertainty have not been clearly identified despite the fact that methane production and emission processes have been extensively explored. In this study, we took advantage of manual CH4 flux measurements under ambient environment from 2011 to 2014 at the Spruce and Peatland Responses Under Changing Environments (SPRUCE) experimental site and developed a data-informed process-based methane module. The module was incorporated into the Terrestrial ECOsystem (TECO) model before its parameters were constrained with multiple years of methane flux data for forecasting CH4 emission under five warming and two elevated CO2 treatments at SPRUCE. We found that 9°C warming treatments significantly increased methane emission by approximately 400%, and elevated CO2 treatments stimulated methane emission by 10.4%–23.6% in comparison with ambient conditions. The relative contribution of plant-mediated transport to methane emission decreased from 96% at the control to 92% at the 9°C warming, largely to compensate for an increase in ebullition. The uncertainty in plant-mediated transportation and ebullition increased with warming and contributed to the overall changes of emissions uncertainties. At the same time, our modeling results indicated a significant increase in the emitted CH4:CO2 ratio. This result, together with the larger warming potential of CH4, will lead to a strong positive feedback from terrestrial ecosystems to climate warming. The model-data fusion approach used in this study enabled parameter estimation and uncertainty quantification for forecasting methane fluxes.*

Ma, W., Domke, G. M., D'Amato, A. W., Woodall, C. W., Walters, B. F., & Deo, R. K. (2018). Using matrix models to estimate aboveground forest biomass dynamics in the eastern USA through various combinations of LiDAR, Landsat, and forest inventory data. *Environmental Research Letters, 13*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060183194&doi=10.1088%2f1748-9326%2faaeaa3&partnerID=40&md5=56d6e746bd0dd17761d85449f4568eb4. doi:10.1088/1748-9326/aaeaa3
Research Tags: Forestry, Research
Abstract: *The ability to harmonize data sources with varying temporal, spatial, and ecosystem measurements (e.g. forest structure to soil organic carbon) for creation of terrestrial carbon baselines is paramount to refining the monitoring of terrestrial carbon stocks and stock changes. In this study, we developed and examined the short- (5 years) and long-term (30 years) performance of matrix models for incorporating light detection and ranging (LiDAR) strip samples and time-series Landsat surface reflectance high-level data products, with field inventory measurements to predict aboveground biomass (AGB) dynamics for study sites across the eastern USA—Minnesota (MN), Maine (ME), Pennsylvania-New Jersey (PANJ) and South Carolina (SC). The rows and columns of the matrix were stand density (i.e. number of trees per unit area) sorted by inventory plot and by species group and diameter class. Through model comparisons in the short-term, we found that average stand basal area (B) predicted by three matrix models all fell within the 95% confidence interval of observed values. The three matrix models were based on (i) only field inventory variables (inventory), (ii) LiDAR and Landsat-derived metrics combined with field inventory variables (LiDAR + Landsat + inventory), and (iii) only Landsat-derived metrics combined with field inventory variables (Landsat + inventory), respectively. In the long term, predicted AGB using LiDAR + Landsat + inventory and Landsat + inventory variables had similar AGB patterns (differences within 7.2 Mg ha−1) to those predicted by matrix models with only inventory variables from 2015–2045. When considering uncertainty derived from fuzzy sets all three matrix models had similar AGBs (differences within 7.6 Mg ha−1) by the year 2045. Therefore, the use of matrix models enabled various combinations of LiDAR, Landsat, and field data, especially Landsat data, to estimate large-scale AGB dynamics*

(i.e. central component of carbon stock monitoring) without loss of accuracy from only using variables from forest inventories. These findings suggest that the use of Landsat data alone incorporating elevation (E), plot slope (S) and aspect (A), and site productivity (C) could produce suitable estimation of AGB dynamics (ranging from 67.1–105.5 Mg ha−1 in 2045) to actual AGB dynamics using matrix models. Such a framework may afford refined monitoring and estimation of terrestrial carbon stocks and stock changes from spatially explicit to spatially explicit and spatially continuous estimates and also provide temporal flexibility and continuity with the Landsat time series.

Ma, W., Woodall, C. W., Domke, G. M., D'amato, A. W., & Walters, B. F. (2018). Stand age versus tree diameter as a driver of forest carbon inventory simulations in the northeastern U.S. *Canadian Journal of Forest Research, 48*(10), 1135-1147. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053940793&doi=10.1139%2fcjfr-2018-0019&partnerID=40&md5=099ca5f9b10959238c7ae4552ec5bb92. doi:10.1139/cjfr-2018-0019

Research Tags: Forestry, Research

Abstract: *Estimating the current status and future trends of carbon (C) stocks and stock changes in forests of the northeastern United States is desired by policy makers and managers as these forests can mitigate climate change through sequestration of atmospheric carbon dioxide (CO2). We developed C flux matrix models using tree and stand variables by tree diameter class and stand age class to compare size-structured models with age-structured models in their capacity to predict forest C dynamics that are central to policy decisions. The primary control variables for the C flux matrix models (diameter at breast height, stand basal area, stem density, and stand age) were all statistically significant at the α ≤ 0.05 level. Through comparing the simulation results and root mean square error of C flux matrix models by tree diameter class and stand age class, we found that tree diameter class more accurately predicted C stock change status across the broad compositional and structural conditions in the spatial and temporal domain. An uncertainty analysis revealed that predictions of aboveground C and soil C would be distinctively different whether using tree diameter class or stand age class with high certainty. Overall, this work may enable better integration of forest inventory data and remotely sensed data for the purpose of strategic-scale forest C dynamic simulations.*

Ma, W., Zhou, X., Liang, J., & Zhou, M. (2019). Coastal Alaska forests under climate change: What to expect? *Forest Ecology and Management, 448*, 432-444. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068512712&doi=10.1016%2fj.foreco.2019.06.030&partnerID=40&md5=579f71b2f5f0cbc8654a670e687a9469. doi:10.1016/j.foreco.2019.06.030

Research Tags: Forestry

Abstract: *Coastal Alaska forests consist of 2.6 million hectares of productive timberland and constitute the largest terrestrial carbon reservoir in the state. It has become increasingly urgent to understand potential climate-induced changes in forest structural and species composition in this region. Based on in situ data from 544 permanent sample plots (PSPs) for calibration and 244 PSPs for validation, we developed a climate-sensitive density-dependent, species-, and size-specific matrix model (CSMatrix-AK), to predict fine-scale dynamics of coastal Alaska forests from the present to Year 2100 under three climate scenarios – Representative Concentration Pathway (RCP) 4.5, RCP6.0, and RCP8.5. With post-sample validation, we showed that the CSMatrix-AK model was more accurate than other existing models for the region. Under low-intensity and high-frequency stochastic shocks which represented natural disturbances typical for the region, we projected a gradual decline of Sitka spruce, a major commercial species in the region, and a significantly lower level of total stand basal area under all three climate scenarios. The results suggest that timber industry, landowners and managers, policymakers, and local communities will need to prepare for substantial impacts of climate change on Coastal Alaska forests and the regional forestry sector. Our CSMatrix-AK model provides a useful tool to better inform the stakeholders of such changes and lays the foundation for adaptive forest management to sustain forests and associated ecosystem services in the region.*

Maaz, T., Wulfhorst, J. D., McCracken, V., Kirkegaard, J., Huggins, D. R., Roth, I., . . . Pan, W. (2018). Economic, policy, and social trends and challenges of introducing oilseed and pulse crops into dryland wheat cropping systems. *Agriculture, Ecosystems and Environment, 253*, 177-194. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017432465&doi=10.1016%2fj.agee.2017.03.018&p

artnerID=40&md5=da2dbcf76cf0f309f3611a6ee2fc11f9. doi:10.1016/j.agee.2017.03.018
Research Tags:
Abstract:

Maaz, T. M., Schillinger, W. F., Machado, S., Brooks, E., Johnson-Maynard, J. L., Young, L. E., . . . Pan, W. L. (2017). Impact of climate change adaptation strategies on winter wheat and cropping system performance across precipitation gradients in the Inland Pacific Northwest, USA. *Frontiers in Environmental Science, 5*(MAY). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026801524&doi=10.3389%2ffenvs.2017.00023&partnerID=40&md5=f51856968f95b6b936f4d6722b9e870c. doi:10.3389/fenvs.2017.00023
Research Tags: Weather, Crops
Abstract: *The productivity of semi-arid, cereal-based agroecosystems is inherently limited by water and nutrient availability, with water limitations expected to be exacerbated by climate change. While previous studies have identified agronomic, economic, and environmental benefits of rotating oilseed, pulse, and cover crops with cereals for mitigating the effects of increasing temperatures and water shortages, the successful integration of alternative crops into cereal based systems is contingent upon economic, social, and policy conditions. This paper analyses the historical spatial and temporal trends in crop diversification in three distinct cropping regions, including the Canadian prairies, Australian wheat belt, and the inland Pacific Northwest USA (iPNW). The first objective was to identify key sociological, economic, and policy drivers that corresponded with historical crop intensification and diversification in Canada and Australia over the last 50 years. The second objective was to identify key economic, policy, and social constraints that have historically limited intensification and diversification in the iPNW, a cereal-dominated region. In Canada and Australia, public policy played a critical role in the adoption of alternative crops through investments in research and boundary-spanning agencies, as well as extension and grower-led efforts. Policies also provided incentives for market development and risk management strategies. Grower perceptions of risk, the ability to utilize existing resources and knowledge, and access to markets were important social considerations for crop diversification. Given the competitiveness of wheat in the iPNW, the largest opportunities for diversification in the iPNW would be provided by (1) the adoption of a crop rotation approach to the economics that capture relative commodity prices, yield stability, and the effects of alternative crops on subsequent wheat performance, (2) the transition away from coupled crop insurance to income-supported, whole farm risk management, and (3) the establishment of multi-commodity groups that replace single crop commodity commissions in the interest of market-driven crop diversification.*

Macdonald, D. W., Bothwell, H. M., Kaszta, Ż., Ash, E., Bolongon, G., Burnham, D., . . . Cushman, S. A. (2019). Multi-scale habitat modelling identifies spatial conservation priorities for mainland clouded leopards (Neofelis nebulosa). *Diversity and Distributions*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069858913&doi=10.1111%2fddi.12967&partnerID=40&md5=5f7adca6d8faa85af2ec88a1a408fbb8. doi:10.1111/ddi.12967
Research Tags: Weather, Wildlife
Abstract: *Aim*
Deforestation is rapidly altering Southeast Asian landscapes, resulting in some of the highest rates of habitat loss worldwide. Among the many species facing declines in this region, clouded leopards rank notably for their ambassadorial potential and capacity to act as powerful levers for broader forest conservation programmes. Thus, identifying core habitat and conservation opportunities are critical for curbing further Neofelis declines and extending umbrella protection for diverse forest biota similarly threatened by widespread habitat loss. Furthermore, a recent comprehensive habitat assessment of Sunda clouded leopards (N. diardi) highlights the lack of such information for the mainland species (N. nebulosa) and facilitates a comparative assessment.
Location
Southeast Asia.
Methods
Species–habitat relationships are scale-dependent, yet <5% of all recent habitat modelling papers apply robust approaches to optimize multivariate scale relationships. Using one of the largest camera trap datasets ever collected, we developed scale-optimized species distribution models for two con-generic carnivores, and

quantitatively compared their habitat niches.
Results
We identified core habitat, connectivity corridors, and ranked remaining habitat patches for conservation prioritization. Closed-canopy forest was the strongest predictor, with ~25% lower Neofelis detections when forest cover declined from 100 to 65%. A strong, positive association with increasing precipitation suggests ongoing climate change as a growing threat along drier edges of the species' range. While deforestation and land use conversion were deleterious for both species, N. nebulosa was uniquely associated with shrublands and grasslands. We identified 800 km2 as a minimum patch size for supporting clouded leopard conservation.
Main conclusions
We illustrate the utility of multi-scale modelling for identifying key habitat requirements, optimal scales of use and critical targets for guiding conservation prioritization. Curbing deforestation and development within remaining core habitat and dispersal corridors, particularly in Myanmar, Laos and Malaysia, is critical for supporting evolutionary potential of clouded leopards and conservation of associated forest biodiversity.

Macintosh, K. A., Doody, D. G., Withers, P. J. A., McDowell, R. W., Smith, D. R., Johnson, L. T., . . . McGrath, J. W. (2019). Transforming soil phosphorus fertility management strategies to support the delivery of multiple ecosystem services from agricultural systems. *Science of the Total Environment, 649*, 90-98. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052483409&doi=10.1016%2fj.scitotenv.2018.08.272&partnerID=40&md5=a40c806513f14dff99afb478131dd39c. doi:10.1016/j.scitotenv.2018.08.272
Research Tags: Soil, Crops
Abstract: *Despite greater emphasis on holistic phosphorus (P) management, current nutrient advice delivered at farm-scale still focuses almost exclusively on agricultural production. This limits our ability to address national and international strategies for the delivery of multiple ecosystem services (ES). Currently there is no operational framework in place to manage P fertility for multiple ES delivery and to identify the costs of potentially sacrificing crop yield and/or quality. As soil P fertility plays a central role in ES delivery, we argue that soil test phosphorus (STP) concentration provides a suitable common unit of measure by which delivering multiple ES can be economically valued relative to maximum potential yield, in \$ ha−1 yr−1 units. This value can then be traded, or payments made against one another, at spatio-temporal scales relevant for farmer and national policy objectives. Implementation of this framework into current P fertility management strategies would allow for the integration and interaction of different stakeholder interests in ES delivery on-farm and in the wider landscape. Further progress in biophysical modeling of soil P dynamics is needed to inform its adoption across diverse landscapes.*

Maclachlan, N. J., Zientara, S., Wilson, W. C., Richt, J. A., & Savini, G. (2019). Bluetongue and epizootic hemorrhagic disease viruses: recent developments with these globally re-emerging arboviral infections of ruminants. *Current Opinion in Virology, 34*, 56-62. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059863871&doi=10.1016%2fj.coviro.2018.12.005&partnerID=40&md5=7fc2515d63ac9675d6abce7f95d357c0. doi:10.1016/j.coviro.2018.12.005
Research Tags: Livestock
Abstract: *Bluetongue (BT) and epizootic hemorrhagic disease (EHD) are globally re-emerging diseases of domestic and wild ruminants, respectively caused by BT virus (BTV) and EHD virus. Both viruses are transmitted by hematophagous midges; however, newly recognized BTV serotypes may be transmitted horizontally without requirement for any biological vector. The global range of these viruses and/or their associated diseases have changed remarkably in recent years, most notably with the invasion of Europe by multiple serotypes of BTV since 1998. Although not zoonoses, the unanticipated emergence of BT and EHD in several different areas of the world provides a uniquely sobering and unambiguous reminder of the potential consequences of climate change on the distribution and severity of vector-borne diseases. Recent experiences with these viruses have also emphasized the need for effective, DIVA-compatible vaccines to combat anticipated future incursions, as existing vaccines have serious inherent deficiencies.*

Magarey, R., Newton, L., Hong, S. C., Takeuchi, Y., Christie, D., Jarnevich, C. S., . . . Koop, A. L. (2018). Comparison of four modeling tools for the prediction of potential distribution for non-indigenous weeds in the United States. *Biological Invasions, 20*(3), 679-694. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029595135&doi=10.1007%2fs10530-017-1567-1&partnerID=40&md5=4f72d13b35dce413dbc17f9db97cf510. doi:10.1007/s10530-017-1567-1
Research Tags: Research
Abstract: *This study compares four models for predicting the potential distribution of non-indigenous weed species in the conterminous U.S. The comparison focused on evaluating modeling tools and protocols as currently used for weed risk assessment or for predicting the potential distribution of invasive weeds. We used six weed species (three highly invasive and three less invasive non-indigenous species) that have been established in the U.S. for more than 75 years. The experiment involved providing non-U. S. location data to users familiar with one of the four evaluated techniques, who then developed predictive models that were applied to the United States without knowing the identity of the species or its U.S. distribution. We compared a simple GIS climate matching technique known as Proto3, a simple climate matching tool CLIMEX Match Climates, the correlative model MaxEnt, and a process model known as the Thornley Transport Resistance (TTR) model. Two experienced users ran each modeling tool except TTR, which had one user. Models were trained with global species distribution data excluding any U.S. data, and then were evaluated using the current known U.S. distribution. The influence of weed species identity and modeling tool on prevalence and sensitivity effects was compared using a generalized linear mixed model. Each modeling tool itself had a low statistical significance, while weed species alone accounted for 69.1 and 48.5% of the variance for prevalence and sensitivity, respectively. These results suggest that simple modeling tools might perform as well as complex ones in the case of predicting potential distribution for a weed not yet present in the United States. Considerations of model accuracy should also be balanced with those of reproducibility and ease of use. More important than the choice of modeling tool is the construction of robust protocols and testing both new and experienced users under blind test conditions that approximate operational conditions.*

Magee, M. R., Hein, C. L., Walsh, J. R., Shannon, P. D., Vander Zanden, M. J., Campbell, T. B., . . . Janowiak, M. K. (2019). Scientific advances and adaptation strategies for Wisconsin lakes facing climate change. *Lake and Reservoir Management*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067891014&doi=10.1080%2f10402381.2019.1622612&partnerID=40&md5=09bcb24d27cd796f7e03fcc8e2e3bcda. doi:10.1080/10402381.2019.1622612
Research Tags: Water
Abstract: *Climate change threatens inland lakes, which are highly valued for their ecological and economic benefits. Here, we synthesize adaptation strategies that could offset climate impacts on Midwestern lakes. Our synthesis is based on results from the Wisconsin Initiative on Climate Change Impacts lake adaptation workshop, in which 48 researchers and managers with expertise on Wisconsin's inland lakes gathered to provide input on climate adaptation strategies. We identified recent scientific advances, knowledge gaps, and examples of successful climate adaptation strategies with respect to four key themes: lake levels, water quality, aquatic invasive species, and fisheries. While adaptation strategies for each theme differed, there was consensus around the need for a multifaceted approach that incorporates communication and outreach, policy and regulation changes, traditional resource conservation approaches, and novel engineering designs. Managers should focus on protecting high-quality lakes, building lake resilience, and retaining beneficial ecosystem services. Most importantly, thoughtful and strategic interactions with stakeholders, policymakers, and researchers across multiple disciplines will be key to implementing climate adaptation strategies.*

Maguire, K. C., Shinneman, D. J., Potter, K. M., & Hipkins, V. D. (2018). Intraspecific niche models for ponderosa pine (Pinus ponderosa) suggest potential variability in population-level response to climate change. *Systematic Biology, 67*(6), 958-978. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055080448&doi=10.1093%2fsysbio%2fsyy017&partnerID=40&md5=6cc7cdcebedab40c0c6874fd30b485bb. doi:10.1093/sysbio/syy017
Research Tags: Forestry, Weather
Abstract: *Unique responses to climate change can occur across intraspecific levels, resulting in individualistic adaptation or movement patterns among populations within a given species. Thus, the need to model potential responses among genetically distinct populations within a species is increasingly recognized. However, predictive models of future distributions are regularly fit at the species level, often because intraspecific variation is unknown or is identified only within limited sample locations. In this study, we considered the role*

of intraspecific variation to shape the geographic distribution of ponderosa pine (Pinus ponderosa), an ecologically and economically important tree species in North America. Morphological and genetic variation across the distribution of ponderosa pine suggest the need to model intraspecific populations: the two varieties (var. ponderosa and var. scopulorum) and several haplotype groups within each variety have been shown to occupy unique climatic niches, suggesting populations have distinct evolutionary lineages adapted to different environmental conditions. We utilized a recently available, geographically widespread dataset of intraspecific variation (haplotypes) for ponderosa pine and a recently devised lineage distance modeling approach to derive additional, likely intraspecific occurrence locations. We confirmed the relative uniqueness of each haplotype-climate relationship using a niche-overlap analysis, and developed ecological niche models (ENMs) to project the distribution for two varieties and eight haplotypes under future climate forecasts. Future projections of haplotype niche distributions generally revealed greater potential range loss than predicted for the varieties. This difference may reflect intraspecific responses of distinct evolutionary lineages. However, directional trends are generally consistent across intraspecific levels, and include a loss of distributional area and an upward shift in elevation. Our results demonstrate the utility in modeling intraspecific response to changing climate and they inform management and conservation strategies, by identifying haplotypes and geographic areas that may be most at risk, or most secure, under projected climate change.

Mahalingam, R. (2017). Phenotypic, physiological and malt quality analyses of US barley varieties subjected to short periods of heat and drought stress. *Journal of Cereal Science, 76*, 199-205. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021371886&doi=10.1016%2fj.jcs.2017.06.007&partnerID=40&md5=e85abb901a98716cb1b8d064f46fed0e. doi:10.1016/j.jcs.2017.06.007

Research Tags: Crops, Weather

Abstract: *Drought and heat are major abiotic stresses that significantly reduce crop yield and seed quality. In this study, we examined the impact of heat, drought and combined effect of heat and drought stress imposed during the grain filling stage in 18 US spring barley varieties. These impacts were assessed based on dry biomass, seed yield and six important malting quality traits, namely, beta-glucan, free amino nitrogen, soluble protein, refractive index, diastatic power and alpha-amylase activity. Singly applied heat or drought stress evoked a diverse set of responses among these varieties with respect to biomass, seed yield and malt quality traits suggesting these varieties can be exploited for enhancing barley production based on local conditions. Majority of the tested varieties performed poorly with reference to seed yield when the stresses were applied in combination, suggesting a lack of genetic diversity in the currently grown spring barley varieties to overcome co-occurring episodic drought and heat regimes, especially during heading stages. In the wake of global climate change, enhancing adaptive capacity of barley varieties by introducing novel germplasm into breeding programs or via new technologies is vital to sustain US barley production and meet the demands of the rapidly growing brewing industry.*

Mahalingam, R., & Bregitzer, P. (2019). Impact on physiology and malting quality of barley exposed to heat, drought and their combination during different growth stages under controlled environment. *Physiologia Plantarum, 165*(2), 277-289. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055046202&doi=10.1111%2fppl.12841&partnerID=40&md5=ba7dbcd90c5c2a87648f45e1fc70fe1c. doi:10.1111/ppl.12841

Research Tags: Crops, Weather

Abstract: *Drought and heat stress are two major abiotic stresses that tend to co-occur in nature. Recent climate change models predict that the frequency and duration of periods of high temperatures and moisture-deficits are on the rise and can be detrimental to crop production and hence a serious threat for global food security. In this study we examined the impact of short-term heat, drought and combined heat and drought stress on four barley varieties. These stresses were applied during vegetative stage or during heading stages. The impact on root and shoot biomass as well as seed yields were analyzed. This study demonstrated that sensitivity to combined stress was generally greater than heat or drought individually, and greater when imposed at heading than at the vegetative stages. Micromalted seeds collected from plants stressed during heading showed differences in malt extract, beta-glucan content and percent soluble protein. Screening barley germplasm during heading stage is recommended to identify novel sources of tolerance to combined stress. Apart from seed yield, assessing the seed quality traits of concern for the stakeholders and/or consumers should* *be an integral part of breeding programs for developing new barley varieties with improved heat and drought stress tolerance.*

Mahat, V., Ramírez, J. A., & Brown, T. C. (2017). Twenty-First-Century climate in CMIP5 simulations: Implications for snow and water yield across the contiguous United States. *Journal of Hydrometeorology, 18*(8), 2079-2099. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027984265&doi=10.1175%2fJHM-D-16-0098.1&partnerID=40&md5=9f4a5cbe9a7df532aef0f672f432ccbe. doi:10.1175/JHM-D-16-0098.1
Research Tags: Weather, Water
Abstract: *For 14 alternative climate futures, water yield and snow water equivalent (SWE) throughout the contiguous United States (CONUS) were projected over the twenty-first century using the Variable Infiltration Capacity model (VIC). The futures correspond to climate projections from seven CMIP5 models each forced by two representative concentration pathways for greenhouse gases (RCP4.5 and RCP8.5). With both RCPs, decreases in water yields are projected for roughly two-thirds of the CONUS, and in 60% of that area—mainly at more northern latitudes, where the greatest temperature increases are expected—this occurs despite projected increases in precipitation. The greatest relative decreases in yield are projected for the southern Great Plains and the Southwest, where temperature and precipitation changes combine to decrease yield. Snow accumulation is projected to decrease almost everywhere by the latter half of the century, with the time of peak SWE in some basins projected to occur up to 2 months earlier than it now does. These changes, should they come to pass, will challenge the adaptation capacity of future water management.*

Maietta, C. E., Bernstein, Z. A., Gaimaro, J. R., Buyer, J. S., Rabenhorst, M. C., Monsaint-Queeney, V. L., . . . Yarwood, S. A. (2019). Aggregation but not organo-metal complexes contributed to C storage in tidal freshwater wetland soils. *Soil Science Society of America Journal, 83*(1), 252-265. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062167602&doi=10.2136%2fsssaj2018.05.0199&partnerID=40&md5=840400e49fafc7ee8c303b8717939bab. doi:10.2136/sssaj2018.05.0199
Research Tags: Water, Soils
Abstract: *One of the many goals of wetland restoration is to promote the long-term storage of carbon (C) in the terrestrial biosphere. Unfortunately, soil C reservoirs in restored wetlands are slow to accumulate even after hydrology and plant communities are reestablished. Oftentimes wetland restoration changes the soil matrix and thus can dramatically alter how soil C is stored and processed. Our research investigated whether soil organic matter (SOM) preservation theories derived from studies in non-wetland soil systems can be extended to wetland soils. We examined C associated with water-stable soil aggregates, minerals, and metal oxides within habitats of one natural and one restored tidal freshwater wetland. This study revealed that a majority of the soil C in the natural site was associated with large macroaggregates (>2000 μm), and soils from the restored site stored more C in small macroaggregates (≥250 to <2000 μm). Despite these different associations, the chemical composition of SOM followed similar patterns across each aggregate-size class. Results from the sequential extraction procedure suggest organo-metal oxide complexes do not contribute to C stabilization in these habitats. This research is one of the few studies that have examined C stabilization related to soil structure in wetland soils. Our results suggest soil aggregate formation may be an important mechanism driving C stabilization, and that disruption to macroaggregates may limit C accumulation in restored wetlands. Additional empirical research and long-term field monitoring are needed to confirm linkages between aggregate-C stabilization and accumulation in wetland soils.*

Maiorano, A., Martre, P., Asseng, S., Ewert, F., Müller, C., Rötter, R. P., . . . Zhu, Y. (2017). Crop model improvement reduces the uncertainty of the response to temperature of multi-model ensembles. *Field Crops Research, 202*, 5-20. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84971612306&doi=10.1016%2fj.fcr.2016.05.001&partnerID=40&md5=f3fff39364f2bb5798e69d68ecf12e5e. doi:10.1016/j.fcr.2016.05.001
Research Tags: Crops, Weather
Abstract: *To improve climate change impact estimates and to quantify their uncertainty, multi-model ensembles (MMEs) have been suggested. Model improvements can improve the accuracy of simulations and reduce the uncertainty of climate change impact assessments. Furthermore, they can reduce the number of*

models needed in a MME. Herein, 15 wheat growth models of a larger MME were improved through re-parameterization and/or incorporating or modifying heat stress effects on phenology, leaf growth and senescence, biomass growth, and grain number and size using detailed field experimental data from the USDA Hot Serial Cereal experiment (calibration data set). Simulation results from before and after model improvement were then evaluated with independent field experiments from a CIMMYT world-wide field trial network (evaluation data set). Model improvements decreased the variation (10th to 90th model ensemble percentile range) of grain yields simulated by the MME on average by 39% in the calibration data set and by 26% in the independent evaluation data set for crops grown in mean seasonal temperatures >24 °C. MME mean squared error in simulating grain yield decreased by 37%. A reduction in MME uncertainty range by 27% increased MME prediction skills by 47%. Results suggest that the mean level of variation observed in field experiments and used as a benchmark can be reached with half the number of models in the MME. Improving crop models is therefore important to increase the certainty of model-based impact assessments and allow more practical, i.e. smaller MMEs to be used effectively.

Maleski, J. J., Bosch, D. D., Anderson, R. G., Coffin, A. W., Anderson, W. F., & Strickland, T. C. (2019). Evaluation of miscanthus productivity and water use efficiency in southeastern United States. *Science of the Total Environment, 692*, 1125-1134. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069750668&doi=10.1016%2fj.scitotenv.2019.07.128&partnerID=40&md5=4e12517429ae80b02ad88dca92edd8a4. doi:10.1016/j.scitotenv.2019.07.128

Research Tags: Energy, Crops, Grassland

Abstract: *Second generation biofuels, such as perennial grasses, have potential to provide biofuel feedstock while growing on degraded land with minimal inputs. Perennial grasses have been reported to sequester large amounts of soil organic carbon (SOC) in the Midwestern United States (USA). However, there has been little work on biofuel and carbon sequestration potential of perennial grasses in the Southeastern US. Biofuel productivity for dryland Miscanthus × gigantus and irrigated maize in Georgia, USA were quantified using eddy covariance observations of evapotranspiration (ET) and net ecosystem exchange (NEE) of carbon. Miscanthus biomass yield was 15.54 Mg ha−1 in 2015 and 11.80 Mg ha−1 in 2016, while maize produced 30.20 Mg ha−1 of biomass in 2016. Carbon budgets indicated that both miscanthus and maize fields lost carbon over the experiment. The miscanthus field lost 5 Mg C ha−1 in both 2015 and 2016 while the maize field lost 1.37 Mg C ha−1 for the single year of study. Eddy covariance measurement indicated that for 2016 the miscanthus crop evapotranspired 598 mm and harvest water use efficiencies ranged from 6.95 to 13.84 kg C ha−1 mm−1. Maize evapotranspired 659 mm with a harvest water use efficiency of 19.12 kg C ha−1 mm−1. While biomass yields and gross primary production were relatively high, high ecosystem respiration rates resulted in a loss of ecosystem carbon. Relatively low biomass production, low water use efficiency and high respiration for Miscanthus × gigantus in this experiment suggest that this strain of miscanthus may not be well-suited for dryland production under the environmental conditions found in South Georgia USA.*

Malone, S. L., Schoettle, A. W., & Coop, J. D. (2018). The future of subalpine forests in the Southern rocky mountains: Trajectories for Pinus aristata genetic lineages. *PLoS ONE, 13*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044226562&doi=10.1371%2fjournal.pone.0193481&partnerID=40&md5=9d2b5c945a7937ebaa2278ca5dac59e2. doi:10.1371/journal.pone.0193481

Research Tags: Forestry

Abstract: *Like many other high elevation alpine tree species, Rocky Mountain bristlecone pine (Pinus aristata Engelm.) may be particularly vulnerable to climate change. To evaluate its potential vulnerability to shifts in climate, we defined the suitable climate space for each of four genetic lineages of bristlecone pine and for other subalpine tree species in close proximity to bristlecone pine forests. Measuring changes in the suitable climate space for lineage groups is an important step beyond models that assume species are genetically homogenous. The suitable climate space for bristlecone pine in the year 2090 is projected to decline by 74% and the proportional distribution of suitable climate space for genetic lineages shifts toward those associated with warmer and wetter conditions. The 2090 climate space for bristlecone pine exhibits a bimodal distribution along an elevation gradient, presumably due to the persistence of the climate space in the Southern Rocky Mountains and exclusion at mid-elevations by conditions that favor the climate space of other species. These shifts have implications for changes in fire regimes, vulnerability to pest and pathogens, and altered carbon* *dynamics across the southern Rockies, which may reduce the likelihood of bristlecone pine trees achieving exceptional longevity in the future. The persistence and expansion of climate space for southern bristlecone pine genetic lineage groups in 2090 suggests that these sources may be the least vulnerable in the future. While these lineages may be more likely to persist and therefore present opportunities for proactive management (e.g., assisted migration) to maintain subalpine forest ecosystem services in a warmer world, our findings also imply heighted conservation concern for vulnerable northern lineages facing range contractions.*

Manter, D. K., Delgado, J. A., Blackburn, H. D., Harmel, D., De León, A. A. P., & Honeycutt, C. W. (2017). Why we need a national living soil repository. *Proceedings of the National Academy of Sciences of the United States of America, 114*(52), 13587-13590. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039712244&doi=10.1073%2fpnas.1720262115&partnerID=40&md5=222695758f10624cf541e4b371621a1d. doi:10.1073/pnas.1720262115
Research Tags: Soil
Abstract: *Soils are the keystone of healthy and vibrant ecosystems, providing physical, chemical, and biological substrates and functions necessary to support life. In particular, it's the extensive and elaborate matrix of soil microorganisms and other life forms that contributes to soil health and utility.*
But soils are under constant threat from heavy use, changing climate, and in some cases poor management (1, 2). In view of soil's key role and threatened status, we believe that there is a need for the scientific community to undertake coordinated research and development efforts that will lead to a unique asset: a National Living Soil Repository (Fig. 1).
Already local and national soil archives have been shown to be of great utility for studying, analyzing, and documenting long-term environmental and ecological trends. For example, the historical soil archive at Hubbard Brook helped researchers discover the link between fossil fuels and acidification of rain and snow (3); the Rothamsted Sample Archive in the United Kingdom has shown a steady increase in dioxins during the last century (4). And yet, a soil repository/archive designed to preserve native biological diversity does not currently exist.
Such an archive would provide the ability to acquire data on the current biological (e.g., soil health) state of soils around the country across soil types, cropping systems, and ecosystems and over time. Further, by maintaining soil archives and a catalog of their microbial communities, we will gain a better understanding of how soil organisms are distributed throughout the world, which could provide valuable insight into limitations on crop survival and production as new soils and/or locations are cultivated.

Marcos-Martinez, R., Bryan, B. A., Schwabe, K. A., Connor, J. D., Law, E. A., Nolan, M., & Sánchez, J. J. (2019). Projected social costs of CO <inf>2</inf> emissions from forest losses far exceed the sequestration benefits of forest gains under global change. *Ecosystem Services, 37*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065539757&doi=10.1016%2fj.ecoser.2019.100935&partnerID=40&md5=3940ec02573fce7dc227dee0b3199033. doi:10.1016/j.ecoser.2019.100935
Research Tags: Forestry, Emissions
Abstract: *Forest cover gains and losses occur in response to complex environmental and anthropogenic pressures. Yet the impact of forest gains and losses on the provision of ecosystem services differs markedly. Here we investigate the social costs of potential forest carbon change in Australia's intensive agricultural region from 2015 to 2050 using spatial forest cover change and forest carbon models combined with climate and socioeconomic projections. More than 24,000 possible scenarios were used to identify the trend and lower and upper bounds of forest cover/carbon change. Net deforestation (3.5 million hectares, Mha) under the lower bound forest cover (LBFC) projection was around one-third less than net reforestation (4.8 Mha) under the upper bound forest cover (UBFC) projection by 2030. However, the CO2 emissions (1.3 Gigatons of CO2, GtCO2) from deforestation were more than double the sequestration (0.5 GtCO2) from reforestation. The social costs (up to 134 billion dollars) of the LBFC were almost five times the benefits of the UBFC (up to 28 billion dollars). The asymmetry decreased over time but persisted to 2050. This shows the markedly different social costs of potential forest carbon losses and gains under global change, evidence which can be useful to policymakers, stakeholders, and practitioners.*

Mariano, D. A., Santos, C. A. C. D., Wardlow, B. D., Anderson, M. C., Schiltmeyer, A. V., Tadesse, T., & Svoboda, M. D.

(2018). Use of remote sensing indicators to assess effects of drought and human-induced land degradation on ecosystem health in Northeastern Brazil. *Remote Sensing of Environment, 213*, 129-143. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047087437&doi=10.1016%2fj.rse.2018.04.048&partnerID=40&md5=d6162e853a14be7319da742adec240d2. doi:10.1016/j.rse.2018.04.048
Research Tags: Weather
Abstract: *Land degradation (LD) is one of the most catastrophic outcomes of long-lasting drought events and anthropogenic activities. Assessing climate and human-induced impacts on land can provide information for decision makers to mitigate the effects of these phenomena. The Northeastern region of Brazil (NEB) is the most populous dryland on the planet, making it a highly vulnerable ecosystem especially when considering the lingering drought that started in 2012. The present work consisted of detecting trends in biomass [leaf area index (LAI)] anomalies as indicators of LD in NEB. We also assessed how the loss of vegetation impacts the LD cycle, by measuring trends in albedo and evapotranspiration (ET). LAI, albedo and ET data were derived from MODIS sensors at 8-day temporal and 500 m spatial resolutions. For precipitation anomalies, we relied on CHIRPS-v2 10-day temporal at 5 km spatial resolution data. For detecting trends, we applied the Theil-Sen slope analysis on time series of MODIS LAI, albedo and ET images. Trend analysis was performed for the periods ranging from 2002–2012 (no severe droughts) to 2002–2016 (including the last drought). LAI trends were more pronounced and had a stronger signal than ET and albedo, therefore, LAI was our choice for mapping LD. The first analysis highlighted the human-induced LD prone areas whereas the last detected drought-induced LD prone areas. Considering only the trending areas, which was about 23.4% of the total, 4.5% of this area has undergone human-induced degradation whereas drought was responsible for 73%, although, not mutually exclusive. As reported in the literature and official data, grazing intensification might be a factor driving human-induced degradation. We noticed that the range of variation of LAI is narrow and even narrower for albedo, which demonstrates that land surface response is more influenced by soil reflectivity rather than the characteristic sparse vegetation coverage (LAI ranging from 0.04 to 0.4 in the Caatinga biome), which can barely alter albedo. Finally, the effects of LD on ET anomalies were assessed by Granger causality and impulse-response analyses as means to link land surface feature changes to the hydrological cycle. Albedo had a slightly weaker impulse than LAI on ET whereas precipitation played a major role. These relations are site-specific and, land surface features (biomass and albedo) showed to have a more substantial influence on ET in severely degraded areas. We concluded that drought led to trends indicating LD prone areas in NEB and the degradation cycle has positive feedback derived from ET reduction resulting in an increased net moisture deficit, although the latter statement has yet to be further investigated. The study warns of the desertification risk that NEB is facing and the need for the authorities to take action to mitigate degradation and drought effects on both traditionally surveyed (desertification nuclei) and newfound LD prone areas. We also highlight the limitation of confirming LD, as to date there is no post-drought data available and, lessons learned from the Sahel case make us cautious about claiming that an area is in fact degraded.*

Marias, D. E., Meinzer, F. C., & Still, C. (2017). Leaf age and methodology impact assessments of thermotolerance of Coffea arabica. *Trees - Structure and Function, 31*(3), 1091-1099. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84991753345&doi=10.1007%2fs00468-016-1476-4&partnerID=40&md5=cea35debcf5753de76059b354c1642b1. doi:10.1007/s00468-016-1476-4
Research Tags: Crops, Weather
Abstract: *Given future climate predictions of increased heatwaves in the tropics, suitable habitat to grow ecologically, economically, and socially valuable Coffea arabica L. is threatened. Accurate assessments of high temperature tolerance or thermotolerance are critical for understanding C. arabica responses to increased temperature. Thermotolerance curves of C. arabica leaf discs were constructed by measuring chlorophyll fluorescence (ratio of variable to maximum fluorescence, F V/F M; minimum fluorescence, F O) across three leaf age classes and two recovery times (15 min, 24 h) after 15 min exposure to temperatures from 25 to 58 °C. Thermotolerance measured with electrolyte leakage after 20 min at 25–65 °C was compared with F V/F M thermotolerance curves. The temperature corresponding to 50 % damage (T 50) was 49.0 and 58.6 °C for the chlorophyll fluorescence and electrolyte leakage methods, respectively. The critical temperature at which the F O rise began on F O-temperature curves (T crit) was 46.0 °C. We found that the 24 h recovery time yielded more accurate estimates of T 50, and that thermotolerance based on T crit increased with leaf age. Differences between the fluorescence and electrolyte leakage methods showed that photosystem II processes were more*

sensitive to temperatures above 40 °C than cell membrane stability.

Marini, L., Økland, B., Jönsson, A. M., Bentz, B., Carroll, A., Forster, B., . . . Schroeder, M. (2017). Climate drivers of bark beetle outbreak dynamics in Norway spruce forests. *Ecography, 40*(12), 1426-1435. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012078092&doi=10.1111%2fecog.02769&partnerID=40&md5=4945830e1fe24c924a1afbc0a6d1a533. doi:10.1111/ecog.02769
Research Tags: Forestry, Wildlife
Abstract: *Bark beetles are among the most devastating biotic agents affecting forests globally and several species are expected to be favored by climate change. Given the potential interactions of insect outbreaks with other biotic and abiotic disturbances, and the potentially strong impact of changing disturbance regimes on forest resources, investigating climatic drivers of destructive bark beetle outbreaks is of paramount importance. We analyzed 17 time-series of the amount of wood damaged by Ips typographus, the most destructive pest of Norway spruce forests, collected across 8 European countries in the last three decades. We aimed to quantify the relative importance of key climate drivers in explaining timber loss dynamics, also testing for possible synergistic effects. Local outbreaks shared the same drivers, including increasing summer rainfall deficit and warm temperatures. Large availability of storm-felled trees in the previous year was also strongly related to an increase in timber loss, likely by providing an alternative source of breeding material. We did not find any positive synergy among outbreak drivers. On the contrary, the occurrence of large storms reduced the positive effect of warming temperatures and rainfall deficit. The large surplus of breeding material likely boosted I. typographus population size above the density threshold required to colonize and kill healthy trees irrespective of other climate triggers. Importantly, we found strong negative density dependence in I. typographus that may provide a mechanism for population decline after population eruptions. Generality in the effects of complex climatic events across different geographical areas suggests that the large-scale drivers can be used as early warning indicators of increasing local outbreak probability.*

Markland, S. M., Ingram, D., Kniel, K. E., & Sharma, M. (2017). Water for agriculture: The convergence of sustainability and safety. *Microbiology Spectrum, 5*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020238691&doi=10.1128%2fmicrobiolspec.PFS-0014-2016&partnerID=40&md5=9b6b2d68c0da4124030087ff788f6c47. doi:10.1128/microbiolspec.PFS-0014-2016
Research Tags: Crops, Water
Abstract: *Undoubtedly, water is one of the world's most precious commodities, and since the beginning of agriculture, irrigating crops and relocating water to hydrate livestock have been essential to sustain society. The first irrigation system is believed to have been a bucket (1) carried back and forth from a river to irrigate plants. Today, the world's most important use of water is for agriculture, more specifically for the production of crops and raising of livestock. In the United States 330 million acres of land are used for the production of food and other agricultural products (2). In 2010 alone over 126 billion gallons of water were used for irrigation, livestock, and aquaculture production, accounting for a total of 37% of total water use in the United States (3). Agriculture accounts for approximately 33% of total water use in Europe, and water use is more intensive in the southern parts of Europe, where 80% of total water consumption is for irrigation of crops (4). According to the Organization for Economic Cooperation and Development, there will be a 55% increase in the demand for water by the year 2050 due to increases in manufacturing, thermal power, and domestic industries that will put water availability for agriculture at risk (5).*

Marsberg, A., Kemler, M., Jami, F., Nagel, J. H., Postma-Smidt, A., Naidoo, S., . . . Slippers, B. (2017). Botryosphaeria dothidea: a latent pathogen of global importance to woody plant health. *Molecular Plant Pathology, 18*(4), 477-488. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006788866&doi=10.1111%2fmpp.12495&partnerID=40&md5=8e44f04c7c9f04163bd4624c34059756. doi:10.1111/mpp.12495
Research Tags: Forestry
Abstract: *Botryosphaeria dothidea is the type species of Botryosphaeria (Botryosphaeriaceae, Botryosphaeriales). Fungi residing in this order are amongst the most widespread and important canker and dieback pathogens of trees worldwide, with B. dothidea one of the most common species on a large number of*

hosts. Its taxonomic circumscription has undergone substantial change in the past decade, making it difficult to interpret the large volume of literature linked to the name B. dothidea. This pathogen profile synthesizes the current understanding of B. dothidea pertaining to its distribution, host associations and role as a pathogen in managed and natural woody environments. The prolonged latent infection or endophytic phase is of particular importance, as it implies that the fungus can easily pass undetected by quarantine systems in traded living plants, fruits and other plant parts. Infections typically become obvious only under conditions of host stress, when disease symptoms develop. This study also considers the knowledge emerging from the recently sequenced B. dothidea genome, elucidating previously unknown aspects of the species, including mating and host infection strategies. Despite more than 150 years of research on B. dothidea, there is clearly much to be learned regarding this global tree pathogen. This is increasingly important given the stresses imposed on various woody hosts as a result of climate change.

Marshall, A. M., Link, T. E., Abatzoglou, J. T., Flerchinger, G. N., Marks, D. G., & Tedrow, L. (2019). Warming Alters Hydrologic Heterogeneity: Simulated Climate Sensitivity of Hydrology-Based Microrefugia in the Snow-to-Rain Transition Zone. *Water Resources Research, 55*(3), 2122-2141. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064434088&doi=10.1029%2f2018WR023063&partnerID=40&md5=e962db874a218112bd349deed4549c8f. doi:10.1029/2018WR023063

Research Tags: Weather, Water

Abstract: *In complex terrain, drifting snow contributes to ecohydrologic landscape heterogeneity and ecological refugia. In this study, we assessed the climate sensitivity of hydrological dynamics in a semiarid mountainous catchment in the snow-to-rain transition zone. This catchment includes a distinct snow drift-subsidized refugium that comprises a small portion (14.5%) of the watershed but accounts for a disproportionate amount (modeled average 56%) of hydrological flux generation. We conducted climate sensitivity experiments using a physically based hydrologic model to assess responses of a suite of hydrologic metrics across the watershed. Experiments with an imposed 3.5 °C warming showed reductions in average maximum snow water equivalent of 58–68% and deep percolation by 72%. While relative decreases were similar across the watershed, much greater absolute decreases in snowpack occurred in the drift-subsidized site than the surrounding landscape. In drift-subsidized locations, warming caused a shift from a regime that included both energy- and water-limited evapotranspiration conditions to exclusively water-limited conditions. Warming also resulted in altered interannual variability of hydrologic metrics. The drift-subsidized unit was more sensitive to warming than the surrounding landscape, with reduced potential for the effects of warming to be offset by increased precipitation. Despite spatially homogeneous changes in climate, the effects of climate change on the hydrological dynamics were spatially heterogeneous in this watershed due to the presence of lateral water transport in the form of drifting snow. These findings suggest an increase in hydrologic homogeneity across the landscape and relatively large changes in snow drift-subsidized refugia.*

Marshall-Colon, A., Long, S. P., Allen, D. K., Allen, G., Beard, D. A., Benes, B., . . . Zhu, X. G. (2017). Crops in silico: Generating virtual crops using an integrative and multi-scale modeling platform. *Frontiers in Plant Science, 8*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021119584&doi=10.3389%2ffpls.2017.00786&partnerID=40&md5=7df67f95588eae65401e58c876dea613. doi:10.3389/fpls.2017.00786

Research Tags: Crops, Research

Abstract: *Multi-scale models can facilitate whole plant simulations by linking gene networks, protein synthesis, metabolic pathways, physiology, and growth. Whole plant models can be further integrated with ecosystem, weather, and climate models to predict how various interactions respond to environmental perturbations. These models have the potential to fill in missing mechanistic details and generate new hypotheses to prioritize directed engineering efforts. Outcomes will potentially accelerate improvement of crop yield, sustainability, and increase future food security. It is time for a paradigm shift in plant modeling, from largely isolated efforts to a connected community that takes advantage of advances in high performance computing and mechanistic understanding of plant processes. Tools for guiding future crop breeding and engineering, understanding the implications of discoveries at the molecular level for whole plant behavior, and improved prediction of plant and ecosystem responses to the environment are urgently needed. The purpose of this perspective is to introduce Crops in silico (cropsinsilico.org), an integrative and multi-scale modeling platform, as one solution* *that combines isolated modeling efforts toward the generation of virtual crops, which is open and accessible to the entire plant biology community. The major challenges involved both in the development and deployment of a shared, multi-scale modeling platform, which are summarized in this prospectus, were recently identified during the first Crops in silico Symposium and Workshop.*

Martin, E. A., Davis, M. P., Moorman, T. B., Isenhart, T. M., & Soupir, M. L. (2019). Impact of hydraulic residence time on nitrate removal in pilot-scale woodchip bioreactors. *Journal of Environmental Management, 237*, 424-432. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062717886&doi=10.1016%2fj.jenvman.2019.01.025&partnerID=40&md5=44737579d4fd64e3d7116fa18d359cda. doi:10.1016/j.jenvman.2019.01.025
Research Tags: Water, Emissions
Abstract: *Nitrate (NO3−N) export from row crop agricultural systems with subsurface tile drainage continues to be a major water quality concern. Woodchip bioreactors are an effective edge-of-field practice designed to remove NO3−N from tile drainage. The NO3−N removal rate of woodchip bioreactors can be impacted by several factors, including hydraulic residence time (HRT). This study examined the impact of three HRTs, 2 h, 8 h, and 16 h, on NO3−N removal in a set of nine pilot-scale woodchip bioreactors in Central Iowa. NO3−N concentration reduction from the inlet to the outlet was significantly different for all HRTs (p < 0.05). The 16 h HRT removed the most NO3−N by concentration (7.5 mg L−1) and had the highest removal efficiency at 53.8%. The 8 h HRT removed an average of 5.5 mg L−1 NO3−N with a removal efficiency of 32.1%. The 2 h HRT removed an average of 1.3 mg L−1 NO3−N with a removal efficiency of 9.0%. The 2 h HRT had the highest NO3−N mass removal rate (MRR) at 9.0 g m−3 day−1, followed by the 8 h HRT at 8.5 g m−3 day−1, and the 16 h HRT at 7.4 g m−3 day−1, all of which were statistically different (p < 0.05). Significant explanatory variables for removal efficiency were HRT (p < 0.001) and influent NO3−N concentration (p < 0.001), (R2 = 0.80), with HRT accounting for 93% contribution. When paired with results from a companion study, the ideal HRT for the bioreactors was 8 h to achieve maximum NO3−N removal while reducing the impact from greenhouse gas emissions.*

Martin, K. L., Hwang, T., Vose, J. M., Coulston, J. W., Wear, D. N., Miles, B., & Band, L. E. (2017). Watershed impacts of climate and land use changes depend on magnitude and land use context. *Ecohydrology, 10*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85024122142&doi=10.1002%2feco.1870&partnerID=40&md5=b39cdb8460cbc8f7689922f440cedbd0. doi:10.1002/eco.1870
Research Tags: Water
Abstract: *Human population growth and urban development are affecting climate, land use, and the ecosystem services provided to society, including the supply of freshwater. We investigated the effects of land use and climate change on water resources in the Yadkin–Pee Dee River Basin of North Carolina, United States. Current and projected land uses were modeled at high resolution for three watersheds representing a forested to urban land use gradient by melding the National Land Cover Dataset with data from the U.S. Forest Service Forest Inventory and Analysis. Forecasts for 2051–2060 of regional land use and climate for scenarios of low (B2) and moderately high (A1B) rates of change, coupled with multiple global circulation models (MIROC, CSIRO, and Hadley), were used to inform a distributed ecohydrological model. Our results identified increases in water yields across the study watersheds, primarily due to forecasts of increased precipitation. Climate change was a more dominant factor for future water yield relative to land use change across all land uses (forested, urban, and mixed). When land use change was high (27% of forested land use was converted to urban development), it amplified the impacts of climate change on both the magnitude and timing of water yield. Our fine-scale (30-m) distributed combined modeling approach of land use and climate change identified changes in watershed hydrology at scales relevant for management, emphasizing the need for modeling efforts that integrate the effects of biophysical (climate) and social economic (land use) changes on the projection of future water resource scenarios.*

Martin, N. P., Russelle, M. P., Powell, J. M., Sniffen, C. J., Smith, S. I., Tricarico, J. M., & Grant, R. J. (2017). Invited review: Sustainable forage and grain crop production for the US dairy industry. *Journal of Dairy Science, 100*(12), 9479-9494. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030545662&doi=10.3168%2fjds.2017-13080&partnerID=40&md5=4ecbdd3742f373c2de5b01f17f78ca6e. doi:10.3168/jds.2017-13080
Research Tags: Livestock, Crops
Abstract: *A resilient US dairy industry will be underpinned by forage and crop production systems that are economically, environmentally, and socially sustainable. Land use for production of perennial and annual forages and grains for dairy cattle must evolve in response to multiple food security and environmental sustainability issues. These include increasing global populations; higher incomes and demand for dairy and other animal products; climate change with associated temperature and moisture changes; necessary reductions in carbon and water footprints; maintenance of soil quality and soil nutrient concerns; and competition for land. Likewise, maintaining producer profitability and utilizing practices accepted by consumers and society generally must also be considered. Predicted changes in climate and water availability will likely challenge current feed and dairy production systems and their national spatial distribution, particularly the western migration of dairy production in the late 20th century. To maintain and stabilize profitability while reducing carbon footprint, particularly reductions in methane emission and enhancements in soil carbon sequestration, dairy production will need to capitalize on genetic and management innovations that enhance forage and grain production and nutritive value. Improved regional and on-farm integration of feed production and manure utilization is needed to reduce environmental nitrogen and phosphorus losses and mitigate greenhouse gas emissions. Resilient and flexible feed production strategies are needed to address each of these challenges and opportunities to ensure profitable feeding of dairy cattle and a sustainable dairy industry.*

Martinez, A. J., Meddens, A. J. H., Kolden, C. A., Strand, E. K., & Hudak, A. T. (2019). Characterizing persistent unburned islands within the Inland Northwest USA. *Fire Ecology, 15*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068066006&doi=10.1186%2fs42408-019-0036-x&partnerID=40&md5=cf6f1a966ebf63299f272f83137b07cf. doi:10.1186/s42408-019-0036-x
Research Tags: Weather, Forestry
Abstract: *Background*
In the Inland Pacific Northwest of the United States, fire is a dominant driver of ecological change. Within wildfire perimeters, fire effects often vary considerably and typically include remnant patches of unburned islands. As fires reburn the landscape, some unburned islands remain persistently unburned. These persistent unburned islands can serve an important ecological function as fire refugia; however, their characteristics have not been quantified. The objective of this study was to assess the characteristics of persistent unburned islands and compare them to the burned areas that surround them. Using an existing database of unburned islands from 1984 to 2014, overlapping unburned islands were delineated. We sampled points in both persistent unburned islands and in areas burned by wildfire. At these sample points, we derived several topographical and other geospatial metrics, and we compared the characteristics of these groups. Because the study area covers many ecosystems, we stratified the analysis by different fire regime groups.
Results
Our analysis revealed that persistent unburned islands are not randomly distributed across the landscape. While the topography and vegetation fuel type that underlie persistent unburned islands differ from burned areas, these differences are dependent upon fire regime group and are less pronounced than what other studies have found. The topographic features that differed the most between persistent unburned islands and burned areas were terrain ruggedness, slope, and transformed aspect. We also found that, as unburned islands increased in persistence (i.e., remained unburned for an increasing number of overlapping fires), they decreased in size and shape complexity.
Conclusions
Our research shows that the biophysical setting underlying persistent unburned islands differs between forests and rangelands, and also differs from burned areas, which has potential applications for fire refugia prediction and management. Characterizing fire refugia and understanding the processes that contribute to their creation and maintenance will be important for land management as climate changes and increasingly large areas are affected by wildfire.

Martínez-Berdeja, A., Hamilton, J. A., Bontemps, A., Schmitt, J., & Wright, J. W. (2019). Evidence for population differentiation among Jeffrey and Ponderosa pines in survival, growth and phenology. *Forest Ecology and*

Management, 434, 40-48. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058145108&doi=10.1016%2fj.foreco.2018.12.009&partnerID=40&md5=b28e87f60b8f0d8f8641a277f08402da. doi:10.1016/j.foreco.2018.12.009
Research Tags: Forestry
Abstract: *Ecological restoration projects that include reforestation require that land managers select appropriate source of seeds for long-term persistence. In California, the standard approach for making this choice is based on seed zone and elevational band, both geographically-based measures. However, given the pace of contemporary climate change, populations previously adapted to local conditions may become increasingly mismatched to the changes in climate. If there is a lag in adaptation, current seed zones which assume local is best, would be less useful for reforestation guidelines. Here we use a historic provenance test to evaluate genetic differences among provenances of two species of pine, Pinus ponderosa and P. jeffreyi, and assess performance following seedling transfer across an elevational gradient. Growth in Ponderosa pine shows evidence of a lag in adaptation: trees transferred from lower elevations had consistently increased growth when compared to those trees from higher elevations. In contrast, Jeffrey pine showed no evidence of a lag in adaptation for height. However, survival of Jeffrey pine provenances showed a significant quadratic relationship with transfer distance, consistent with local adaptation. In particular, Jeffrey pine trees from cooler, higher elevation sites had increased survival at high elevation. Jeffrey pine trees from higher elevation also exhibited earlier bud burst than trees from lower elevation grown in the same site, consistent with counter-gradient adaptation in phenology. Together, our results show that genetic variation within species is important for tree survival, growth and phenology in different climates. However, species-specific responses to elevational transfer indicates generalizing seed transfer guidelines across conifer species may be challenging and additional information is necessary to inform managed relocation in a changing climate.*

Martins, C. S. C., Nazaries, L., Delgado-Baquerizo, M., Macdonald, C. A., Anderson, I. C., Hobbie, S. E., . . . Singh, B. K. (2017). Identifying environmental drivers of greenhouse gas emissions under warming and reduced rainfall in boreal–temperate forests. *Functional Ecology, 31*(12), 2356-2368. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026731666&doi=10.1111%2f1365-2435.12928&partnerID=40&md5=01127001e750a57eea9f913707f94e86. doi:10.1111/1365-2435.12928
Research Tags: Emissions, Weather, Forestry
Abstract: *Atmospheric concentrations of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) are predicted to increase as a consequence of fossil fuel emissions and the impact on biosphere–atmosphere interactions. Forest ecosystems in general, and forest soils in particular, can be sinks or sources for CO2, CH4, and N2O. Environmental studies traditionally target soil temperature and moisture as the main predictors of soil greenhouse gas (GHG) flux from different ecosystems; however, these emissions are primarily biologically driven. Thus, little is known about the degree of regulation by soil biotic vs. abiotic factors on GHG emissions, particularly under predicted increase in global temperatures, and changes in intensity and frequency of precipitation events.*
Here we measured net CO2, CH4 and N2O fluxes after 5 years of experimental warming (+3.4°C), and 2 years of ≈45% summer rainfall reduction, in two forest sites in a boreal–temperate ecotone under different habitat conditions (closed or open canopy) in Minnesota, USA. We evaluated the importance of microbial gene abundance and climo-edaphic factors (soil texture, canopy, seasonality, climate, and soil physicochemical properties) driving GHG emissions.
We found that changes in CO2 fluxes were predominantly determined abiotically by temperature and moisture, after accounting for bacterial abundance. Methane fluxes on the other hand, were determined both abiotically, by gas diffusivity (via soil texture) and microbially, by methanotroph pmoA gene abundance, whereas, N2O emissions showed only a strong biotic regulation via ammonia-oxidizing bacteria amoA gene abundance. Warming did not significantly alter CO2 and CH4 fluxes after 5 years of manipulation, while N2O emissions were greater with warming under open canopy.
Our findings provide evidence that soil GHG emissions result from multiple direct and indirect interactions of microbial and abiotic drivers. Overall, this study highlights the need to include both microbial and climo-edaphic properties in predictive models in order to provide improved mechanistic understanding for the development of future mitigation strategies.

Martinuzzi, S., Allstadt, A. J., Pidgeon, A. M., Flather, C. H., Jolly, W. M., & Radeloff, V. C. (2019). Future changes in fire weather, spring droughts, and false springs across U.S. National Forests and Grasslands. *Ecological Applications, 29*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068220688&doi=10.1002%2feap.1904&partnerID=40&md5=e54229e98456ccaa082cd5b8a0043ae3. doi:10.1002/eap.1904

Research Tags: Weather, Forestry, Grassland

Abstract: *Public lands provide many ecosystem services and support diverse plant and animal communities. In order to provide these benefits in the future, land managers and policy makers need information about future climate change and its potential effects. In particular, weather extremes are key drivers of wildfires, droughts, and false springs, which in turn can have large impacts on ecosystems. However, information on future changes in weather extremes on public lands is lacking. Our goal was to compare historical (1950–2005) and projected mid-century (2041–2070) changes in weather extremes (fire weather, spring droughts, and false springs) on public lands. This case study looked at the lands managed by the U.S. Forest Service across the conterminous United States including 501 ranger district units. We analyzed downscaled projections of daily records from 19 Coupled Model Intercomparison Project 5 General Circulation Models for two climate scenarios, with either medium-low or high CO2− equivalent concentration (RCPs 4.5 and 8.5). For each ranger district, we estimated: (1) fire potential, using the Keetch-Byram Drought Index; (2) frequency of spring droughts, using the Standardized Precipitation Index; and (3) frequency of false springs, using the extended Spring Indices. We found that future climates could substantially alter weather conditions across Forest Service lands. Under the two climate scenarios, increases in wildfire potential, spring droughts, and false springs were projected in 32–72%, 28–29%, and 13–16% of all ranger districts, respectively. Moreover, a substantial number of ranger districts (17–30%), especially in the Southwestern, Pacific Southwest, and Rocky Mountain regions, were projected to see increases in more than one type of weather extreme, which may require special management attention. We suggest that future changes in weather extremes could threaten the ability of public lands to provide ecosystem services and ecological benefits to society. Overall, our results highlight the value of spatially-explicit weather projections to assess future changes in key weather extremes for land managers and policy makers.*

Mason, S. A., Hamlington, P. E., Hamlington, B. D., Matt Jolly, W., & Hoffman, C. M. (2017). Effects of climate oscillations on wildland fire potential in the continental United States. *Geophysical Research Letters, 44*(13), 7002-7010. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023206170&doi=10.1002%2f2017GL074111&partnerID=40&md5=868b9b550f3d624862c596181ca4cbce. doi:10.1002/2017GL074111

Research Tags: Weather, Forestry

Abstract: *The effects of climate oscillations on spatial and temporal variations in wildland fire potential in the continental U.S. are examined from 1979 to 2015 using cyclostationary empirical orthogonal functions (CSEOFs). The CSEOF analysis isolates effects associated with the modulated annual cycle and the El Niño–Southern Oscillation (ENSO). The results show that, in early summer, wildland fire potential is reduced in the southwest during El Niño but is increased in the northwest, with opposite trends for La Niña. In late summer, El Niño is associated with increased wildland fire potential in the southwest. Relative to the mean, the largest impacts of ENSO are observed in the northwest and southeast. Climate impacts on fire potential due to ENSO are found to be most closely associated with variations in relative humidity. The connections established here between fire potential and climate oscillations could result in improved wildland fire risk assessment and resource allocation.*

Matamala, R., Jastrow, J. D., Calderón, F. J., Liang, C., Fan, Z., Michaelson, G. J., & Ping, C. L. (2019). Predicting the decomposability of arctic tundra soil organic matter with mid infrared spectroscopy. *Soil Biology and Biochemistry, 129*, 1-12. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057245577&doi=10.1016%2fj.soilbio.2018.10.014&partnerID=40&md5=fb7dde9b949220283143ee90bfcc457f. doi:10.1016/j.soilbio.2018.10.014

Research Tags:

Abstract:

Matos, P., Geiser, L., Hardman, A., Glavich, D., Pinho, P., Nunes, A., . . . Branquinho, C. (2017). Tracking global change using lichen diversity: towards a global-scale ecological indicator. *Methods in Ecology and Evolution, 8*(7), 788-798. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022072267&doi=10.1111%2f2041-210X.12712&partnerID=40&md5=2d31ff516347d408d7687771f427f760. doi:10.1111/2041-210X.12712

Research Tags: Research

Abstract: *Lichens have been used to efficiently track major drivers of global change from the local to regional scale since the beginning of the industrial revolution (sulphur dioxide) to the present (nitrogen deposition and climate change). Currently, the challenge is to universalize monitoring methodologies to compare global change drivers' simultaneous and independent effects on ecosystems and to assess the efficacy of mitigation measures.*

Because two protocols are now used at a continental scale North America (US) and Europe (EU), it is timely to investigate the compatibility of the interpretation of their outcomes. For the first time, we present an analytical framework to compare the interpretation of data sets coming from these methods utilizing broadly accepted biodiversity metrics, featuring a paired data set from the US Pacific Northwest.

The methodologies yielded highly similar interpretation trends between response metrics: taxonomic diversity, functional diversity and community composition shifts in response to two major drivers of global change (nitrogen deposition and climate). A framework was designed to incorporate surrogates of species richness (the most commonly used empirical trend in taxonomic diversity), shifts in species composition (compositional turnover) and metrics of functional diversity (link between community shifts to effects and ecosystem structure and functioning). These metrics are essential to more thoroughly comprehend biodiversity response to global change. Its inclusion in this framework enables future cross-continental analysis of lichen biodiversity change from North America and Europe in response to global change. Future works should focus on developing independent metrics for response to global change drivers, namely climate and pollution, taking us one step closer to a lichen-based global ecological indicator.

Matosziuk, L. M., Alleau, Y., Kerns, B. K., Bailey, J., Johnson, M. G., & Hatten, J. A. (2019). Effects of season and interval of prescribed burns on pyrogenic carbon in ponderosa pine stands in the southern Blue Mountains, Oregon, USA. *Geoderma, 348*, 1-11. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064327027&doi=10.1016%2fj.geoderma.2019.04.009&partnerID=40&md5=1ad40e6845d6ad48c49279f0892ce6df. doi:10.1016/j.geoderma.2019.04.009

Research Tags: Forestry

Abstract: *In ponderosa pine (Pinus ponderosa) forests of the western United States, prescribed burns are used to reduce fuel loads and restore historical fire regimes. The season of and interval between burns can have complex consequences for the ecosystem, including the production of pyrogenic carbon (PyC). PyC plays a crucial role in soil carbon cycling, displaying turnover times that are orders of magnitude longer than unburned organic matter. This work investigated how the season of and interval between prescribed burns affects soil organic matter, including the formation and retention of PyC, in a ponderosa pine forest of eastern Oregon. In 1997 a prescribed burn study was implemented in Malheur National Forest to examine the ecological effects of burning at 5 and 15-year intervals in either the spring or fall. In October 2015, both O-horizon and mineral soil (0–15 cm) samples were collected and analyzed for PyC concentration, content, and structure using the benzene polycarboxylic acid (BPCA) method. O-horizon depth, carbon and nitrogen concentration and content, pH, and bulk density were also measured. Plots burned in the spring and fall had lower C and N stocks in the O-horizon compared to the unburned controls due to a reduction in O-horizon depth; however, we did not observe any differences in O-horizon concentration of C or N. Moreover, the concentrations and stocks of C and N in the mineral soil of plots burned in the spring or fall were the same as or only very slightly different from the unburned controls, suggesting that the prescribed burns on these sites have not adversely affected SOM quantity in the surface mineral soil carbon pools over the course of this 18-year experiment. Compared to unburned controls, we estimate that fall burns increased the mean PyC concentration of the mineral soil by 8.42 g BPCA/kg C. We did not detect a difference in mean PyC concentration of the mineral soil between the spring burns and the unburned controls; however, the spring burn plots did contain a number of isolated pockets with very high concentrations of PyC, suggesting a patchier burn pattern for these plots. In general, there was no detectable difference in any of the response variables when comparing the various prescribed*

burn treatments to one another. Reestablishing fire in these forests resulted in minor effects on the PyC concentration and pH, which may have beneficial impacts on soil carbon and available nutrients, while having few effects on other soil characteristics. This suggests that the application of low severity prescribed fires should result in little detrimental change to soils of ponderosa pine forests of the Southern Blue Mountains, while achieving management objectives such as reduction of surface fuels.

Matthews, S. N., & Iverson, L. R. (2017). Managing for delicious ecosystem service under climate change: Can United States sugar maple (acer saccharum) syrup production be maintained in a warming climate? *International Journal of Biodiversity Science, Ecosystem Services and Management, 13*(2), 40-52. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034604376&doi=10.1080%2f21513732.2017.1285815&partnerID=40&md5=1ca8c38ab432985a3f3d623e77173bd9. doi:10.1080/21513732.2017.1285815

Research Tags: Forestry, Weather, Crops

Abstract: *Sugar maple (Acer saccharum) is a highly valued tree in United States (US) and Canada, and its sap when collected from taps and concentrated, makes a delicious syrup. Understanding how this resource may be impacted by climate change and other threats is essential to continue management for maple syrup into the future. Here, we evaluate the current distribution of maple syrup production across twenty-three states within the US and estimate the current potential sugar maple resource based on tree inventory data. We model and project the potential habitat responses of sugar maple using a species distribution model with climate change under two future General Circulation Models (GCM) and emission scenarios and three time periods (2040, 2070, 2100). Our results show that under GFDL-A1Fi (high CO2 emissions), sugar maple habitat is projected to decline (mean ratio of future habitat to current habitat per state = 0.46, sd ± 0.33), which could lead to reduced maple syrup production per tree and nearly 5 million additional taps required to maintain current projection levels. If global emissions are reduced and follow a lower trajectory of warming (under PCM-B1), then habitat for the species may be maintained but would still require management intervention. Finally, our results point to regions, particularly along the northern tier, where both climate change impacts and currently developing sugar maple habitat may signify viable opportunities to increase maple syrup production.*

Matthews, T. J., Sadler, J. P., Kubota, Y., Woodall, C. W., & Pugh, T. A. M. (2019). Systematic variation in North American tree species abundance distributions along macroecological climatic gradients. *Global Ecology and Biogeography, 28*(5), 601-611. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060730446&doi=10.1111%2fgeb.12879&partnerID=40&md5=008c82c78f3dd4414f2308a2f31cf92f. doi:10.1111/geb.12879

Research Tags: Forestry

Abstract: *Aim*
The species abundance distribution (SAD) is a fundamental pattern in macroecology. Understanding how SADs vary spatially, and identifying the variables that drive any change, is important from a theoretical perspective because it enables greater understanding of the factors that underpin the relative abundance of species. However, precise knowledge on how the form of SADs varies across large (continental) scales is limited. Here, we use the shape parameter of the gambin distribution to assess how meta-community-scale SAD shape varies spatially as a function of various climatic variables and dataset characteristics.
Location
Eastern North America (ENA).
Time period
Present day.
Major taxa studied
Trees.
Methods
Using an extensive continental-scale dataset of 863,930 individual trees in plots across ENA sampled using a standardized method, we use a spatial regression framework to examine the effect of temperature and precipitation on the form of the SAD. We also assess whether the prevalence of multimodality in the SAD varies spatially across ENA as a function of temperature and precipitation, in addition to other sample characteristics.
Results
We found that temperature, precipitation and species richness can explain two-thirds of the variation in tree

SAD form across ENA. Temperature had the largest effect on SAD shape, and it was found that increasing temperature resulted in more logseries-like SAD shapes (i.e. SADs with a relatively higher proportion of rarer species). We also found spatial variation in SAD multimodality as a function of temperature and species richness.
Main conclusions
Our results indicate that temperature is a key environmental driver governing the form of ENA tree meta-community-scale SADs. This finding has implications for our understanding of local-scale variation in tree abundance and suggests that niche factors and environmental filtering are important in the structuring of ENA tree communities at larger scales.

Mattia, F., Balenzano, A., Satalino, G., Lovergine, F., Peng, J., Wegmuller, U., . . . Jackson, T. (2018). *Sentinel-1 & Sentinel-2 for soil moisture retrieval at field scale.* Paper presented at the International Geoscience and Remote Sensing Symposium (IGARSS).
Research Tags: Soil, Research
Abstract: *Soil moisture content is an essential climate variable that is operationally delivered at low resolution (e.g. 36-9 km) by earth observation missions, such as ESA/SMOS, NASA/SMAP and EUMETSAT/ASCAT. However numerous land applications would benefit from the availability of soil moisture maps at higher resolution. For this reason, there is a large research effort to develop soil moisture products at higher resolution using, for instance, data acquired by the new ESA's Sentinel missions. The objective of this study is twofold. First, it presents the validation status of a pre-operational soil moisture product derived from Sentinel-1 at 1 km resolution. Second, it assesses the possibility of integrating Sentinel-2 data and additional ancillary information, such as parcel borders and high resolution soil texture maps, in order to obtain soil moisture maps at "field scale" resolution, i.e. ~0.1 km. Case studies concerning agricultural sites located in Europe are presented.*

Mau, A. C., Reed, S. C., Wood, T. E., & Cavaleri, M. A. (2018). Temperate and tropical forest canopies are already functioning beyond their thermal thresholds for photosynthesis. *Forests, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050926621&doi=10.3390%2fF9010047&partnerID=40&md5=5c87c9dd6d45af12501500244a40f3a9. doi:10.3390/F9010047
Research Tags: Forestry
Abstract: *Tropical tree species have evolved under very narrow temperature ranges compared to temperate forest species. Studies suggest that tropical trees may be more vulnerable to continued warming compared to temperate species, as tropical trees have shown declines in growth and photosynthesis at elevated temperatures. However, regional and global vegetation models lack the data needed to accurately represent such physiological responses to increased temperatures, especially for tropical forests. To address this need, we compared instantaneous photosynthetic temperature responses of mature canopy foliage, leaf temperatures, and air temperatures across vertical canopy gradients in three forest types: tropical wet, tropical moist, and temperate deciduous. Temperatures at which maximum photosynthesis occurred were greater in the tropical forests canopies than the temperate canopy (30 ± 0.3 °C vs. 27 ± 0.4 °C). However, contrary to expectations that tropical species would be functioning closer to threshold temperatures, photosynthetic temperature optima was exceeded by maximum daily leaf temperatures, resulting in sub-optimal rates of carbon assimilation for much of the day, especially in upper canopy foliage (>10 m). If trees are unable to thermally acclimate to projected elevated temperatures, these forests may shift from net carbon sinks to sources, with potentially dire implications to climate feedbacks and forest community composition.*

Mauget, S. A. (2018). Optimal ranking regime analysis of U.S. summer temperature and degree-days: 1895-2015. *Journal of Applied Meteorology and Climatology, 57*(9), 2141-2159. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053461287&doi=10.1175%2fJAMC-D-18-0063.1&partnerID=40&md5=52a26f3af9ce0c873e5e6360bc97f91c. doi:10.1175/JAMC-D-18-0063.1
Research Tags: Weather, Crops
Abstract: *The optimal ranking regime (ORR) method was applied to mean summer maximum (TMXS) and mean summer minimum (TMNS) temperature and to cumulative summer cooling degree-days (CDDS) calculated from U.S. climate-division data during 1895–2015. CDDS is proposed as a proxy for growing degree-days for summer corn given their high rank correlation in station data during 1950–2014. The TMXS*

and CDDS ORR analyses show similar climate-regime patterns. Western and northeastern divisions experienced multidecadal cool periods before 1930 and warm periods after 1990. The 1930s drought appears as decadal warm regimes over the Midwest and Great Plains. Multidecadal TMXS and CDDS temperature cycles are evident over the Southeast, but TMXS and CDDS variation over the Midwest's Corn Belt agricultural region has been regime free since the early 1940s. By contrast, TMNS regimes consistent with centennial-scale warming trends are found over most divisions outside the Southeast. From the multidecadal regime patterns detected by the ORR analyses, the TMXS, TMNS, and CDDS series of each climate division were tested for significant linear trends during 1910–2015 and 1970–2015. Significant positive TMNS trends during 1910–2015 are found in 48 of the 102 divisions, with some western trend magnitudes being greater than 15% of the twentieth-century climatological mean. During 1970–2015, positive TMXS trends are detected over 39 western and northeastern divisions, but warming TMNS trends are evident nationally. In some cooler western divisions, positive 1970–2015 CDDS trend magnitudes exceed 90% of the climatological mean. Consistent with the ORR analyses, Corn Belt TMXS and CDDS trends are insignificant during 1970–2015.

Mauget, S. A. (2018). Reconstructed and projected U.S. residential natural gas consumption during 1896-2043. *Journal of Applied Meteorology and Climatology, 57*(3), 607-625. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043975243&doi=10.1175%2fJAMC-D-17-0155.1&partnerID=40&md5=da14f247b8d045a08fe47bde3660bcda. doi:10.1175/JAMC-D-17-0155.1
Research Tags: Energy
Abstract: *Using state-level monthly heating degree-day data, reconstructed per capita natural gas (NGr) consumption records for each state of the continental United States were calculated for 1895–2014 using linear regressions. The regressed monthly NGr values estimate the effects of twentieth- and early twenty-first-century climate variation on per capita natural gas usage, assuming a modern (1990–2013) consumption environment. Using these extended consumption records, the hypothetical effects of climate on past, current, and future natural gas (NG) use are estimated. By controlling for nonclimatic consumption effects, these extended reconstructions provide estimates of the sensitivity of NG consumption to historical climate variation, particularly long-term warming trends, occurring before the period of available consumption records. After detrending, the reconstructions are used to form improved estimates of interannual NG variation under current climate conditions. Given estimates of each state's current consumption climatology and long-term trends in per capita consumption and current population trends, the net effect of warming and increasing population on future consumption is estimated. Significant long-term negative trends in per capita NG consumption are found in western and northeastern states and in Florida, while southeastern consumption effects reflect a multidecadal temperature cycle. Climate-related consumption effects found here are generally consistent with previous studies, with long-term trend effects limited to less than 12% and multidecadal regime effects limited to less than 9%. Given the stronger positive effects of increasing population on total state natural gas consumption, reduced per capita use associated with warming trends has a weak moderating effect on estimates of projected total consumption in 2043.*

Mauget, S. A., Leiker, G. L., Schroeder, J., Hirth, B., Burgett, W., & Haynie, K. B. (2017). A web application for managing regional crop production: The West Texas Mesonet agro-climate monitor. *Agronomy Journal, 109*(4), 1602-1611. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023754427&doi=10.2134%2fagronj2016.07.0424&partnerID=40&md5=cdbee0c8d1eb8ac24beeda9857def474. doi:10.2134/agronj2016.07.0424
Research Tags: Research, Crops
Abstract: *Although dependent on rainfall and other climate factors to produce crops, West Texas crop consultants, extension agents, and agricultural producers have few tools that allow them to track the current growing season's climate conditions and determine how current conditions compare with those of past years. The West Texas Mesonet Agro-Climate Monitor (ACM), a JavaScript web application based on daily data from Texas Tech University's mesonet weather station network, was designed to meet this need. By displaying continuously updated information on variables such as soil temperature, cumulative growing degree days (GDD), cumulative precipitation, and first freeze dates, the ACM allows producers to monitor planting conditions, track crop development, and compare current conditions with those during the previous 10 yr's growing seasons. In illustrating how mesonet data might be used as an operational climate data resource, the*

ACM might also serve as a conceptual model for other high resolution climate tools that estimate measures of current climate using continuously updated daily data sets.

Maurer, D. L., Koziel, J. A., Bruning, K., & Parker, D. B. (2017). Farm-scale testing of soybean peroxidase and calcium peroxide for surficial swine manure treatment and mitigation of odorous VOCs, ammonia and hydrogen sulfide emissions. *Atmospheric Environment, 166*, 467-478. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026733187&doi=10.1016%2fj.atmosenv.2017.07.048&partnerID=40&md5=38b00ae8bd4f58ae497518a2309ed2d9. doi:10.1016/j.atmosenv.2017.07.048

Research Tags: Emissions, Livestock

Abstract: *The swine industry, regulatory agencies, and the public are interested in farm-tested methods for controlling gaseous emissions from swine barns. In earlier lab- and pilot-scale studies, a renewable catalyst consisting of soybean peroxidase (SBP) mixed with calcium peroxide (CaO2) was found to be effective in mitigating gaseous emissions from swine manure. Thus, a farm-scale experiment was conducted at the university's 178-pig, shallow-pit, mechanically-ventilated swine barn to evaluate SBP/CaO2 as a surficial manure pit additive under field conditions. The SBP was applied once at the beginning of the 42-day experiment at an application rate of 2.28 kg m−2 with 4.2% CaO2 added by weight. Gas samples were collected from the primary barn exhaust fans. As compared to the control, significant reductions in gaseous emissions were observed for ammonia (NH3, 21.7%), hydrogen sulfide (H2S, 79.7%), n-butyric acid (37.2%), valeric acid (47.7%), isovaleric acid (39.3%), indole (31.2%), and skatole (43.5%). Emissions of dimethyl disulfide/methanethiol (DMDS/MT) increased by 30.6%. Emissions of p-cresol were reduced by 14.4% but were not statistically significant. There were no significant changes to the greenhouse gas (GHG) emissions of methane (CH4), carbon dioxide (CO2) and nitrous oxide (N2O). The total (material + labor) treatment cost was $2.62 per marketed pig, equivalent to 1.5% of the pig market price. The cost of CaO2 catalyst was ~60% of materials cost. The cost of soybean hulls (SBP source) was $0.60 per marketed pig, i.e., only 40% of materials cost.*

Maurer, D. L., Koziel, J. A., Bruning, K., & Parker, D. B. (2017). Pilot-scale testing of renewable biocatalyst for swine manure treatment and mitigation of odorous VOCs, ammonia and hydrogen sulfide emissions. *Atmospheric Environment, 150*, 313-321. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006000164&doi=10.1016%2fj.atmosenv.2016.11.021&partnerID=40&md5=429c3e5d37c2e831f99e53b59fa4fce2. doi:10.1016/j.atmosenv.2016.11.021

Research Tags: Emissions, Livestock

Abstract: *Comprehensive control of odors, hydrogen sulfide (H2S), ammonia (NH3), and greenhouse gas (GHG) emissions associated with swine production is a critical need. A pilot-scale experiment was conducted to evaluate surface-applied soybean peroxidase (SBP) and calcium peroxide (CaO2) as a manure additive to mitigate emissions of odorous volatile organic compounds (VOC) including dimethyl disulfide/methanethiol (DMDS/MT), dimethyl trisulfide, n-butyric acid, valeric acid, isovaleric acid, p-cresol, indole, and skatole. The secondary impact on emissions of NH3, H2S, and GHG was also measured. The SBP was tested at four treatments (2.28–45.7 kg/m2 manure) with CaO2 (4.2% by weight of SBP) over 137 days. Significant reductions in VOC emissions were observed: DMDS/MT (36.2%–84.7%), p-cresol (53.1%–89.5%), and skatole (63.2%–92.5%). There was a corresponding significant reduction in NH3 (14.6%–67.6%), and significant increases in the greenhouse gases CH4 (32.7%–232%) and CO2 (20.8%–124%). The remaining emissions (including N2O) were not statistically different. At a cost relative to 0.8% of a marketed hog it appears that SBP/CaO2 treatment could be a promising option at the lowest (2.28 kg/m2) treatment rate for reducing odorous gas and NH3 emissions at swine operations, and field-scale testing is warranted.*

Maynard, J. J., & Karl, J. W. (2017). A hyper-temporal remote sensing protocol for high-resolution mapping of ecological sites. *PLoS ONE, 12*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017585791&doi=10.1371%2fjournal.pone.0175201&partnerID=40&md5=7539fdcc1edd8d5b2ae34fdd736c4e70. doi:10.1371/journal.pone.0175201

Research Tags: Research

Abstract: *Ecological site classification has emerged as a highly effective land management framework, but its utility at a regional scale has been limited due to the spatial ambiguity of ecological site locations in the U.S. or*

the absence of ecological site maps in other regions of the world. In response to these shortcomings, this study evaluated the use of hyper-temporal remote sensing (i.e., hundreds of images) for high spatial resolution mapping of ecological sites. We posit that hyper-temporal remote sensing can provide novel insights into the spatial variability of ecological sites by quantifying the temporal response of land surface spectral properties. This temporal response provides a spectral 'fingerprint' of the soil-vegetation-climate relationship which is central to the concept of ecological sites. Consequently, the main objective of this study was to predict the spatial distribution of ecological sites in a semi-arid rangeland using a 28-year time series of normalized difference vegetation index from Landsat TM 5 data and modeled using support vector machine classification. Results from this study show that support vector machine classification using hyper-temporal remote sensing imagery was effective in modeling ecological site classes, with a 62% correct classification. These results were compared to Gridded Soil Survey Geographic database and expert delineated maps of ecological sites which had a 51 and 89% correct classification, respectively. An analysis of the effects of ecological state on ecological site misclassifications revealed that sites in degraded states (e.g., shrub-dominated/shrubland and bare/annuals) had a higher rate of misclassification due to their close spectral similarity with other ecological sites. This study identified three important factors that need to be addressed to improve future model predictions: 1) sampling designs need to fully represent the range of both within class (i.e., states) and between class (i.e., ecological sites) spectral variability through time, 2) field sampling protocols that accurately characterize key soil properties (e.g., texture, depth) need to be adopted, and 3) additional environmental covariates (e.g. terrain attributes) need to be evaluated that may help further differentiate sites with similar spectral signals. Finally, the proposed hyper-temporal remote sensing framework may provide a standardized approach to evaluate and test our ecological site concepts through examining differences in vegetation dynamics in response to climatic variability and other drivers of land-use change. Results from this study demonstrate the efficacy of the hyper-temporal remote sensing approach for high resolution mapping of ecological sites, and highlights its utility in terms of reduced cost and time investment relative to traditional manual mapping approaches.

Maynard, J. J., & Levi, M. R. (2017). Hyper-temporal remote sensing for digital soil mapping: Characterizing soil-vegetation response to climatic variability. *Geoderma, 285*, 94-109. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84988978335&doi=10.1016%2fj.geoderma.2016.09.024&partnerID=40&md5=890cb87ba1eb9a27d5c8d9991cbb5d3d. doi:10.1016/j.geoderma.2016.09.024

Research Tags: Soil, Research

Abstract: *Indices derived from remotely-sensed imagery are commonly used to predict soil properties with digital soil mapping (DSM) techniques. The use of images from single dates or a small number of dates is most common for DSM; however, selection of the appropriate images is complicated by temporal variability in land surface spectral properties. We argue that hyper-temporal remote sensing (RS) (i.e., hundreds of images) can provide novel insights into soil spatial variability by quantifying the temporal response of land surface spectral properties. This temporal response provides a spectral 'fingerprint' of the soil-vegetation relationship which is directly related to a range of soil properties. To evaluate the hyper-temporal RS approach, this study first reviewed and synthesized, within the context of temporal variability, previous research that has used RS imagery for DSM. Results from this analysis support the notion that temporal variability in RS spectra, as driven by soil and climate feedbacks, is an important predictor of soil variability. To explicitly evaluate this idea and to demonstrate the utility of the hyper-temporal approach, we present a case study in a semiarid landscape of southeastern Arizona, USA. In this case study surface soil texture and coarse fragment classes were predicted using a 28 year time series of Landsat TM derived normalized difference vegetation index (NDVI) and modeled using support vector machine (SVM) classification, and results evaluated relative to more traditional RS approaches (e.g., mono-, bi-, and multi-temporal). Results from the case study show that SVM classification using hyper-temporal RS imagery was more effective in modeling both soil texture and coarse fragment classes relative to mono-, bi-, or multi-temporal RS, with classification accuracies of 67% and 62%, respectively. Short-term transitions between wet and dry periods (i.e., < 6 months) were the dominant drivers of vegetation spectral variability and corresponded to the general timing of significant RS scenes within in our SVM models, confirming the importance of spectral variability in predicting soil texture and coarse fragment classes. Results from the case study demonstrate the efficacy of the hyper-temporal RS approach in predicting soil properties and highlights how hyper-temporal RS can improve current methods of soil mapping efforts through its ability*

to characterize subtle changes in RS spectra relating to variation in soil properties.

Maynard, J. J., Nauman, T. W., Salley, S. W., Bestelmeyer, B. T., Duniway, M. C., Talbot, C. J., & Brown, J. R. (2019). Digital mapping of ecological land units using a nationally scalable modeling framework. *Soil Science Society of America Journal, 83*(3), 666-686. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068650549&doi=10.2136%2fsssaj2018.09.0346&partnerID=40&md5=f5852a7cf0b79c2e0b39fbafa3db4c93. doi:10.2136/sssaj2018.09.0346

Research Tags: Research

Abstract: *Ecological site descriptions (ESDs) and associated state-and-transition models (STMs) provide a nationally consistent classification and information system for defining ecological land units for management applications in the United States. Current spatial representations of ESDs, however, occur via soil mapping and are therefore confined to the spatial resolution used to map soils within a survey area. Land management decisions occur across a range of spatial scales and therefore require ecological information that spans similar scales. Digital mapping provides an approach for optimizing the spatial scale of modeling products to best serve decision makers and have the greatest impact in addressing land management concerns. Here, we present a spatial modeling framework for mapping ecological sites using machine learning algorithms, soil survey field observations, soil survey geographic databases, ecological site data, and a suite of remote sensing-based spatial covariates (e.g., hyper-temporal remote sensing, terrain attributes, climate data, land-cover, lithology). Based on the theoretical association between ecological sites and landscape biophysical properties, we hypothesized that the spatial distribution of ecological sites could be predicted using readily available geospatial data. This modeling approach was tested at two study areas within the western United States, representing 6.1 million ha on the Colorado Plateau and 7.5 million ha within the Chihuahuan Desert. Results show our approach was effective in mapping grouped ecological site classes (ESGs), with 10-fold cross-validation accuracies of 70% in the Colorado Plateau based on 1405 point observations across eight expertly-defined ESG classes and 79% in the Chihuahuan Desert based on 2589 point observations across nine expertly-defined ESG classes. Model accuracies were also evaluated using external-validation datasets; resulting in 56 and 44% correct classification for the Colorado Plateau and Chihuahuan Desert, respectively. National coverage of the training and covariate data used in this study provides opportunities for a consistent national-scale mapping effort of ecological sites.*

McAvoy, T. J., Régnière, J., St-Amant, R., Schneeberger, N. F., & Salom, S. M. (2017). Mortality and recovery of hemlockwoolly adelgid (Adelges tsugae) in response towinter temperatures and predictions for the future. *Forests, 8*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038213906&doi=10.3390%2ff8120497&partnerID=40&md5=17d4c7e6f9750bd3d1a53884f522a753. doi:10.3390/f8120497

Research Tags: Weather, Forestry

Abstract: *Eastern (Tsuga canadensis) and Carolina hemlocks (T. caroliniana) of eastern North America have been attacked by the non-native hemlock woolly adelgid (Adelges tsugae Annand) (HWA) since the first half of the 20th century. Unlike most insects, HWA develops through one generation from fall to late winter, exposing this insect to the lethal effects of winter temperatures. The mortality inflicted by winter temperatures on HWA determines the surviving population density as well as its ability to spread to uninfested areas. With the ongoing changes in climate, knowledge of this species' ability to survive and spread in the future can help land managers prepare for its management. This study began during the winter of 2014 and ended in the spring of 2017. During this period, winter mortality of HWA was recorded at 100 sites from Maine to Georgia (n = 209). Changes in population density from the sistens to the succeeding progrediens generation were recorded at 24 sites (n = 35). Models were developed to predict HWA mortality using the lowest minimum temperature prior to the mortality assessment date, the number of days with mean temperature < −1 °C, and the mean daily temperature of the three days preceding that minimum. Models were also developed to predict population density changes from the overwintering sistens generation to the following progrediens generation. Future projections under climate change showed increases in winter survival and population growth rates over time. Especially towards the northeastern edge of T. canadensis' distribution as minimum temperatures are predicted to increase at a greater rate. This will result in an increase in density throughout its current distribution and expansion northward causing an increase in its impact on eastern Tsuga spp.*

McCaffrey, S., Wilson, R., & Konar, A. (2018). Should I Stay or Should I Go Now? Or Should I Wait and See? Influences on Wildfire Evacuation Decisions. *Risk Analysis, 38*(7), 1390-1404. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034848272&doi=10.1111%2frisa.12944&partnerID=40&md5=c88763481ef98285dc420af59328c8a4. doi:10.1111/risa.12944

Research Tags: Economics, Weather, Forestry

Abstract: *As climate change has contributed to longer fire seasons and populations living in fire-prone ecosystems increase, wildfires have begun to affect a growing number of people. As a result, interest in understanding the wildfire evacuation decision process has increased. Of particular interest is understanding why some people leave early, some choose to stay and defend their homes, and others wait to assess conditions before making a final decision. Individuals who tend to wait and see are of particular concern given the dangers of late evacuation. To understand what factors might influence different decisions, we surveyed homeowners in three areas in the United States that recently experienced a wildfire. The Protective Action Decision Model was used to identify a suite of factors previously identified as potentially relevant to evacuation decisions. Our results indicate that different beliefs about the efficacy of a particular response or action (evacuating or staying to defend), differences in risk attitudes, and emphasis on different cues to act (e.g., official warnings, environmental cues) are key factors underlying different responses. Further, latent class analysis indicates there are two general classes of individuals: those inclined to evacuate and those inclined to stay, and that a substantial portion of each class falls into the wait and see category.*

McCollum, D. W., Tanaka, J. A., Morgan, J. A., Mitchell, J. E., Fox, W. E., Maczko, K. A., . . . Kreuter, U. P. (2017). Climate change effects on rangelands and rangeland management: affirming the need for monitoring. *Ecosystem Health and Sustainability, 3*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051394676&doi=10.1002%2fehs2.1264&partnerID=40&md5=0d90f47dd454ef8fe7e3bd1dde63d8ab. doi:10.1002/ehs2.1264

Research Tags: Livestock, Grassland

Abstract: *Uncertainty as to the extent and magnitude of changes in conditions that might occur due to climate change poses a problem for land and resource managers as they seek to adapt to changes and mitigate effects of climate variability. We illustrate using scenarios of projected future conditions on rangelands in the Northern Great Plains and Desert Southwest of the United States. These two regions are different in the ways climate change is projected to affect the regions. Projection of a longer and warmer growing season in the Northern Great Plains could lead to increased forage production and land productivity. Highly uncertain effects on summer monsoons that primarily control rangeland productivity in the Desert Southwest, combined with the possibility of more intense and/or frequent drought events, could present land managers with challenges stemming from decreased forage production and land productivity. Climate projections, though uncertain, provide land managers with basic insight into future conditions they might encounter. They need more. A focus on vulnerability and resilience, with explicit recognition of interactions between ecological and socio-economic factors, coupled with systematic monitoring and assessment of observable conditions on the land to supplement information based on climate projections, will more effectively provide critical and specific information managers need to adaptively manage rangelands under uncertain climate futures.*

McDonald, J. M., Srock, A. F., & Charney, J. J. (2018). Development and application of a Hot-Dry-Windy Index (HDW) climatology. *Atmosphere, 9*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050457378&doi=10.3390%2fatmos9070285&partnerID=40&md5=089f89b1e66387770abfa5a36aceed8e. doi:10.3390/atmos9070285

Research Tags: Research, Weather

Abstract: *In this paper, we describe and analyze a climatology of the Hot-Dry-Windy Index (HDW), with the goal of providing fire-weather forecasters with information about the daily and seasonal variability of the index. The 30-year climatology (1981–2010) was produced using the Climate Forecast System Reanalysis (CFSR) for the contiguous United States, using percentiles to show seasonal and geographical variations of HDW contained within the climatology. The method for producing this climatology is documented and the application of the climatology to historical fire events is discussed. We show that the HDW climatology provides insight into near-surface climatic conditions that can be used to identify temperature and humidity trends that* *correspond to climate classification systems. Furthermore, when used in conjunction with daily traces of HDW values, users can follow trends in HDW and compare those trends with historical values at a given location. More usefully, this climatology adds value to HDW forecasts; by combining the CFSR climatology and a Global Ensemble Forecast System (GEFS) ensemble history and forecast, we can produce a single product that provides seasonal, climatological, and short-term context to help determine the appropriate fire-management response to a given HDW value.*

McDowell, N., Allen, C. D., Anderson-Teixeira, K., Brando, P., Brienen, R., Chambers, J., . . . Xu, X. (2018). Drivers and mechanisms of tree mortality in moist tropical forests. *New Phytologist, 219*(3), 851-869. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042113356&doi=10.1111%2fnph.15027&partnerID=40&md5=1d7deb0c0769e7b438bb54286987b758. doi:10.1111/nph.15027

Research Tags: Forestry

Abstract: *Tree mortality rates appear to be increasing in moist tropical forests (MTFs) with significant carbon cycle consequences. Here, we review the state of knowledge regarding MTF tree mortality, create a conceptual framework with testable hypotheses regarding the drivers, mechanisms and interactions that may underlie increasing MTF mortality rates, and identify the next steps for improved understanding and reduced prediction. Increasing mortality rates are associated with rising temperature and vapor pressure deficit, liana abundance, drought, wind events, fire and, possibly, CO2 fertilization-induced increases in stand thinning or acceleration of trees reaching larger, more vulnerable heights. The majority of these mortality drivers may kill trees in part through carbon starvation and hydraulic failure. The relative importance of each driver is unknown. High species diversity may buffer MTFs against large-scale mortality events, but recent and expected trends in mortality drivers give reason for concern regarding increasing mortality within MTFs. Models of tropical tree mortality are advancing the representation of hydraulics, carbon and demography, but require more empirical knowledge regarding the most common drivers and their subsequent mechanisms. We outline critical datasets and model developments required to test hypotheses regarding the underlying causes of increasing MTF mortality rates, and improve prediction of future mortality under climate change.*

McDowell, R. W., Elkin, K. R., & Kleinman, P. J. A. (2017). Temperature and nitrogen effects on phosphorus uptake by agricultural stream-bed sediments. *Journal of Environmental Quality, 46*(2), 295-301. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015922473&doi=10.2134%2fjeq2016.09.0352&partnerID=40&md5=54fa625e528563dec5912a5a845c60a8. doi:10.2134/jeq2016.09.0352

Research Tags: Water

Abstract: *Climate change will likely increase the growing season, temperatures, and ratio of nitrogen (N) to phosphorus (P) loss from land to water. However, it is unknown how these factors influence P concentrations in streams. We sought to evaluate differences in biotic and abiotic processes affecting stream sediment P dynamics under different temperature and N-enrichment regimes. Three sediments of varying P composition and sorption characteristics were placed into a fluvarium. Synthetic runoff water, with or without added N, was added to the flume's reservoir, and the solution was maintained at 19 or 26°C. Water and sediment samples were taken with time since runoff was introduced. The rate and magnitude of P uptake by sediment was greater at 19°C compared with 26°C, and also when N was added compared with no N added. Analysis of sediment samples indicated that P uptake via abiotic processes was greater at 19 than at 26°C. The addition of N stimulated P uptake by the microbial biomass at 19°C, but microbial uptake was potentially inhibited at 26°C. Because microbial biomass is a temporary store of P, these data suggest that more P may be available with increasing temperatures during the growing season, especially under baseflow, implying that strategies to mitigate P losses from land to water should be strengthened to prevent potential water quality impairment.*

McFadden, J. R., & Miranowski, J. A. (2017). *Extreme weather, biotechnology, and corn productivity.* Paper presented at the Springer Proceedings in Mathematics and Statistics.

Research Tags: Weather, Crops

Abstract: *U.S. agriculture has made impressive strides over the past 50 years in crop yield and input productivity growth, especially since the advent of genetically-modified crops in 1996. However, future growth rates could decline if U.S. agriculture does not sufficiently adapt to climate change. We examine the magnitudes of weather impacts on U.S. corn yields during 1960–2011—with a focus on intense precipitation* *and nitrogen use efficiency—and use the empirical results to forecast yields for the subsequent 20 years (2012-2031). We improve upon past methodologies by employing dynamic Bayesian regressions. These dynamic models permit rapid updating of new information, consistent with both pronounced yield growth in recent years and agricultural adaptation to changing growing conditions. We find that corn yields will increase by 27–41% over 2011 yields in top-growing states, though yields will gradually decline in less-productive states where climate change impacts could be among the most harmful. Our forecasts are generally robust to the empirical specification and assumptions about the econometric disturbance term, and have similar out-of-sample performance. To the extent that increasingly intense rainfall could contribute to nitrogen and other nutrient leaching, farmers may need to adjust nutrient applications in response to changing production environments.*

McGuire, A. D., Genet, H., Lyu, Z., Pastick, N., Stackpoole, S., Birdsey, R., . . . Zhu, Z. (2018). Assessing historical and projected carbon balance of Alaska: A synthesis of results and policy/management implications. *Ecological Applications, 28*(6), 1396-1412. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051591224&doi=10.1002%2feap.1768&partnerID=40&md5=15cdfb625e169716ebbb2759c5b6151f. doi:10.1002/eap.1768

Research Tags: Emissions

Abstract: *We summarize the results of a recent interagency assessment of land carbon dynamics in Alaska, in which carbon dynamics were estimated for all major terrestrial and aquatic ecosystems for the historical period (1950–2009) and a projection period (2010–2099). Between 1950 and 2009, upland and wetland (i.e., terrestrial) ecosystems of the state gained 0.4 Tg C/yr (0.1% of net primary production, NPP), resulting in a cumulative greenhouse gas radiative forcing of 1.68 × 10−3 W/m2. The change in carbon storage is spatially variable with the region of the Northwest Boreal Landscape Conservation Cooperative (LCC) losing carbon because of fire disturbance. The combined carbon transport via various pathways through inland aquatic ecosystems of Alaska was estimated to be 41.3 Tg C/yr (17% of terrestrial NPP). During the projection period (2010–2099), carbon storage of terrestrial ecosystems of Alaska was projected to increase (22.5–70.0 Tg C/yr), primarily because of NPP increases of 10–30% associated with responses to rising atmospheric CO2, increased nitrogen cycling, and longer growing seasons. Although carbon emissions to the atmosphere from wildfire and wetland CH4 were projected to increase for all of the climate projections, the increases in NPP more than compensated for those losses at the statewide level. Carbon dynamics of terrestrial ecosystems continue to warm the climate for four of the six future projections and cool the climate for only one of the projections. The attribution analyses we conducted indicated that the response of NPP in terrestrial ecosystems to rising atmospheric CO2 (~5% per 100 ppmv CO2) saturates as CO2 increases (between approximately +150 and +450 ppmv among projections). This response, along with the expectation that permafrost thaw would be much greater and release large quantities of permafrost carbon after 2100, suggests that projected carbon gains in terrestrial ecosystems of Alaska may not be sustained. From a national perspective, inclusion of all of Alaska in greenhouse gas inventory reports would ensure better accounting of the overall greenhouse gas balance of the nation and provide a foundation for considering mitigation activities in areas that are accessible enough to support substantive deployment.*

McGuire, A. D., Zhu, Z., Birdsey, R., Pan, Y., & Schimel, D. S. (2018). Introduction to the Alaska Carbon Cycle Invited Feature. *Ecological Applications, 28*(8), 1938-1939. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057869376&doi=10.1002%2feap.1808&partnerID=40&md5=53910ad7b7f82be3ca1a807eeaa161db. doi:10.1002/eap.1808

Research Tags: Emissions

Abstract: *Ongoing warming of ecosystems in Alaska has the potential to release carbon to the atmosphere and coastal waters through (1) exposing and mobilizing the large quantity of carbon stored in permafrost soils and (2) emissions associated with potentially more frequent and severe fires. However, other ecological pathways in the carbon cycle could counter this carbon release. The papers in this Invited Feature provide a synthesis of the Alaska carbon cycle through analyses of driving factors and carbon dynamics for uplands, wetlands, and inland waters in the state. The Invited Feature also explores the implications for climate policy and management of carbon at local to international scales.*

McGwire, K. C., Weltz, M. A., Snyder, K. A., Huntington, J. L., Morton, C. G., & McEvoy, D. J. (2017). Satellite Assessment of Early-Season Forecasts for Vegetation Conditions of Grazing Allotments in Nevada, United States. *Rangeland Ecology and Management, 70*(6), 730-739. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032862719&doi=10.1016%2fj.rama.2017.06.005&partnerID=40&md5=32808063e94507e51fdeb4878a2d3ce7. doi:10.1016/j.rama.2017.06.005

Research Tags: Grassland, Livestock

Abstract: *The extent and heterogeneity of rangelands in the state of Nevada (United States) pose a challenging situation for land managers when determining stocking levels for livestock grazing. Overutilization can cause lasting environmental damage, while underutilization can create unnecessary economic hardship for livestock operators. An improved ability to forecast vegetation stress later in the growing season would allow resource managers to better manage the tradeoffs between ecological and economic concerns. This research maps how well growing season conditions for vegetation within grazing allotments of Nevada can be predicted at different times of the year by analyzing 15 yr of enhanced vegetation index (EVI) data from the Moderate Resolution Imaging Spectroradiometer sensor, cumulative monthly precipitation, and the Palmer drought severity index. Land cover classes within the grazing allotments that are not relevant to grazing were removed from the analysis, as well as areas that showed > 50% change in EVI since these likely represented transitions or disturbances that were not related to interannual climate variability. The datasets were gridded at spatial resolutions from 4 to 72 km, and the correspondence between image and meteorological datasets was found to improve as measurements were averaged over larger areas. A 16-km sampling grid was judged to provide the best balance between predictive ability and spatial precision. The average R2 of regressions between the vegetation index and meteorological variables within each of the 16-km grid cells was 0.69. For most of Nevada, the ability to predict vegetation conditions for the entire growing season (February–September) generally peaks by the end of May. However, results vary by region, with the northeast particularly benefiting from late-season data. Regressions were performed with and without very wet years, and the ability to make early predictions is better when including wet years than in dry to typical conditions.*

McIntosh, M. M., Holechek, J. L., Spiegal, S. A., Cibils, A. F., & Estell, R. E. (2019). Long-Term Declining Trends in Chihuahuan Desert Forage Production in Relation to Precipitation and Ambient Temperature. *Rangeland Ecology and Management*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070311389&doi=10.1016%2fj.rama.2019.06.002&partnerID=40&md5=4ad33fcd4e50fb3cefdbf36d62863940. doi:10.1016/j.rama.2019.06.002

Research Tags: Weather, Grassland

Abstract: *Rising temperatures and more frequent droughts are posing new challenges to range livestock producers in the southwestern United States and many other parts of the world. We analyzed a 52-yr time series (1967 − 2018) of precipitation, ambient temperature, and perennial grass production (PGP), as well as 14 yr (2001 − 2014) of Moderate Resolution Imaging Spectrometer (MODIS)-derived vegetation phenometrics at a site in the Chihuahuan Desert of New Mexico. PGP was positively associated with December through September precipitation (r = 0.69; P < 0.01) but negatively associated with spring and summer (May − September) maximum average ambient temperature (r = − 0.47; P < 0.01). PGP decreased by 43% in the second (1993 − 2018) compared with the first half (1967 − 1992) of our study (165 vs. 94 kg dry matter • ha−1; P < 0.01). Precipitation was lower and more erratic in the second half of the time series, decreasing by 18.6% (265.2 ± 15.0 vs. 215.8 ± 15.8 mm; P = 0.01). Conversely, mean maximum and mean ambient temperatures were higher during the 1993 − 2018 period (max T: 24.5 ± 0.1 vs. 25.3 ± 0.1°C; P < 0.01; mean T:14.4 ± 0.1 vs. 15.3 ± 0.2°C; P < 0.01). MODIS-derived Normalized Difference Vegetation Index (NDVI) analysis showed that growing seasons began and ended later and became shorter (P < 0.05) over the 14 yr analyzed. During this period, increasing maximum spring and summer (May − September) ambient temperatures were associated with decreasing growing season NDVI values (P < 0.01). Over the 52-yr study period, Chihuahuan Desert rangelands at our research site lost 43% of grazing capacity based on PGP. Nine drought yr occurred in the second half of our study compared with 2 yr in the first half. Our research supports predictions by climate scientists that higher temperatures, more frequent droughts, and lower, as well as more erratic, precipitation will adversely impact grazing capacity of rangelands in the southwestern United States.*

McKelvey, K. S., & Buotte, P. C. (2018) Effects of Climate Change on Wildlife in the Northern Rockies. In*: Vol. 63*.

Advances in Global Change Research (pp. 143-167).
Research Tags: Wildlife
Abstract: *Few data exist on the direct effects of climatic variability and change on animal species. Therefore, projected climate change effects must be inferred from what is known about habitat characteristics and the autecology of each species. Habitat for mammals, including predators (Canada lynx, fisher, wolverine) and prey (snowshoe hare) that depend on high-elevation, snowy environments, is expected to deteriorate relatively soon if snowpack continues to decrease. Species that are highly dependent on a narrow range of habitat (pygmy rabbit, Brewer's sparrow, greater sage-grouse) will be especially vulnerable if that habitat decreases from increased disturbance (e.g., sagebrush mortality from wildfire). Species that are mobile or respond well to increased disturbance and habitat patchiness (deer, elk) will probably be resilient to a warmer climate in most locations. Some amphibian species (Columbia spotted frog, western toad) may be affected by pathogens (e.g., amphibian chytrid fungus) that are favored by a warmer climate.*

McManis, A. E., Powell, J. A., & Bentz, B. J. (2019). Developmental parameters of a southern mountain pine beetle (Coleoptera: Curculionidae) population reveal potential source of latitudinal differences in generation time. *Canadian Entomologist, 151*(1), 1-15. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056811554&doi=10.4039%2ftce.2018.51&partnerID=40&md5=ec880a4197be2712f46988a885cd1719. doi:10.4039/tce.2018.51
Research Tags: Forestry, Wildlife
Abstract: *Mountain pine beetle (Dendroctonus ponderosae Hopkins; Coleoptera: Curculionidae) is a major disturbance agent in pine (Pinus Linnaeus; Pinaceae) ecosystems of western North America. Adaptation to local climates has resulted in primarily univoltine generation time across a thermally diverse latitudinal gradient. We hypothesised that voltinism patterns have been shaped by selection for slower developmental rates in southern populations inhabiting warmer climates. To investigate traits responsible for latitudinal differences we measured lifestage-specific development of southern mountain pine beetle eggs, larvae, and pupae across a range of temperatures. Developmental rate curves were fit using maximum posterior likelihood estimation with a Bayesian prior to improve fit stability. When compared to previously published data for a northern population, optimal development of southern individuals occurred at higher temperatures, with higher development thresholds, as compared with northern individuals. Observed developmental rates of the southern and northern populations were similar across studied lifestages at 20 °C, and southern lifestages were generally faster at temperature extremes (10 °C, 27 °C). At 25 °C southern fourth instars were significantly slower than northern fourth instars. Our results suggest that evolved traits in the fourth instar and remaining unstudied lifestage, teneral (i.e., preemergent) adult, likely influence latitudinal differences in mountain pine beetle generation time.*

McManis, A. E., Powell, J. A., & Bentz, B. J. (2019). Modeling mountain pine beetle (Dendroctonus ponderosae) oviposition. *Entomologia Experimentalis et Applicata, 167*(5), 457-466. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063798296&doi=10.1111%2feea.12783&partnerID=40&md5=2506323804a7822f9e3f95e39c7a2a84. doi:10.1111/eea.12783
Research Tags: Wildlife, Forestry
Abstract: *Mountain pine beetle, Dendroctonus ponderosae Hopkins (Coleoptera: Curculionidae, Scolytinae), is a significant forest disturbance agent with a widespread distribution in western North America. Population success is influenced by temperatures that drive phenology and ultimately the adult emergence synchrony required to mass attack and kill host trees during outbreaks. In addition to lifestage-specific developmental rates and thresholds, oviposition timing can be a source of variance in adult emergence synchrony, and is a critical aspect of mountain pine beetle phenology. Adaptation to local climates has resulted in longer generation times in southern compared to northern populations in common gardens, and the role of oviposition rate in these differences is unclear. Oviposition rates and fecundity in a northern population have been described, although data are lacking for southern populations. We assessed southern mountain pine beetle oviposition rates and fecundity in a range of temperatures using a non-destructive technique that included frequent X-ray imaging. We found that oviposition rate and fecundity vary independently such that a female with high oviposition rate did not necessarily have high fecundity and vice versa. Observed fecundity within the 30-day experimental period was lowest at the lowest temperature, although estimated potential*

fecundity did not differ among temperatures. Females at varying temperatures have the potential to lay similar numbers of eggs, although it will take longer at lower temperatures. Southern mountain pine beetle reared in Pinus strobiformis Engelm. (Pinaceae) had a higher upper threshold for oviposition, a similar lower threshold, and slightly greater potential fecundity compared to a northern population reared in Pinus contorta Douglas. A comparison of modeled oviposition rates between the two populations, which could be influenced by host tree, suggests that differences in oviposition rate do not explain observed differences in total generation time. Our oviposition model will facilitate development of a phenology model for southern mountain pine beetle populations.

McNicol, G., Bulmer, C., D'Amore, D., Sanborn, P., Saunders, S., Giesbrecht, I., . . . Buma, B. (2019). Large, climate-sensitive soil carbon stocks mapped with pedology-informed machine learning in the North Pacific coastal temperate rainforest. *Environmental Research Letters, 14*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064121852&doi=10.1088%2f1748-9326%2faaed52&partnerID=40&md5=7e1edaf70a60a7548e2b71bc9940676a. doi:10.1088/1748-9326/aaed52
Research Tags: Soil
Abstract: *Accurate soil organic carbon (SOC) maps are needed to predict the terrestrial SOC feedback to climate change, one of the largest remaining uncertainties in Earth system modeling. Over the last decade, global scale models have produced varied predictions of the size and distribution of SOC stocks, ranging from 1000 to >3000 Pg of C within the top 1 m. Regional assessments may help validate or improve global maps because they can examine landscape controls on SOC stocks and offer a tractable means to retain regionally-specific information, such as soil taxonomy, during database creation and modeling. We compile a new transboundary SOC stock database for coastal watersheds of the North Pacific coastal temperate rainforest, using soil classification data to guide gap-filling and machine learning approaches to explore spatial controls on SOC and predict regional stocks. Precipitation and topographic attributes controlling soil wetness were found to be the dominant controls of SOC, underscoring the dependence of C accumulation on high soil moisture. The random forest model predicted stocks of 4.5 Pg C (to 1 m) for the study region, 22% of which was stored in organic soil layers. Calculated stocks of 228 ± 111 Mg C ha−1 fell within ranges of several past regional studies and indicate 11–33 Pg C may be stored across temperate rainforest soils globally. Predictions compared very favorably to regionalized estimates from two spatially-explicit global products (Pearson's correlation: ρ = 0.73 versus 0.34). Notably, SoilGrids 250 m was an outlier for estimates of total SOC, predicting 4-fold higher stocks (18 Pg C) and indicating bias in this global product for the soils of the temperate rainforest. In sum our study demonstrates that CTR ecosystems represent a moisture-dependent hotspot for SOC storage at mid-latitudes.*

McNulty, S., Du, E., & Paoletti, E. (2017). Virtual Special Issue Preface: Forest Response to Environmental Stress: Impacts and Adaptation. *Science of the Total Environment, 607-608*, 647-648. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022180785&doi=10.1016%2fj.scitotenv.2017.06.204&partnerID=40&md5=69fba6ab1668a5040dca95fd471b2a19. doi:10.1016/j.scitotenv.2017.06.204
Research Tags: Forestry
Abstract: *The current distribution of forest typeswas largely established at the beginning of the Holocene epoch (approximately 12,000 BCE), but forests are constantly in flux. Many regional scale stresses (e.g., drought, heat, fire, and insect) and even a few multi-regional or global stresses (e.g., 8200 BCE cooling, or the medievalwarming period) have occurred over the past 12 millennia. However, modern ecology is less than 200 years old, and large-scale anthropogenic impacts on climate are mainly confined to the latter half of the 20th century. Given the large number of potential climate, geographic, demographic combinations, and relatively short time of study, we should not be surprised that there are an increasing number of observed environmental stresses with no antecedent point of reference. Chronic anthropogenic stressors (e.g., elevated nitrogen, sulfur and heavy metal deposition, and tropospheric ozone) have mentality precondition human thought to accept these impacts as part of the environmental condition in the areas in which they occur. Therefore, the acceptance of non-antecedent variability is part of the challenge associatedwith climate change in which variability exceeds historic observation. This desensitizing of human reaction to disturbance impedes societies' ability to acknowledge unprecedented environmental change, and thereby delays measures to reduce or adapt to these non-antecedent stresses. A poor understanding of non-antecedent stress also contributes to the*

challenges of addressing these unprecedented disturbances.

McNulty, S. G., Boggs, J. L., Aber, J. D., & Rustad, L. E. (2017). Spruce-fir forest changes during a 30-year nitrogen saturation experiment. *Science of the Total Environment, 605-606*, 376-390. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021428825&doi=10.1016%2fj.scitotenv.2017.06.147&partnerID=40&md5=9de88ec73368c67a22b029966027e67f. doi:10.1016/j.scitotenv.2017.06.147
Research Tags: Forestry
Abstract: *A field experiment was established in a high elevation red spruce (Picea rubens Sarg.) – balsam fir (Abies balsamea) forest on Mount Ascutney Vermont, USA in 1988 to test the nitrogen (N) saturation hypothesis, and to better understand the mechanisms causing forest decline at the time. The study established replicate control, low and high dose nitrogen addition plots (i.e., 0, 15.7 and 31.4 kg NH4Cl-N ha− 1 yr− 1). The treatments began in 1988 and continued annually until 2010, but monitoring has continued to present. During the fertilization period, forest floor C:N, net in situ N mineralization, spruce foliar Ca%, and live spruce basal area decreased with increasing N addition, while foliar spruce N% and forest floor net nitrification increased with increasing N addition. The control plots aggraded forest floor N at a rate equal to the sum of the net in situ N mineralization plus average ambient deposition. Conversely, N addition plots lost forest floor N. Following the termination of N additions in 2010, the measured tree components returned to pre-treatment levels, but forest floor processes were slower to respond. During the 30 year study, site surface air temperature has increased by 0.5 °C per decade, and total N deposition has decreased 5.5 to 4.0 kg N ha− 1 yr− 1. There have also been three significant drought years and at least one freeze injury year after which much of the forest mortality on the N addition plots occurred. Given that there was no control for the air temperature increase, discussion of the interactive impacts of climate and change and N addition is only subjective. Predicted changes in climate, N deposition and other stressors suggest that even in the absence of N saturation, regeneration of the spruce-fir ecosystem into the next century seems unlikely despite recent region-wide growth increases.*

McPartland, M. Y., Kane, E. S., Falkowski, M. J., Kolka, R., Turetsky, M. R., Palik, B., & Montgomery, R. A. (2019). The response of boreal peatland community composition and NDVI to hydrologic change, warming, and elevated carbon dioxide. *Global Change Biology, 25*(1), 93-107. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055526693&doi=10.1111%2fgcb.14465&partnerID=40&md5=a2627d3fe768f86624350567983d532d. doi:10.1111/gcb.14465
Research Tags: Soil, Water, Weather, Emissions
Abstract: *Widespread changes in arctic and boreal Normalized Difference Vegetation Index (NDVI) values captured by satellite platforms indicate that northern ecosystems are experiencing rapid ecological change in response to climate warming. Increasing temperatures and altered hydrology are driving shifts in ecosystem biophysical properties that, observed by satellites, manifest as long-term changes in regional NDVI. In an effort to examine the underlying ecological drivers of these changes, we used field-scale remote sensing of NDVI to track peatland vegetation in experiments that manipulated hydrology, temperature, and carbon dioxide (CO2) levels. In addition to NDVI, we measured percent cover by species and leaf area index (LAI). We monitored two peatland types broadly representative of the boreal region. One site was a rich fen located near Fairbanks, Alaska, at the Alaska Peatland Experiment (APEX), and the second site was a nutrient-poor bog located in Northern Minnesota within the Spruce and Peatland Responses Under Changing Environments (SPRUCE) experiment. We found that NDVI decreased with long-term reductions in soil moisture at the APEX site, coincident with a decrease in photosynthetic leaf area and the relative abundance of sedges. We observed increasing NDVI with elevated temperature at the SPRUCE site, associated with an increase in the relative abundance of shrubs and a decrease in forb cover. Warming treatments at the SPRUCE site also led to increases in the LAI of the shrub layer. We found no strong effects of elevated CO2 on community composition. Our findings support recent studies suggesting that changes in NDVI observed from satellite platforms may be the result of changes in community composition and ecosystem structure in response to climate warming.*

McPherson, E. G., Berry, A. M., & van Doorn, N. S. (2018). Performance testing to identify climate-ready trees. *Urban Forestry and Urban Greening, 29*, 28-39. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033409596&doi=10.1016%2fj.ufug.2017.09.003&partnerID=40&md5=4180d58133fbb702db76e18abbe2beaf. doi:10.1016/j.ufug.2017.09.003

Research Tags: Forestry
Abstract: *Urban forests produce ecosystem services that can benefit city dwellers, but are especially vulnerable to climate change stressors such as heat, drought, extreme winds and pests. Tree selection is an important decision point for managers wanting to transition to a more stable and resilient urban forest structure. This study describes a five-step process to identify and evaluate the performance of promising but infrequently used tree species. The approach is illustrated for the Central Valley of California, USA and has been implemented in the Inland Empire and Southern Coastal regions of California. Horticultural advisors nominated 134 taxon for consideration. A filtering process eliminated taxon that were relatively abundant in a compilation of 8 municipal tree inventories, then those with low adaptive capacity when scored on habitat suitability, physiology and biological interactions. In 2015, 144 trees were planted, with 2 trees of each of 12 species planted in 4 Sacramento parks and 4 replicates planted in the Davis, California reference site. This approach can serve as an international model for cities interested in climate adaptation through urban forestry.*

McPherson, E. G., Xiao, Q., van Doorn, N. S., de Goede, J., Bjorkman, J., Hollander, A., . . . Thorne, J. H. (2017). The structure, function and value of urban forests in California communities. *Urban Forestry and Urban Greening, 28*, 43-53. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031507941&doi=10.1016%2fj.ufug.2017.09.013&partnerID=40&md5=ea97432264a82649c45b30082a9dabca. doi:10.1016/j.ufug.2017.09.013
Research Tags: Economics, Forestry, Wildlife
Abstract: *This study used tree data from field plots in urban areas to describe forest structure in urban areas throughout California. The plot data were used with numerical models to calculate several ecosystem services produced by trees. A series of transfer functions were calculated to scale-up results from the plots to the landscape using urban tree canopy (UTC) mapped at 1-m resolution for each combination of 6 land use classes and climate zones. California's UTC covered 15% of the urban area and contained 173.2 million trees, five per city resident. UTC per capita was lowest among U.S. states (90.8 m2), indicating ample opportunity for tree planting. Oaks were the most abundant taxon (22%) and overall plantings were youthful. The annual value of ecosystem services was estimated at $8.3 billion and the urban forests asset value was $181 billion. Assuming an average annual per tree management cost of $19 and benefit of $47.83, $2.52 in benefit was returned for every dollar spent. The threat posed by Invasive Shot Hole Borer (Euwallacea sp.) illustrates that urban forests are a relatively fragile resource whose contributions to human health and well-being can be suddenly jeopardized. One scenario projected that should Southern California cities lose 50% (11.6 million) of all susceptible trees, the value of ecoservices foregone over 10 years was $616.6 million. The approximate cost of removing and replacing the trees was $15.9 billion. Strategies to reduce the risk of catastrophic loss by increasing the resilience of California's urban forests are discussed.*

McRoberts, R. E., Næsset, E., & Gobakken, T. (2018). Comparing the stock-change and gain–loss approaches for estimating forest carbon emissions for the aboveground biomass pool. *Canadian Journal of Forest Research, 48*(12), 1535-1542. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057773463&doi=10.1139%2fcjfr-2018-0295&partnerID=40&md5=832519a8f69beafd42b8e26bd7f49142. doi:10.1139/cjfr-2018-0295
Research Tags: Emissions, Forestry
Abstract: *Two approaches to greenhouse gas (GHG) inventories are common, namely the stock-change approach and the gain–loss approach. With the stock-change approach, mean annual emissions are estimated as the ratio of the difference in stock estimates at two points in time and the number of intervening years. The stock-change approach is fairly easy to implement for countries with well-established forest sampling programs. However, countries without established forest sampling programs more commonly use the gain–loss approach. With this approach, emissions are estimated as the product of the areas of classes of land use change, characterized as activity data, and the responses of carbon stocks for those classes, characterized as emission factors. Regardless of the approach, the Intergovernmental Panel on Climate Change (IPCC) good practice guidelines specify that GHG inventories produce neither over- nor under-estimates and reduce uncertainties to the degree possible. For a study area in southeastern Norway, the objectives of the study were to compare the stock-change and gain–loss approaches with respect to estimates of carbon emissions for the aboveground biomass pool and to illustrate statistically rigorous methods for complying with the two IPCC*

good practice guidelines for both approaches. The primary conclusions were that the two approaches produced comparable estimates of mean annual emissions, but that the stock-change approach produced considerably smaller estimates of uncertainty.

Mech, A. M., Tobin, P. C., Teskey, R. O., Rhea, J. R., & Gandhi, K. J. K. (2018). Increases in summer temperatures decrease the survival of an invasive forest insect. *Biological Invasions, 20*(2), 365-374. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027505905&doi=10.1007%2fs10530-017-1537-7&partnerID=40&md5=363939f00c9d8d924717c613af7644e0. doi:10.1007/s10530-017-1537-7

Research Tags: Forestry, Wildlife, Weather

Abstract: *Higher temperatures projected under current climate change models are generally predicted to exert an overall positive effect on the success of invasive insects through increased survivability, developmental rates and fecundity, and by facilitating geographic range expansion. However, these effects have primarily focused on the shifts in winter temperatures with limited attention to the role that summer heat may play in shaping species ranges or fitness. We examined the thermal ecology of an ecologically important invasive forest insect, the hemlock woolly adelgid (Adelges tsugae), by determining survival during its summer dormancy phase under increasing temperature regimens. From laboratory and field experiments, we documented a positive association between increased temperatures and duration of exposure, and A. tsugae mortality. Adelges tsugae mortality was minimal (<20%) when exposed to summer temperatures characteristic to its native range (<25 °C), but markedly increased (up to 100%) when exposed to temperatures that occur occasionally or rarely in natural settings (>30 °C). At the warmest, southernmost edge of their range, field mortality of A. tsugae ranged from 8.5 to 81.9% and was strongly correlated with site temperature regimens. Further, we found no significant differences in A. tsugae survival between populations collected from Maine and Georgia, and over a 3-year period within Georgia, indicating that A. tsugae may not be acclimating to heat. These results highlight the importance of including summer temperatures in studies regarding increased temperatures on insect dynamics, and may alter historical predictions of climate change impacts on invasive insects and the conservation of forest ecosystems.*

Mehan, S., Aggarwal, R., Gitau, M. W., Flanagan, D. C., Wallace, C. W., & Frankenberger, J. R. (2019). Assessment of hydrology and nutrient losses in a changing climate in a subsurface-drained watershed. *Science of the Total Environment, 688*, 1236-1251. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068168488&doi=10.1016%2fj.scitotenv.2019.06.314&partnerID=40&md5=b6eebb110ee5ad61c0018d17913dabb5. doi:10.1016/j.scitotenv.2019.06.314

Research Tags: Water

Abstract: *Studies assessing the impact of subsurface drains on hydrology and nutrient yield in a changing climate are limited, specifically for Western Lake Erie Basin. This study aimed to evaluate the impact of changing climate on hydro-climatology and nutrient loadings in agricultural subsurface-drained areas on a watershed in northeastern Indiana. The study was conducted using a hydrologic model - the Soil and Water Assessment Tool (SWAT) - under two different greenhouse gas emission scenarios (RCP 4.5 and RCP 8.5). Based on analysis, annual subsurface drain flow totals could increase by 70% with respect to the baseline by the end of the 21st century. Surface runoff could increase by 10 to 140% and changes are expected to be greater under RCP 8.5. Soluble phosphorus yield over the basin in a year via subsurface drains could decrease by 30 to 60% under either emission scenarios. Annual total soluble phosphorus yield (soluble phosphorus loading to stream) from subsurface drains and surface runoff could vary from 0.041 to 0.058 kg/ha under RCP 4.5 and 0.035 to 0.064 kg/ha under RCP 8.5 by the end of the 21st century while the values from the baseline model were 0.051 kg/ha. This was attributable to the fact that future climate could have a greater increase in surface runoff than subsurface drain flow based on analysis of the different climate scenarios. Outputs from individual climate model data rather than ensembles provided a band of influence of watershed responses, while outputs from different timelines provided details for evaluating management practice suitability with respect to anticipated differences in climate. Results provide valuable information for stakeholders and policy makers for planning management practices to protect water quality.*

Mehan, S., Gitau, M. W., & Flanagan, D. C. (2019). Reliable future climatic projections for sustainable hydro-meteorological assessments in the Western Lake Erie Basin. *Water (Switzerland), 11*(3). Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065013336&doi=10.3390%2fw11030581&partnerID=40&md5=008703f0c46950d898f5e2a4b3863e76. doi:10.3390/w11030581
Research Tags: Water
Abstract: *Modeling efforts to simulate hydrologic processes under different climate conditions rely on accurate input data. Among other inaccuracies, errors in climate projections can lead to incorrect decisions. This study aimed to develop a reliable climate (precipitation and temperature) database for the Western Lake Erie Basin for the 21st century. Two statistically downscaled bias-corrected sources of climate projections (GDO: Global Downscaled Climate and Hydrology Projections and MACA: Multivariate Adaptive Constructed Analogs) were tested for their effectiveness in simulating historic climate (1966–2005) using ground-based station data from the National Climatic Data Center. MACA was found to have less bias than GDO and was better at simulating selected climate indices; thus, its climate projections were subsequently tested with different bias correction methods including the power transformation method, variance scaling of temperature, and Stochastic Weather Generators. The power transformation method outperformed the other methods and was used in bias corrections for 2006 to 2099. From the analysis, mean daily precipitation values were expected to remain more or less the same under both RCP (Representative Concentration Pathway) 4.5 and RCP 8.5 scenarios, ranging between 2.4 mm and 3.2 mm, while standard deviations were expected to increase, pointing to a rescaling of the distribution. Maximum one-day precipitation was expected to increase and could vary between 120 and 650 mm across the basin, while the number of wet days could potentially increase under the effects of RCP 4.5 and RCP 8.5. Both mean maximum and mean minimum daily air temperatures were expected to increase by up to 5.0 °C across the basin, while absolute maximum and minimum values could increase by more than 10 °C. The number of days in which precipitation could potentially fall as snow was expected to decrease, as was the annual number of days for optimal corn growth, although an earlier start to the growing season could be expected. Results from this study were very useful in creating a reliable climate database for the entire Western Lake Erie Basin (WLEB), which can be used for hydrologic, water resources, and other applications in the basin. The resulting climate database is published and accessible through the Purdue University Research Repository (Mehan et al., 2019), which is an open-access repository.*

Mehan, S., Guo, T., Gitau, M. W., & Flanagan, D. C. (2017). Comparative study of different stochasticweather generators for long-term climate data simulation. *Climate, 5*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027383062&doi=10.3390%2fcli5020026&partnerID=40&md5=ec5c3784ca2eaf3bfe36fa7da6d0262a. doi:10.3390/cli5020026
Research Tags: Weather, Research
Abstract: *Climate is one of the single most important factors affecting watershed ecosystems and water resources. The effect of climate variability and change has been studied extensively in some places; in many places, however, assessments are hampered by limited availability of long-term continuous climate data. Weather generators provide a means of synthesizing long-term climate data that can then be used in natural resource assessments. Given their potential, there is the need to evaluate the performance of the generators; in this study, three commonly used weather generators—CLImate GENerator (CLIGEN), Long Ashton Research Station Weather Generator (LARS-WG), and Weather Generators (WeaGETS) were compared with regard to their ability to capture the essential statistical characteristics of observed data (distribution, occurrence of wet and dry spells, number of snow days, growing season temperatures, and growing degree days). The study was based on observed 1966–2015 weather station data from the Western Lake Erie Basin (WLEB), from which 50 different realizations were generated, each spanning 50 years. Both CLIGEN and LARS-WG performed fairly well with respect to representing the statistical characteristics of observed precipitation and minimum and maximum temperatures, although CLIGEN tended to overestimate values at the extremes. This generator also overestimated dry sequences by 18%–30% and snow-day counts by 12%–19% when considered over the entire WLEB. It (CLIGEN) was, however, well able to simulate parameters specific to crop growth such as growing degree days and had an added advantage over the other generators in that it simulates a larger number of weather variables. LARS-WG overestimated wet sequence counts across the basin by 15%–38%. In addition, the optimal growth period simulated by LARS-WG also exceeded that obtained from observed data by 16%–29% basin-wide. Preliminary results with WeaGETS indicated that additional evaluation is needed to better define its parameters. Results provided insights into the suitability of both CLIGEN and LARS-WG for use with water resource applications.*

Mehmood, K., Chávez Garcia, E., Schirrmann, M., Ladd, B., Kammann, C., Wrage-Mönnig, N., . . . Borchard, N. (2017). Biochar research activities and their relation to development and environmental quality. A meta-analysis. *Agronomy for Sustainable Development, 37*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020537248&doi=10.1007%2fs13593-017-0430-1&partnerID=40&md5=cc7771f75b67af009a714e16d9e00b92. doi:10.1007/s13593-017-0430-1

Research Tags: Soil

Abstract: *Biochar is the solid product that results from pyrolysis of organic materials. Its addition to highly weathered soils changes physico-chemical soil properties, improves soil functions and enhances crop yields. Highly weathered soils are typical of humid tropics where agricultural productivity is low and needs to be raised to reduce human hunger and poverty. However, impact of biochar research on scientists, politicians and end-users in poor tropical countries remains unknown; assessing needs and interests on biochar is essential to develop reliable knowledge transfer/translation mechanisms. The aim of this publication is to present results of a meta-analysis conducted to (1) survey global biochar research published between 2010 and 2014 to assess its relation to human development and environmental quality, and (2) deduce, based on the results of this analysis, priorities required to assess and promote the role of biochar in the development of adapted and sustainable agronomic methods. Our main findings reveal for the very first time that: (1) biochar research associated with less developed countries focused on biochar production technologies (26.5 ± 0.7%), then on biochars' impact on chemical soil properties (18.7 ± 1.2%), and on plant productivity (17.1 ± 2.6%); (2) China dominated biochar research activities among the medium developed countries focusing on biochar production technologies (26.8 ± 0.5%) and on use of biochar as sorbent for organic and inorganic compounds (29.1 ± 0.4%); and (3) the majority of biochar research (69.0±2.9%) was associated with highly developed countries that are able to address a higher diversity of questions. Evidently, less developed countries are eager to improve soil fertility and agricultural productivity, which requires transfer and/or translation of biochar knowledge acquired in highly developed countries. Yet, improving local research capacities and encouraging synergies across scientific disciplines and countries are crucial to foster development of sustainable agronomy in less developed countries.*

Mehra, P., Baker, J., Sojka, R. E., Bolan, N., Desbiolles, J., Kirkham, M. B., . . . Gupta, R. (2018) A Review of Tillage Practices and Their Potential to Impact the Soil Carbon Dynamics. In*: Vol. 150. Advances in Agronomy* (pp. 185-230).

Research Tags: Soil, Crops, Emissions

Abstract: *The intensification of global agriculture has led to a decline in arable land. Globally, agriculture intensification has not only degraded the soil quality but also contributed to increasing the greenhouse gas (GHG) levels. These concerns attract the interest of environmental scientists and academicians to find ways to sequester more carbon (C) in the agricultural soils. Tillage is one method that can affect biological C sequestration and effects the GHG production. The components of GHGs are produced slowly from the soil through the reactions taking place between C and nutrients (nitrogen in particular), which remain present in the soil. An understanding of biological C sequestration processes in agricultural production systems can lead to potentially cost-effective strategies able to mitigate global warming. Globally, the shift in tillage practice from conventional tillage to no-tillage is effectively protecting soils under cropping, improving their quality—or reducing their rate of soil organic matter decline—as well as enhancing the resilience of cropping systems. This review summarizes the current knowledge about no-till technology and its impacts on soil properties related to carbon dynamics and explores the potential role of tillage practices in mitigating climate change.*

Meiners, J. M., Griswold, T. L., & Carril, O. M. (2019). Decades of native bee biodiversity surveys at Pinnacles National Park highlight the importance of monitoring natural areas over time. *PLoS ONE, 14*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060183144&doi=10.1371%2fjournal.pone.0207566&partnerID=40&md5=245fc000651adf81d2a7fac3b07fa0d5. doi:10.1371/journal.pone.0207566

Research Tags: Wildlfie

Abstract: *Thousands of species of bees are in global decline, yet research addressing the ecology and status of these wild pollinators lags far behind work being done to address similar impacts on the managed honey bee. This knowledge gap is especially glaring in natural areas, despite knowledge that protected habitats harbor and* *export diverse bee communities into nearby croplands where their pollination services have been valued at over $3 billion per year. Surrounded by ranches and farmlands, Pinnacles National Park in the Inner South Coast Range of California contains intact Mediterranean chaparral shrubland. This habitat type is among the most valuable for bee biodiversity worldwide, as well as one of the most vulnerable to agricultural conversion, urbanization and climate change. Pinnacles National Park is also one of a very few locations where extensive native bee inventory efforts have been repeated over time. This park thus presents a valuable and rare opportunity to monitor long-term trends and baseline variability of native bees in natural habitats. Fifteen years after a species inventory marked Pinnacles as a biodiversity hotspot for native bees, we resurveyed these native bee communities over two flowering seasons using a systematic, plot-based design. Combining results, we report a total of 450 bee species within this 109km2 natural area of California, including 48 new species records as of 2012 and 95 species not seen since 1999. As far as we are aware, this species richness marks Pinnacles National Park as one of the most densely diverse places known for native bees. We explore patterns of bee diversity across this protected landscape, compare results to other surveyed natural areas, and highlight the need for additional repeated inventories in protected areas over time amid widespread concerns of bee declines.*

Meiners, J. M., Griswold, T. L., Harris, D. J., & Ernest, S. K. M. (2017). Bees without flowers: Before peak bloom, diverse native bees find insect-produced honeydew sugars. *American Naturalist, 190*(2), 281-291. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026287971&doi=10.1086%2f692437&partnerID=40&md5=ce286af793d93b5a6f6fae7fa0c4e634. doi:10.1086/692437

Research Tags: Wildlife

Abstract: *Bee foragers respond to complex visual, olfactory, and extrasensory cues to optimize searches for floral rewards. Their abilities to detect and distinguish floral colors, shapes, volatiles, and ultraviolet signals and even gauge nectar availability from changes in floral humidity or electric fields are well studied. Bee foraging behaviors in the absence of floral cues, however, are rarely considered. We observed 42 species of wild bees visiting inconspicuous, nonflowering shrubs during early spring in a protected Mediterranean habitat. We determined experimentally that these bees were accessing sugary honeydew secretions from scale insects without the aid of standard cues. While honeydew use is known among some social Hymenoptera, its use across a diverse community of solitary bees is a novel observation. The widespread ability of native bees to locate and use unadvertised, nonfloral sugars suggests unappreciated sensory mechanisms and/or the existence of an interspecific foraging network among solitary bees that may influence how native bees cope with scarcity of floral resources and increasing environmental change.*

Mejia, F. H., Fremier, A. K., Benjamin, J. R., Bellmore, J. R., Grimm, A. Z., Watson, G. A., & Newsom, M. (2019). Stream metabolism increases with drainage area and peaks asynchronously across a stream network. *Aquatic Sciences, 81*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057991093&doi=10.1007%2fs00027-018-0606-z&partnerID=40&md5=0632409d5347bfbfe7d7ef9af1febaed. doi:10.1007/s00027-018-0606-z

Research Tags: Water

Abstract: *Quantifying the spatial and temporal dynamics of stream metabolism across stream networks is key to understanding carbon cycling and stream food web ecology. To better understand intra-annual temporal patterns of gross primary production (GPP) and ecosystem respiration (ER) and their variability across space, we continuously measured dissolved oxygen and modeled stream metabolism for an entire year at ten sites across a temperate river network in Washington State, USA. We expected GPP and ER to increase with stream size and peak during summer and autumn months due to warmer temperatures and higher light availability. We found that GPP and ER increased with drainage area and that only four sites adhered to our expectations of summer peaks in GPP and autumn peaks in ER while the rest either peaked in winter, spring or remained relatively constant. Our results suggest the spatial arrangement and temporal patterns of discharge, temperature, light and nutrients within watersheds may result in asynchronies in GPP and ER, despite similar regional climatic conditions. These findings shed light on how temporal dynamics of stream metabolism can shift across a river network, which likely influence the dynamics of carbon cycling and stream food webs at larger scales.*

Meng, R., Dennison, P. E., Zhao, F., Shendryk, I., Rickert, A., Hanavan, R. P., . . . Serbin, S. P. (2018). Mapping canopy

defoliation by herbivorous insects at the individual tree level using bi-temporal airborne imaging spectroscopy and LiDAR measurements. *Remote Sensing of Environment, 215*, 170-183. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048265825&doi=10.1016%2fj.rse.2018.06.008&partnerID=40&md5=e9664c0f9ac7fce251fd3bc3278f9aa8. doi:10.1016/j.rse.2018.06.008
Research Tags: Forestry, Wildlife
Abstract: *Defoliation by herbivorous insects is a widespread forest disturbance driver, affecting global forest health and ecosystem dynamics. Compared with time- and labor-intensive field surveys, remote sensing provides the only realistic approach to mapping canopy defoliation by herbivorous insects over large spatial and temporal scales. However, the spectral and structural signatures of defoliation by insects at the individual tree level have not been well studied. Additionally, the predictive power of spectral and structural metrics for mapping canopy defoliation has seldom been compared. These critical knowledge gaps prevent us from consistently detecting and mapping canopy defoliation by herbivorous insects across multiple scales. During the peak of a gypsy moth outbreak in Long Island, New York in summer 2016, we leveraged bi-temporal airborne imaging spectroscopy (IS, i.e., hyperspectral imaging) and LiDAR measurements at 1 m spatial resolution to explore the spectral and structural signatures of canopy defoliation in a mixed oak-pine forest. We determined that red edge and near-infrared spectral regions within the IS data were most sensitive to crown-scale defoliation severity. LiDAR measurements including B70 (i.e., 70th bincentile height), intensity skewness, and kurtosis were effectively able to detect structural changes caused by herbivorous insects. In addition to canopy leaf loss, increased exposure of understory and non-photosynthetic materials contributed to the detected spectral and structural signatures. Comparing the ability of individual sensors to map canopy defoliation, the LiDAR-only Ordinary Least-Square (OLS) model performed better than the IS-only model (Adj. R-squared = 0.77, RMSE = 15.37% vs. Adj. R-squared = 0.63, RMSE = 19.11%). The IS + LiDAR model improved on performance of the individual sensors (Adj. R-squared = 0.81, RMSE = 14.46%). Our study improves our understanding of spectral and structural signatures of defoliation by herbivorous insects and presents a novel approach for mapping insect defoliation at the individual tree level. Additionally, with the current and next generation of spaceborne sensors (e.g., WorldView-3, Landsat, Sentinel-2, HyspIRI, and GEDI), higher accuracy and frequent monitoring of insect defoliation may become more feasible across a range of spatial scales, which are critical for ecological research and management of forest resources including the economic consequences of forest insect infestations (e.g., reduced growth and increased mortality), as well as for informing and testing of carbon cycle models.*

Meng, R., Wu, J., Zhao, F., Cook, B. D., Hanavan, R. P., & Serbin, S. P. (2018). Measuring short-term post-fire forest recovery across a burn severity gradient in a mixed pine-oak forest using multi-sensor remote sensing techniques. *Remote Sensing of Environment, 210*, 282-296. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044455257&doi=10.1016%2fj.rse.2018.03.019&partnerID=40&md5=0a840ae848da242b518501ae264ee43e. doi:10.1016/j.rse.2018.03.019
Research Tags: Weather, Forestry
Abstract: *Understanding post-fire forest recovery is pivotal to the study of forest dynamics and global carbon cycle. Field-based studies indicated a convex response of forest recovery rate to burn severity at the individual tree level, related with fire-induced tree mortality; however, these findings were constrained in spatial/temporal extents, while not detectable by traditional optical remote sensing studies, largely attributing to the contaminated effect from understory recovery. Here, we examined whether the combined use of multi-sensor remote sensing techniques (i.e., 1 m simultaneous airborne imaging spectroscopy and LiDAR and 2 m satellite multi-spectral imagery) to separate canopy recovery from understory recovery would enable to quantify post-fire forest recovery rate spanning a large gradient in burn severity over large-scales. Our study was conducted in a mixed pine-oak forest in Long Island, NY, three years after a top-killing fire. Our studies remotely detected an initial increase and then decline of forest recovery rate to burn severity across the burned area, with a maximum canopy area-based recovery rate of 10% per year at moderate forest burn severity class. More intriguingly, such remotely detected convex relationships also held at species level, with pine trees being more resilient to high burn severity and having a higher maximum recovery rate (12% per year) than oak trees (4% per year). These results are one of the first quantitative evidences showing the effects of fire adaptive strategies on post-fire forest recovery, derived from relatively large spatial-temporal scales. Our study thus provides the methodological advance to link multi-sensor remote sensing techniques to monitor forest*

dynamics in a spatially explicit manner over large-scales, with important implications for fire-related forest management and constraining/benchmarking fire effect schemes in ecological process models.

Metlen, K. L., Skinner, C. N., Olson, D. R., Nichols, C., & Borgias, D. (2018). Regional and local controls on historical fire regimes of dry forests and woodlands in the Rogue River Basin, Oregon, USA. *Forest Ecology and Management, 430*, 43-58. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051117129&doi=10.1016%2fj.foreco.2018.07.010&partnerID=40&md5=a34eca0da5b63a512d1d4e7475461d4e. doi:10.1016/j.foreco.2018.07.010

Research Tags: Weather, Forestry

Abstract: *Fire regimes structure plant communities worldwide with regional and local factors, including anthropogenic fire management, influencing fire frequency and severity. Forests of the Rogue River Basin in Oregon, USA, are both productive and fire-prone due to ample winter precipitation and summer drought; yet management in this region is strongly influenced by forest practices that depend on fire exclusion. Regionally, climate change is increasing fire frequency, elevating the importance of understanding historically frequent-fire regimes.*

We use cross-dated fire-scars to characterize historical fire return intervals, seasonality, and relationships with climate beginning in 1650 CE for 13 sites representative of southwestern Oregon dry forests. Using systematic literature review, we link our local fire histories to a regional dataset and evaluate our data relative to more intensively studied conifer/hardwood forest types in California.

Fire-scars show that fires in the Rogue Basin were frequent and regular until disrupted in the 1850s through 1910s, corresponding with forced displacement of Native Americans and Euro-American settlement. Median historical fire return intervals were 8 years at the stand-scale (<25 ha), with site medians ranging from five to 14 years and no significant differences between sampled vegetation types. Burn seasonality was broadly distributed with 47% of recorded fires in the latewood (midsummer), 30% at the ring boundary (late summer and fall), and 23% in the earlywood (spring and early summer).

The number of sites recording fire each year was associated with Palmer Drought Severity Index (PDSI) and El Niño Southern Oscillation Index (ENSO). Fires were detected in the study area every other year, and synchrony among sites was associated with stronger annual drought. The ENSO synchronization of fire suggests an herbaceous fuel signal, with warm winters/wet summers two years prior to widespread fire-years, a pattern observed globally in fuel-limited systems.

Stand-scale fire histories in the Klamath, southern Cascades, and northern Sierra Nevada ecoregions resemble Rogue River Basin stand-scale fire histories. Across dry mixed conifer, yellow pine, and mixed evergreen forests, fire return intervals converged on 8 years. Moist mixed conifer and red fir forests exhibited 13-year fire return intervals. Across ecoregions, fire periodicity was weakly correlated with climatic water deficit, but well-modeled by elevation, precipitation, and temperature. These data highlight the need for decadal fire and burning outside of the contemporary fire season for forest restoration and climate adaptation in the dry forests of the Rogue Basin.

Meurisse, N., Rassati, D., Hurley, B. P., Brockerhoff, E. G., & Haack, R. A. (2019). Common pathways by which non-native forest insects move internationally and domestically. *Journal of Pest Science, 92*(1), 13-27. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047821550&doi=10.1007%2fs10340-018-0990-0&partnerID=40&md5=25b3e3eb19fe27aeb9436ab9ccf79d8b. doi:10.1007/s10340-018-0990-0

Research Tags: Forestry, Wildlife

Abstract: *International trade and movement of people are largely responsible for increasing numbers of non-native insect introductions to new environments. For forest insects, trade in live plants and transport of wood packaging material (WPM) are considered the most important pathways facilitating long-distance invasions. These two pathways as well as trade in firewood, logs, and processed wood are commonly associated with insect infestations, while "hitchhiking" insects can be moved on cargo, in the conveyances used for transport (e.g., containers, ships), or associated with international movement of passengers and mail. Once established in a new country, insects can spread domestically through all of the above pathways. Considerable national and international efforts have been made in recent years to reduce the risk of international movement of plant pests. International Standards for Phytosanitary Measures (ISPMs) No. 15 (WPM), 36 (plants for planting), and 39 (wood) are examples of phytosanitary standards that have been adopted by the International*

Plant Protection Convention to reduce risks of invasions of forest pests. The implementation of ISPMs by exporting countries is expected to reduce the arrival rate and establishments of new forest pests. However, many challenges remain to reduce pest transportation through international trade, given the ever-increasing volume of traded goods, variations in quarantine procedures between countries, and rapid changes in distribution networks. It is therefore likely that many more human-assisted invasions of forest insects will take place. New geographic expansions by natural modes are also made possible due to changes in host distribution and/or climate.

Meyer, V., Saatchi, S., Clark, D. B., Keller, M., Vincent, G., Ferraz, A., . . . Chave, J. (2018). Canopy area of large trees explains aboveground biomass variations across neotropical forest landscapes. *Biogeosciences, 15*(11), 3377-3390. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048321096&doi=10.5194%2fbg-15-3377-2018&partnerID=40&md5=14dd881d7931c7e55166bd3a3bff0c0f. doi:10.5194/bg-15-3377-2018
Research Tags: Forestry
Abstract: *Large tropical trees store significant amounts of carbon in woody components and their distribution plays an important role in forest carbon stocks and dynamics. Here, we explore the properties of a new lidar-derived index, the large tree canopy area (LCA) defined as the area occupied by canopy above a reference height. We hypothesize that this simple measure of forest structure representing the crown area of large canopy trees could consistently explain the landscape variations in forest volume and aboveground biomass (AGB) across a range of climate and edaphic conditions. To test this hypothesis, we assembled a unique dataset of high-resolution airborne light detection and ranging (lidar) and ground inventory data in nine undisturbed old-growth Neotropical forests, of which four had plots large enough (1 ha) to calibrate our model. We found that the LCA for trees greater than 27 m (∼25–30 m) in height and at least 100 m2 crown size in a unit area (1 ha), explains more than 75 % of total forest volume variations, irrespective of the forest biogeographic conditions. When weighted by average wood density of the stand, LCA can be used as an unbiased estimator of AGB across sites (R2 = 0.78, RMSE = 46.02 Mg ha−1, bias = −0.63 Mg ha−1). Unlike other lidar-derived metrics with complex nonlinear relations to biomass, the relationship between LCA and AGB is linear and remains unique across forest types. A comparison with tree inventories across the study sites indicates that LCA correlates best with the crown area (or basal area) of trees with diameter greater than 50 cm. The spatial invariance of the LCA–AGB relationship across the Neotropics suggests a remarkable regularity of forest structure across the landscape and a new technique for systematic monitoring of large trees for their contribution to AGB and changes associated with selective logging, tree mortality and other types of tropical forest disturbance and dynamics.*

Miao, G., Noormets, A., Domec, J. C., Fuentes, M., Trettin, C. C., Sun, G., . . . King, J. S. (2017). Hydrology and microtopography control carbon dynamics in wetlands: Implications in partitioning ecosystem respiration in a coastal plain forested wetland. *Agricultural and Forest Meteorology, 247*, 343-355. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028394022&doi=10.1016%2fj.agrformet.2017.08.022&partnerID=40&md5=918f8c589b56717a4d7ab9a701a73ec5. doi:10.1016/j.agrformet.2017.08.022
Research Tags: Water, Forestry
Abstract: *Wetlands store a disproportionately large fraction of organic carbon relative to their areal coverage, and thus play an important role in global climate mitigation. As destabilization of these stores through land use or environmental change represents a significant climate feedback, it is important to understand the functional regulation of respiratory processes that catabolize them. In this study, we established an eddy covariance flux tower project in a coastal plain forested wetland in North Carolina, USA, and measured total ecosystem respiration (Re) over three years (2009–2011). We evaluated the magnitude and variability of three respiration components – belowground (Rs), coarse woody debris (RCWD), and aboveground plant (Ragp) respiration at the ecosystem scale, by accounting microtopographic variation for upscaling and constraining the mass balance with Re. Strong hydrologic control was detected for Rs and RCWD, whereas Ragp and Re were relatively insensitive to water table fluctuations. In a relatively dry year (2010), this forested wetland respired a total of about 2000 g CO2-C m-2 y-1 annually, 51% as Rs, 37% as Ragp, and 12% as RCWD. During non-flooded periods Rs contributed up to 57% of Re and during flooded periods Ragp contributed up to 69%. The contribution of Rs to Re increased by 2.4% for every cm of decrease in water level at intermediate water*

table level, and was nearly constant when flooded or when the water level more than 15 cm below ground. The contrasting sensitivity of different respiration components highlights the need for explicit consideration of this dynamic in ecosystem and Earth System Models.

Michaelides, K., Hollings, R., Singer, M. B., Nichols, M. H., & Nearing, M. A. (2018). Spatial and temporal analysis of hillslope–channel coupling and implications for the longitudinal profile in a dryland basin. *Earth Surface Processes and Landforms, 43*(8), 1608-1621. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042066498&doi=10.1002%2fesp.4340&partnerID=40&md5=5d51046ed63500718dceed26ee3c9e23. doi:10.1002/esp.4340

Research Tags: Water

Abstract: *The long-term evolution of channel longitudinal profiles within drainage basins is partly determined by the relative balance of hillslope sediment supply to channels and the evacuation of channel sediment. However, the lack of theoretical understanding of the physical processes of hillslope–channel coupling makes it challenging to determine whether hillslope sediment supply or channel sediment evacuation dominates over different timescales and how this balance affects bed elevation locally along the longitudinal profile. In this paper, we develop a framework for inferring the relative dominance of hillslope sediment supply to the channel versus channel sediment evacuation, over a range of temporal and spatial scales. The framework combines distinct local flow distributions on hillslopes and in the channel with surface grain-size distributions. We use these to compute local hydraulic stresses at various hillslope-channel coupling locations within the Walnut Gulch Experimental Watershed (WGEW) in southeast Arizona, USA. These stresses are then assessed as a local net balance of geomorphic work between hillslopes and channel for a range of flow conditions generalizing decadal historical records. Our analysis reveals that, although the magnitude of hydraulic stress in the channel is consistently higher than that on hillslopes, the product of stress magnitude and frequency results in a close balance between hillslope supply and channel evacuation for the most frequent flows. Only at less frequent, high-magnitude flows do channel hydraulic stresses exceed those on hillslopes, and channel evacuation dominates the net balance. This result suggests that WGEW exists mostly (~50% of the time) in an equilibrium condition of sediment balance between hillslopes and channels, which helps to explain the observed straight longitudinal profile. We illustrate how this balance can be upset by climate changes that differentially affect relative flow regimes on slopes and in channels. Such changes can push the long profile into a convex or concave condition.*

Miesel, J., Reiner, A., Ewell, C., Maestrini, B., & Dickinson, M. (2018). Quantifying changes in total and pyrogenic carbon stocks across fire severity gradients using active wildfire incidents. *Frontiers in Earth Science, 6*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049534754&doi=10.3389%2ffeart.2018.00041&partnerID=40&md5=b77e21f15142419b84b04aa95042bfb4. doi:10.3389/feart.2018.00041

Research Tags: Forestry, Weather, Emissions, Soil

Abstract: *Positive feedbacks between wildfire emissions and climate are expected to increase in strength in the future; however, fires not only release carbon (C) from terrestrial to atmospheric pools, they also produce pyrogenic C (PyC) which contributes to longer-term C stability. Our objective was to quantify wildfire impacts on total C and PyC stocks in California mixed-conifer forest, and to investigate patterns in C and PyC stocks and changes across gradients of fire severity, using metrics derived from remote sensing and field observations. Our unique study accessed active wildfires to establish and measure plots within days before and after fire, prior to substantial erosion. We measured pre- and post-fire aboveground forest structure and woody fuels to calculate aboveground biomass, C and PyC, and collected forest floor and 0–5 cm mineral soil samples. Immediate tree mortality increased with severity, but overstory C loss was minimal and limited primarily to foliage. Fire released 85% of understory and herbaceous C (comprising < 1.0% of total ecosystem C). The greatest C losses occurred from downed wood and forest floor pools (19.3 ± 5.1 Mg ha−1 and 25.9 ± 3.2 Mg ha−1, respectively). Tree bark and downed wood contributed the greatest PyC gains (1.5 ± 0.3 Mg ha−1 and 1.9 ± 0.8 Mg ha−1, respectively), and PyC in tree bark showed non-significant positive trends with increasing severity. Overall PyC losses of 1.9 ± 0.3 Mg ha−1 and 0.5 ± 0.1 Mg ha−1 occurred from forest floor and 0–5 cm mineral soil, with no clear patterns across severity. Fire resulted in a net ecosystem PyC gain (1.0 ± 1.0 Mg ha−1) across aboveground and belowground components of these forests, and there were no differences* *among severity levels. Carbon emissions represented only 21.6% of total forest C; however, extensive conversion of C from live to dead pools will contribute to large downed wood C pools susceptible to release in a subsequent fire, indicating that there may be a delayed relationship between fire severity and C emissions. This research advances understanding of forest C loss and stabilization as PyC in wildfires; however, poor relationships between C and PyC gains or losses and fire severity highlight the complexity of fire impacts on forest C.*

Mildrexler, D. J., Shaw, D. C., & Cohen, W. B. (2019). Short-term climate trends and the Swiss needle cast epidemic in Oregon's public and private coastal forestlands. *Forest Ecology and Management, 432*, 501-513. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054185668&doi=10.1016%2fj.foreco.2018.09.025&partnerID=40&md5=4d7541acd978fadd0294dfbd87fea0ee. doi:10.1016/j.foreco.2018.09.025

Research Tags: Forestry

Abstract: *Swiss needle cast (SNC) is a fungal disease of Douglas-fir (Pseudotsuga menziesii) that is having important consequences on tree growth in the Pacific Northwest (PNW) region of the USA. Once considered innocuous in PNW forests, SNC symptom expression has increased rapidly in extent and intensity in recent decades. Previous research has linked the disease epidemiology of SNC to climate, and observations indicate a link with forestry practices of the 20th century as well, particularly with the conversion of old growth and mature mixed-conifer forests to young monocultures of Douglas-fir on private forestlands. Given the sensitivity of SNC intensification to forestry practices and changing climatic conditions, it seems plausible that disease behavior response to short-term directional climate changes could differ between contrasting forest management regimes. We compared the relationship between trends in canopy energy and water flux parameters detected during the spring and summer months (May–August) along the Pacific Coast of Oregon from 2003 to 2012, and the distribution of SNC symptoms in 2012 on private and public lands. Canopy energy and water exchange parameters were calculated with MODIS Land Surface Temperature (LST), and evapotranspiration (ET) data, and with Parameter-elevation Relationships on Independent Slopes Model (PRISM) precipitation data. We found that a higher level of deviance in SNC presence/absence could be explained on private land compared with public land. Proximity to coast explained 9.3% of the deviance on private land and 6.7% on public land. Trends in LST during May and August emerged as important and explained 7% of the deviance in SNC symptom distribution on private land compared with 2% on public land. When combined with proximity to coast, May and August LST explained 14% of the deviance in SNC symptom expression on private land and 8.7% on public land. We found a significant difference between public and private ownership for the proportion of SNC (p = 0.0006), and a significant interaction between ownership and distance to coast (p = 0.0019), such that across public and private ownership, distance to coast has a different effect. LST may provide valuable information on leaf wetness, or thermal properties of the canopy, possibly capturing both early season and late season dynamics important to SNC epidemiology. We find evidence that recent short-term directional climate changes may have contributed to differences in symptom development in Douglas-fir forests on private and public land, with symptoms more prevalent on private land.*

Mildrexler, D. J., Zhao, M., Cohen, W. B., Running, S. W., Song, X. P., & Jones, M. O. (2018). Thermal anomalies detect critical global land surface changes. *Journal of Applied Meteorology and Climatology, 57*(2), 391-411. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042423107&doi=10.1175%2fJAMC-D-17-0093.1&partnerID=40&md5=0f53cbe800ece6e6145356226b973352. doi:10.1175/JAMC-D-17-0093.1

Research Tags: Weather, Research

Abstract: *Measurements that link surface conditions and climate can provide critical information on important biospheric changes occurring in the Earth system. As the direct driving force of energy and water fluxes at the surface–atmosphere interface, land surface temperature (LST) provides information on physical processes of land-cover change and energy-balance changes that air temperature cannot provide. Annual maximum LST (LSTmax) is especially powerful at minimizing synoptic and seasonal variability and highlighting changes associated with extreme climatic events and significant land-cover changes. The authors investigate whether maximum thermal anomalies from satellite observations could detect heat waves and droughts, a melting cryosphere, and disturbances in the tropical forest from 2003 to 2014. The 1-km2 LSTmax anomalies peaked in*

2010 when 20% of the global land area experienced anomalies of greater than 1 standard deviation and over 4% of the global land area was subject to positive anomalies exceeding 2 standard deviations. Positive LSTmax anomalies display complex spatial patterns associated with heat waves and droughts across the global land area. The findings presented herein show that entire biomes are experiencing shifts in their LSTmax distributions driven by extreme climatic events and large-scale land surface changes, such as melting of ice sheets, severe droughts, and the incremental effects of forest loss in tropical forests. As climate warming and land-cover changes continue, it is likely that Earth's maximum surface temperatures will experience greater and more frequent directional shifts, increasing the possibility that critical thresholds in Earth's ecosystems and climate system will be surpassed, resulting in profound and irreversible changes.

Millar, C. I., Charlet, D. A., Delany, D. L., King, J. C., & Westfall, R. D. (2019). Shifts of demography and growth in limber pine forests of the Great Basin, USA, across 4000 yr of climate variability. *Quaternary Research (United States), 91*(2), 679-690. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063949393&doi=10.1017%2fqua.2018.120&partnerID=40&md5=32bd928aed5203e4318c2258def234ca. doi:10.1017/qua.2018.120

Research Tags: Research, Forestry

Abstract: *Annually dated tree-rings of 509 live and deadwood limber pine (Pinus flexilis) samples from the semi-arid Wassuk Range, Nevada, yielded a 3996-yr record extending from 1983 BC to AD 2013. Correlations of radial growth with climate were positive for water relations and negative for summer temperatures. Long-term trends of ring-width corresponded to climate variability documented from other proxies, including low growth during the Late Holocene Dry Period and Medieval Climate Anomaly (MCA) and elevated growth during cool, wet periods of the Neoglacial and Little Ice Age. Spline fit of the data indicated that growth decrease in the last 20 years was second lowest on record, surpassed by lowest growth at 20 BC—AD 150. Demographics of limber pine by aspect and elevation were not strongly related to long-term climate dynamics, except in the case of extirpations on all but north aspects at the end of the MCA. Pines occurred persistently on north aspects, where a continuous record existed to present. Elevation shifts were not obvious on any aspect, and no evidence existed for migration above current treeline. Non-climatic factors appear to interact with climate to make north slopes refugial for upland pines in semi-arid regions across four millennia.*

Millar, C. I., Charlet, D. A., Westfall, R. D., King, J. C., Delany, D. L., Flint, A. L., & Flint, L. E. (2018). Do low-elevation ravines provide climate refugia for subalpine limber pine (Pinus flexilis) in the Great Basin, USA? *Canadian Journal of Forest Research, 48*(6), 663-671. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047764232&doi=10.1139%2fcjfr-2017-0374&partnerID=40&md5=1fd341a53acba102e8233e20f09f7e71. doi:10.1139/cjfr-2017-0374

Research Tags: Forestry

Abstract: *Climate refugia are locations where decoupled climate processes enable species to persist despite unfavorable climate changes in surrounding landscapes. Despite theoretic bases and paleo-ecological evidence, refugia have not been widely characterized under modern conditions in mountain regions. Conifers in the Great Basin, USA, provide an opportunity to evaluate the potential of low-elevation ravine and riparian (LERR) contexts to function as climate refugia. We provide evidence for significantly higher than expected occurrence of limber pine (Pinus flexilis E. James) in LERR contexts (mean 64%) across 43 mountain ranges. We document with observed and modeled data that LERR contexts are cooler and wetter than expected for their elevations, have low solar radiation, and produce larger (more positive) lapse rates relative to upland slopes. Together these findings suggest that LERR contexts generate decoupled microclimates that provide climate refugia for limber pine. In that refugia management has been promoted as a contemporary climate adaptation strategy, our findings suggest that LERR contexts be further evaluated for their conservation potential.*

Millar, C. I., Delany, D. L., Hersey, K. A., Jeffress, M. R., Smith, A. T., Van Gunst, K. J., & Westfall, R. D. (2018). Distribution, climatic relationships, and status of American pikas (Ochotona princeps) in the Great Basin, USA. *Arctic, Antarctic, and Alpine Research, 50*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055246600&doi=10.1080%2f15230430.2018.1436296&partnerID=40&md5=fac0f0af774ae360becdd80ea0ac1b26. doi:10.1080/15230430.2018.1436296

Research Tags: Wildlife

Abstract: *To advance understanding of the distribution, climatic relationships, and status of American pikas (Ochotona princeps) in the Great Basin, United States, we compiled 2,387 records of extant pika sites surveyed since 2005, 89 records of documented extirpated sites (resurvey of historic sites), and 774 records of sites with old sign only. Extant sites extended across five degrees latitude and ten degrees longitude, encompassed six subregions, traversed forty mountain ranges, spanned 2,378 m in elevation (1,631–4,009 m), and comprised three of five currently described pika subspecies. A climate envelope for extant sites using the PRISM climate model expands the range of temperature and precipitation values that have been previously described. Extirpated and old-sign sites were mostly found within the geographic and climatic space of extant sites, but often in warmer and drier portions. Considerable overlap of extirpated, old, and extant groups within the same climate space suggests that nonclimatic factors have also contributed to population losses. The broad distribution and enlarged climate envelope of extant pika sites indicate that despite some localized extirpations, pika populations are persisting across Great Basin mountains, and appear to be able to tolerate a broader set of habitat conditions than previously understood.*

Millar, D. J., Cooper, D. J., Dwire, K. A., Hubbard, R. M., & von Fischer, J. (2017). Mountain Peatlands Range from CO<inf>2</inf> Sinks at High Elevations to Sources at Low Elevations: Implications for a Changing Climate. *Ecosystems, 20*(2), 416-432. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84988660471&doi=10.1007%2fs10021-016-0034-7&partnerID=40&md5=e821e9598c0a1471339abe001b4c4c70. doi:10.1007/s10021-016-0034-7

Research Tags: Soil, Emissions

Abstract: *Mountain fens found in western North America have sequestered atmospheric carbon dioxide (CO2) for millennia, provide important habitat for wildlife, and serve as refugia for regionally-rare plant species typically found in boreal regions. It is unclear how Rocky Mountain fens are responding to a changing climate. It is possible that fens found at lower elevations may be particularly susceptible to changes because hydrological cycles that control water tables are likely to vary the most. In this study, we fit models of growing season ecosystem-atmosphere CO2 exchange to field-measured data among eight fen plant communities at four mountain fens along a climatic gradient in the Rocky Mountains of Colorado and Wyoming. Differences in growing season net ecosystem production (NEP) among study sites were not well correlated with monsoon precipitation, despite a twofold increase in summer rainfall between two study regions. Our results show that NEP was higher for fens located at high elevations compared to those found at lower elevations, with growing season estimates ranging from −342 to 256 g CO2-C m−2. This was reflected in the negative correlation of growing season NEP with air temperature, and positive correlation with water table position, as the high elevation sites had the lowest air temperatures and highest water tables due to greater snowpack and later onset of melt. Our results suggest that sustainability of mountain fens occurring at the lower end of the known elevation range may be particularly susceptible to a changing climate, as these peatlands already experience lower snowpack, earlier snow melt, and warmer growing season air temperatures, which are all likely to be exacerbated under a future climate.*

Miller, D. A. W., Grant, E. H. C., Muths, E., Amburgey, S. M., Adams, M. J., Joseph, M. B., . . . Sigafus, B. H. (2018). Quantifying climate sensitivity and climate-driven change in North American amphibian communities. *Nature Communications, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053920761&doi=10.1038%2fs41467-018-06157-6&partnerID=40&md5=8f2a8e8bc320fce02f78fff9a8e974ee. doi:10.1038/s41467-018-06157-6

Research Tags: Wildlife

Abstract: *Changing climate will impact species' ranges only when environmental variability directly impacts the demography of local populations. However, measurement of demographic responses to climate change has largely been limited to single species and locations. Here we show that amphibian communities are responsive to climatic variability, using >500,000 time-series observations for 81 species across 86 North American study areas. The effect of climate on local colonization and persistence probabilities varies among eco-regions and depends on local climate, species life-histories, and taxonomic classification. We found that local species richness is most sensitive to changes in water availability during breeding and changes in winter conditions. Based on the relationships we measure, recent changes in climate cannot explain why local species richness of North American amphibians has rapidly declined. However, changing climate does explain why some*

populations are declining faster than others. Our results provide important insights into how amphibians respond to climate and a general framework for measuring climate impacts on species richness.

Miller, J. E. D., Root, H. T., & Safford, H. D. (2018). Altered fire regimes cause long-term lichen diversity losses. *Global Change Biology, 24*(10), 4909-4918. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052398601&doi=10.1111%2fgcb.14393&partnerID=40&md5=e9bc1ebbb769db17073710c6c5acfb51. doi:10.1111/gcb.14393

Research Tags: Forestry, Weather

Abstract: *Many global ecosystems have undergone shifts in fire regimes in recent decades, such as changes in fire size, frequency, and/or severity. Recent research shows that increases in fire size, frequency, and severity can lead to long-persisting deforestation, but the consequences of shifting fire regimes for biodiversity of other vegetative organisms (such as understory plants, fungi, and lichens) remain poorly understood. Understanding lichen responses to wildfire is particularly important because lichens play crucial roles in nutrient cycling and supporting wildlife in many ecosystems. Lichen responses to fire have been little studied, and most previous research has been limited to small geographic areas (e.g. studies of a single fire), making it difficult to establish generalizable patterns. To investigate long-term effects of fire severity on lichen communities, we sampled epiphytic lichen communities in 104 study plots across California's greater Sierra Nevada region in areas that burned in five wildfires, ranging from 4 to 16 years prior to sampling. The conifer forest ecosystems we studied have undergone a notable increase in fire severity in recent decades, and we sample across the full gradient of fire severity to infer how shifting fire regimes may influence landscape-level biodiversity. We find that low-severity fire has little to no effect on lichen communities. Areas that burned at moderate and high severities, however, have significantly and progressively lower lichen richness and abundance. Importantly, we observe very little postfire lichen recolonization on burned substrates even more than 15 years after fire. Our multivariate model suggests that the hotter, drier microclimates that occur after fire removes forest canopies may prevent lichen reestablishment, meaning that lichens are not likely to recolonize until mature trees regenerate. These findings suggest that altered fire regimes may cause broad and long-persisting landscape-scale biodiversity losses that could ultimately impact multiple trophic levels.*

Miller, J. O., Ducey, T. F., Brigman, P. W., Ogg, C. O., & Hunt, P. G. (2017). Greenhouse Gas Emissions and Denitrification within Depressional Wetlands of the Southeastern US Coastal Plain in an Agricultural Landscape. *Wetlands, 37*(1), 33-43. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84991608373&doi=10.1007%2fs13157-016-0837-5&partnerID=40&md5=d19c21de7a6b9b9f1a13300ab9e202e5. doi:10.1007/s13157-016-0837-5

Research Tags: Emissions, Crops, Water

Abstract: *Carolina Bays are depressional wetlands on the Coastal Plain of the southeastern United States. These wetlands are often the recipient of nutrient runoff from adjacent agricultural lands and there is potential for production of greenhouse gases during nitrification and denitrification processes occurring in the wetland sediments. Because of their saturated conditions, Carolina Bays may improve regional water quality through denitrification of soil nitrate. Three small bays in South Carolina were selected for denitrification and greenhouse gas analysis. A transect of four points was sampled within each Carolina Bay in May, July, September, and November over a two year period. Gas emissions were measured in-situ using a photoacoustic gas analyzer and soil samples were brought back to the lab for denitrification enzyme activity and microbial analysis. Emissions of nitrous oxide (N2O) averaged 1.8 mg m−2 d−1, with a median of 0.47 (with a range of below detectable limits to 9.414 mg m−2 d−1). Many measurement events of N2O were below detection and did not vary within the bays. The carbon dioxide emissions from Carolina Bays averaged 15.8 g m−2 d−1 and were largely controlled by temperature. Denitrification enzyme activity had a larger response to nitrate additions further into the bays. Gram + bacteria were also greater deeper into the bays, while Gram- and fungal populations were greater at the field/wetland interface. Manure application had some minor effects on DEA within the bays, but did not appear to increase gas emissions over the period measured.*

Mills, G., Sharps, K., Simpson, D., Pleijel, H., Frei, M., Burkey, K., . . . Agrawal, M. (2018). Closing the global ozone yield gap: Quantification and cobenefits for multistress tolerance. *Global Change Biology, 24*(10), 4869-4893. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052436143&doi=10.1111%2fgcb.14381&partnerID=40&md5=9cae2706f85e0f443025ab5af9c69f55. doi:10.1111/gcb.14381
Research Tags: Emissions, Crops
Abstract: *Increasing both crop productivity and the tolerance of crops to abiotic and biotic stresses is a major challenge for global food security in our rapidly changing climate. For the first time, we show how the spatial variation and severity of tropospheric ozone effects on yield compare with effects of other stresses on a global scale, and discuss mitigating actions against the negative effects of ozone. We show that the sensitivity to ozone declines in the order soybean > wheat > maize > rice, with genotypic variation in response being most pronounced for soybean and rice. Based on stomatal uptake, we estimate that ozone (mean of 2010–2012) reduces global yield annually by 12.4%, 7.1%, 4.4% and 6.1% for soybean, wheat, rice and maize, respectively (the "ozone yield gaps"), adding up to 227 Tg of lost yield. Our modelling shows that the highest ozone-induced production losses for soybean are in North and South America whilst for wheat they are in India and China, for rice in parts of India, Bangladesh, China and Indonesia, and for maize in China and the United States. Crucially, we also show that the same areas are often also at risk of high losses from pests and diseases, heat stress and to a lesser extent aridity and nutrient stress. In a solution-focussed analysis of these results, we provide a crop ideotype with tolerance of multiple stresses (including ozone) and describe how ozone effects could be included in crop breeding programmes. We also discuss altered crop management approaches that could be applied to reduce ozone impacts in the shorter term. Given the severity of ozone effects on staple food crops in areas of the world that are also challenged by other stresses, we recommend increased attention to the benefits that could be gained from addressing the ozone yield gap.*

Mills, R. T., Sripathi, V., Kumar, J., Sreepathi, S., Hoffman, F., & Hargrove, W. (2019). *Parallel k-means clustering of geospatial data sets using manycore CPU architectures.* Paper presented at the IEEE International Conference on Data Mining Workshops, ICDMW.
Research Tags: Research
Abstract: *The increasing availability of high-resolution geospatiotemporal data sets from sources such as observatory networks, remote sensing platforms, and computational Earth system models has opened new possibilities for knowledge discovery and mining of weather, climate, ecological, and other geoscientific data sets fused from disparate sources. Many of the standard tools used on individual workstations are impractical for the analysis and synthesis of data sets of this size; however, new algorithmic approaches that can effectively utilize the complex memory hierarchies and the extremely high levels of parallelism available in state-of-the-art high-performance computing platforms can enable such analysis. Here, we describe pKluster, an open-source tool we have developed for accelerated k-means clustering of geospatial and geospatiotemporal data, and discuss algorithmic modifications and code optimizations we have made to enable it to effectively use parallel machines based on novel CPU architectures-such as the Intel Knights Landing Xeon Phi and Skylake Xeon processors-with many cores and hardware threads, and employing significant single instruction, multiple data (SIMD) parallelism. We outline some applications of the code in ecology and climate science contexts and present a detailed discussion of the performance of the code for one such application, LiDAR-derived vertical vegetation structure classification.*

Mims, M. C., Olson, D. H., Pilliod, D. S., & Dunham, J. B. (2018). Functional and geographic components of risk for climate sensitive vertebrates in the Pacific Northwest, USA. *Biological Conservation, 228*, 183-194. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055676917&doi=10.1016%2fj.biocon.2018.10.012&partnerID=40&md5=ece2d01072ca8f6fcc73b84d713d3b0d. doi:10.1016/j.biocon.2018.10.012
Research Tags: Forestry, Wildlife
Abstract: *Rarity and life history traits inform multiple dimensions of intrinsic risk to climate and environmental change and can help systematically identify at-risk species. We quantified relative geographic rarity (area of occupancy), climate niche breadth, and life history traits for 114 freshwater fishes, amphibians, and reptiles in the U.S. Pacific Northwest. Our approach leveraged presence-only, publicly available data and traits-based inference to evaluate area of occupancy, climate sensitivity (i.e., climate niche breadth), and a Rarity and Climate Sensitivity (RCS) index of all species across multiple geographic extents, grain sizes, and data types. The RCS index was relatively stable across extents, grains, and data types, with climate sensitivity differentiating*

species with otherwise similar areas of occupancy. We also found that species with sensitivity-associated traits (e.g., long generation time, low fecundity) were not necessarily the same species identified as at-risk with geographical approaches (small range size, small climate niche breadth). Many multispecies assessments using coarse-scale data (e.g., entire range maps or convex-hull approaches) often focus on a single dimension of intrinsic risk; others rely on data-intensive models only applicable to a few well-studied species. What remains is a need for an approach that enables multispecies, multidimensional assessment efforts. This is particularly true at regional scales, where management needs require assessments that are intermediate to coarse- and fine-scale approaches. We demonstrate that by considering multiple dimensions of intrinsic risk to climate change (range size, climate sensitivity, and traits), site-specific locality data may offer a pathway for ensuring vulnerable, understudied species do not go overlooked in conservation.

Minasny, B., Berglund, Ö., Connolly, J., Hedley, C., de Vries, F., Gimona, A., . . . Widyatmanti, W. (2019). Digital mapping of peatlands – A critical review. *Earth-Science Reviews, 196*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067246460&doi=10.1016%2fj.earscirev.2019.05.014&partnerID=40&md5=088ef671f1ff5bfbab1d932e4a6863a6. doi:10.1016/j.earscirev.2019.05.014
Research Tags: Soil, Research
Abstract: *Peatlands offer a series of ecosystem services including carbon storage, biomass production, and climate regulation. Climate change and rapid land use change are degrading peatlands, liberating their stored carbon (C) into the atmosphere. To conserve peatlands and help in realising the Paris Agreement, we need to understand their extent, status, and C stocks. However, current peatland knowledge is vague—estimates of global peatland extent ranges from 1 to 4.6 million km2, and C stock estimates vary between 113 and 612 Pg (or billion tonne C). This uncertainty mostly stems from the coarse spatial scale of global soil maps. In addition, most global peatland estimates are based on rough country inventories and reports that use outdated data. This review shows that digital mapping using field observations combined with remotely-sensed images and statistical models is an avenue to more accurately map peatlands and decrease this knowledge gap. We describe peat mapping experiences from 12 countries or regions and review 90 recent studies on peatland mapping. We found that interest in mapping peat information derived from satellite imageries and other digital mapping technologies is growing. Many studies have delineated peat extent using land cover from remote sensing, ecology, and environmental field studies, but rarely perform validation, and calculating the uncertainty of prediction is rare. This paper then reviews various proximal and remote sensing techniques that can be used to map peatlands. These include geophysical measurements (electromagnetic induction, resistivity measurement, and gamma radiometrics), radar sensing (SRTM, SAR), and optical images (Visible and Infrared). Peatland is better mapped when using more than one covariate, such as optical and radar products using nonlinear machine learning algorithms. The proliferation of satellite data available in an open-access format, availability of machine learning algorithms in an open-source computing environment, and high-performance computing facilities could enhance the way peatlands are mapped. Digital soil mapping allows us to map peat in a cost-effective, objective, and accurate manner. Securing peatlands for the future, and abating their contribution to atmospheric C levels, means digitally mapping them now.*

Minasny, B., Malone, B. P., McBratney, A. B., Angers, D. A., Arrouays, D., Chambers, A., . . . Winowiecki, L. (2017). Soil carbon 4 per mille. *Geoderma, 292*, 59-86. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009919368&doi=10.1016%2fj.geoderma.2017.01.002&partnerID=40&md5=8ea1baf4f6daef2d4bc9e2b0d7c6b27b. doi:10.1016/j.geoderma.2017.01.002
Research Tags: Soil, Crops
Abstract: *The '4 per mille Soils for Food Security and Climate' was launched at the COP21 with an aspiration to increase global soil organic matter stocks by 4 per 1000 (or 0.4 %) per year as a compensation for the global emissions of greenhouse gases by anthropogenic sources. This paper surveyed the soil organic carbon (SOC) stock estimates and sequestration potentials from 20 regions in the world (New Zealand, Chile, South Africa, Australia, Tanzania, Indonesia, Kenya, Nigeria, India, China Taiwan, South Korea, China Mainland, United States of America, France, Canada, Belgium, England & Wales, Ireland, Scotland, and Russia). We asked whether the 4 per mille initiative is feasible for the region. The outcomes highlight region specific efforts and scopes for soil carbon sequestration. Reported soil C sequestration rates globally show that under best management practices, 4 per mille or even higher sequestration rates can be accomplished. High C*

sequestration rates (up to 10 per mille) can be achieved for soils with low initial SOC stock (topsoil less than 30 t C ha− 1), and at the first twenty years after implementation of best management practices. In addition, areas which have reached equilibrium will not be able to further increase their sequestration. We found that most studies on SOC sequestration only consider topsoil (up to 0.3 m depth), as it is considered to be most affected by management techniques. The 4 per mille number was based on a blanket calculation of the whole global soil profile C stock, however the potential to increase SOC is mostly on managed agricultural lands. If we consider 4 per mille in the top 1m of global agricultural soils, SOC sequestration is between 2-3 Gt C year− 1, which effectively offset 20–35% of global anthropogenic greenhouse gas emissions. As a strategy for climate change mitigation, soil carbon sequestration buys time over the next ten to twenty years while other effective sequestration and low carbon technologies become viable. The challenge for cropping farmers is to find disruptive technologies that will further improve soil condition and deliver increased soil carbon. Progress in 4 per mille requires collaboration and communication between scientists, farmers, policy makers, and marketeers.

Minucci, J. M., Miniat, C. F., Teskey, R. O., & Wurzburger, N. (2017). Tolerance or avoidance: drought frequency determines the response of an N<inf>2</inf>-fixing tree. *New Phytologist, 215*(1), 434-442. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017429704&doi=10.1111%2fnph.14558&partnerID=40&md5=e162bc7f2359670a7068a2d129ba506c. doi:10.1111/nph.14558

Research Tags: Forestry, Weather

Abstract: *Climate change is increasing drought frequency, which may affect symbiotic N2 fixation (SNF), a process that facilitates ecosystem recovery from disturbance. Here, we assessed the effect of drought frequency on the ecophysiology and SNF rate of a common N2-fixing tree in eastern US forests.*
We grew Robinia pseudoacacia seedlings under the same mean soil moisture, but with different drought frequency caused by wet–dry cycles of varying periodicity.
We found no effect of drought frequency on final biomass or mean SNF rate. However, seedlings responded differently to wet and dry phases depending on drought frequency. Under low-frequency droughts, plants fixed carbon (C) and nitrogen (N) at similar rates during wet and dry phases. Conversely, under high-frequency droughts, plants fixed C and N at low rates during dry phases and at high rates during wet phases.
Our findings suggest that R. pseudoacacia growth is resistant to increased drought frequency because it employs two strategies – drought tolerance or drought avoidance, followed by compensation. SNF may play a role in both by supplying N to leaf tissues for acclimation and by facilitating compensatory growth following drought. Our findings point to SNF as a mechanism for plants and ecosystems to cope with drought.

Mirchi, A., Watkins, D. W., Engel, V., Sukop, M. C., Czajkowski, J., Bhat, M., . . . Weisskoff, R. (2018). A hydro-economic model of South Florida water resources system. *Science of the Total Environment, 628-629*, 1531-1541. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041541301&doi=10.1016%2fj.scitotenv.2018.02.111&partnerID=40&md5=0e1caacd95bdf8d1a111abb1b645d3dd. doi:10.1016/j.scitotenv.2018.02.111

Research Tags: Water, Economics

Abstract: *South Florida's water infrastructure and ecosystems are under pressure from socio-economic growth. Understanding the region's water resources management tradeoffs is essential for developing effective adaptation strategies to cope with emerging challenges such as climate change and sea level rise, which are expected to affect many other regions in the future. We describe a network-based hydro-economic optimization model of the system to investigate the tradeoffs, incorporating the economic value of water in urban and agricultural sectors and economic damages due to urban flooding while also accounting for water supply to sustain fragile ecosystems such as the Everglades and coastal estuaries. Results illustrate that maintaining high reliability of urban water supply under scenarios of reduced water availability (i.e., drier climate conditions) may trigger economic losses to the Everglades Agricultural Area, which will likely become more vulnerable as competition over scarce water resources increases. More pronounced economic losses are expected in urban and agricultural areas when flows to the Everglades are prioritized. Flow targets for coastal estuaries are occasionally exceeded under optimal flow allocations to various demand nodes, indicating that additional storage may be needed to maintain the environmental integrity of the estuarine ecosystems. Wetter climate conditions, on the other hand, generally lead to increased flows throughout the system with positive effects on meeting water demands, although flood mitigation efforts will necessitate additional releases to the estuaries.*

Strengths and limitations of the hydro-economic model are discussed.

Mishra, V., Cruise, J. F., Hain, C. R., Mecikalski, J. R., & Anderson, M. C. (2018). Development of soil moisture profiles through coupled microwave-thermal infrared observations in the southeastern United States. *Hydrology and Earth System Sciences, 22*(9), 4935-4957. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054104346&doi=10.5194%2fhess-22-4935-2018&partnerID=40&md5=99da42cdeeb9963c3e669a66bbfd0dcc. doi:10.5194/hess-22-4935-2018

Research Tags: Soil

Abstract: *The principle of maximum entropy (POME) can be used to develop vertical soil moisture (SM) profiles. The minimal inputs required by the POME model make it an excellent choice for remote sensing applications. Two of the major input requirements of the POME model are the surface boundary condition and profile-mean moisture content. Microwave-based SM estimates from the Advanced Microwave Scanning Radiometer (AMSR-E) can supply the surface boundary condition whereas thermal infrared-based moisture estimated from the Atmospheric Land EXchange Inverse (ALEXI) surface energy balance model can provide the mean moisture condition. A disaggregation approach was followed to downscale coarse-resolution (~25 km) microwave SM estimates to match the finer resolution (~5 km) thermal data. The study was conducted over multiple years (2006–2010) in the southeastern US. Disaggregated soil moisture estimates along with the developed profiles were compared with the Noah land surface model (LSM), as well as in situ measurements from 10 Natural Resource Conservation Services (NRCS) Soil Climate Analysis Network (SCAN) sites spatially distributed within the study region. The overall disaggregation results at the SCAN sites indicated that in most cases disaggregation improved the temporal correlations with unbiased root mean square differences (ubRMSD) in the range of 0.01–0.09 m3 m−3. The profile results at SCAN sites showed a mean bias of 0.03 and 0.05 (m3 m−3); ubRMSD of 0.05 and 0.06 (m3 m−3); and correlation coefficient of 0.44 and 0.48 against SCAN observations and Noah LSM, respectively. Correlations were generally highest in agricultural areas where values in the 0.6–0.7 range were achieved.*

Mitra, B., Miao, G., Minick, K., McNulty, S. G., Sun, G., Gavazzi, M., . . . Noormets, A. (2019). Disentangling the Effects of Temperature, Moisture, and Substrate Availability on Soil CO<inf>2</inf> Efflux. *Journal of Geophysical Research: Biogeosciences*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069923143&doi=10.1029%2f2019JG005148&partnerID=40&md5=c68d908a9fd5e486221ecdbb021723c5. doi:10.1029/2019JG005148

Research Tags: Weather, Soil, Emissions

Abstract: *"Soil respiration" (RS) is the net emission of carbon dioxide (CO_2) from the soil to the atmosphere. Rs has traditionally been quantified as a function of soil temperature, even though it originates from a suite of biological processes in the soil. Recent experimental studies have shown strong dependence of both plant root and microbial activity on plant-internal carbohydrate status. Here we report how different physical (soil temperature and soil moisture) and biological (plant carbohydrate supply, approximated with photosynthetically active radiation [PAR]) process covary with soil CO_2 emissions in two forest stands of different age. The individual and pairwise variation in Rs, soil temperature, soil moisture, and PAR time series at different frequencies was used to infer causal relationships between them. Environmental factor temperature and soil moisture significantly covaried with Rs at weekly to seasonal time scales, whereas diurnal variability of Rs was attributed to carbohydrate substrate availability. The consistent 1.5- to 3-hr time lag between Rs and PAR (as a proxy for carbohydrate availability) did not differ between forests of different stature. We hypothesize that this suggests that carbohydrate availability throughout the plant was regulated by pressure-concentration waves from phloem loading rather than actual mass transport of the loaded carbohydrates.*

Mock, C. J., Carter, K. C., & Birkeland, K. W. (2017). Some Perspectives on Avalanche Climatology. *Annals of the American Association of Geographers, 107*(2), 299-308. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84987887232&doi=10.1080%2f24694452.2016.1203285&partnerID=40&md5=01ea2fb01b4b03f467e831180a029234. doi:10.1080/24694452.2016.1203285

Research Tags: Weather

Abstract: *Avalanche climatology is defined as the study of the relationships between climate and snow avalanches, and it contributes in aiding avalanche hazard mitigation efforts. The field has evolved over the past*

six decades concerning methodology, data monitoring and field collection, and interdisciplinary linkages. Avalanche climate research directions are also expanding concerning treatment in both spatial scale and temporal timescales. This article provides an overview of the main themes of avalanche climate research in issues of scale from local to global, its expanding interdisciplinary nature, as well as its future challenges and directions. The growth of avalanche climatology includes themes such as its transformation from being mostly descriptive to innovative statistical methods and modeling techniques, new challenges in microscale efforts that include depth hoar aspects and increased field studies, expanding synoptic climatology applications on studying avalanche variations, efforts to reconstruct past avalanches and relate them to climatic change, and research on potential avalanche responses to recent twentieth-century and future global warming. Some suggestions on future avalanche climatology research directions include the expansion of data networks and studies that include lesser developed countries, stronger linkages of avalanche climate studies with GIScience and remote sensing applications, more innovative linkages of avalanches with climate and societal applications, and increased emphases on modeling and process-oriented approaches.

Moffet, C. A., Hardegree, S. P., Abatzoglou, J. T., Hegewisch, K. C., Reuter, R. R., Sheley, R. L., . . . Boehm, A. R. (2019). Weather Tools for Retrospective Assessment of Restoration Outcomes. *Rangeland Ecology and Management, 72*(2), 225-229. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058409003&doi=10.1016%2fj.rama.2018.10.011&partnerID=40&md5=3a5b44a3bf9e4b45003d7c2af2987d3b. doi:10.1016/j.rama.2018.10.011

Research Tags: Grassland, Weather

Abstract: *Rangeland seeding practices in the Intermountain western United States are predominantly implemented in the year immediately following wildfire for the purposes of Emergency Stabilization and Rehabilitation (ESR). This necessarily links restoration and rehabilitation outcomes to the probability of a single year providing sufficiently favorable microclimatic conditions for desirable plant establishment. Field research studies in rangeland restoration are also typically of limited duration, and published results may not represent the full spectrum of conditions likely to be experienced at a given site. We propose that location-specific and temporal weather analysis may enhance the interpretation of historical planting data, support expanded inferences from short-term field studies, and facilitate meta-analysis of diverse field studies in rangeland restoration. We describe access and use of new databases and tools that can be used to characterize and rank weather and soil-microclimatic variables and suggest some standard graphs and weather metrics to establish a longer-term perspective for the interpretation of rangeland restoration outcomes. Tools of this type may also be useful in the interpretation of a wide range of agricultural and natural resource applications that are driven by similar weather inputs, particularly in arid and semiarid systems that exhibit high annual and seasonal variability in precipitation and temperature.*

Mohammed, A. A., Schincariol, R. A., Quinton, W. L., Nagare, R. M., & Flerchinger, G. N. (2017). On the use of mulching to mitigate permafrost thaw due to linear disturbances in sub-arctic peatlands. *Ecological Engineering, 102*, 207-223. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013774482&doi=10.1016%2fj.ecoleng.2017.02.020&partnerID=40&md5=e1c364593ae24845f3ece9abf891b364. doi:10.1016/j.ecoleng.2017.02.020

Research Tags: Soil

Abstract: *The presence or absence of permafrost strongly influences the hydrology and ecology of northern watersheds. Resource exploration activities are currently having profound effects on hydrological and ecological processes in sub-arctic peatlands. In wetland-dominated zones of discontinuous permafrost, permafrost occurs below tree-covered peat plateaus where the tree-canopy and vadose zone act to insulate and preserve permafrost below. Linear disturbances such as seismic lines result in removal of the canopy, and cause permafrost thaw, which results in increased soil moisture, land subsidence, and deforestation. This contributes to land-cover transformation, habitat and vegetation loss, and changes to basin hydrologic cycles. The resultant permafrost-degraded corridors comprise large portions of the drainage density of sub-arctic basins, and alter the region's water and energy balances. Mulching over disturbances, with the removed tree canopy, has been proposed as a best management practice to help reduce this environmental impact. Here we present climate chamber and numerical modeling results which quantify the effects of mulching and its ability to limit permafrost thaw and alterations to the ground thermal regime. Overall, the thermal buffering ability of the* *mulch had beneficial effects on slowing thaw, due to its low thermal conductivity, which decouples the subsurface from meteorological forcing and impedes heat conduction. Results indicate that mulching is an effective technique to reduce permafrost thaw and provides a scientific basis to assess the mitigation measure on its ability to slow permafrost degradation. This study will provide guidance as to how northern exploration may be performed in a more environmentally sustainable manner.*

Mohanty, B. P., Cosh, M. H., Lakshmi, V., & Montzka, C. (2017). Soil moisture remote sensing: State-of-the-science. *Vadose Zone Journal, 16*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011345102&doi=10.2136%2fvzj2016.10.0105&partnerID=40&md5=c8297d386d5974ee2b7842fccb0461ce. doi:10.2136/vzj2016.10.0105

Research Tags: Soil

Abstract: *This is an update to the special section "Remote Sensing for Vadose Zone Hydrology—A Synthesis from the Vantage Point" [Vadose Zone Journal 12(3)]. Satellites (e.g., Soil Moisture Active Passive [SMAP] and Soil Moisture and Ocean Salinity [SMOS]) using passive microwave techniques, in particular at L-band frequency, have shown good promise for global mapping of near-surface (0–5-cm) soil moisture at a spatial resolution of 25 to 40 km and temporal resolution of 2 to 3 d. C- and X-band soil moisture records date back to 1978, making available an invaluable data set for long-term climate research. Near-surface soil moisture is further extended to the root zone (top 1 m) using process-based models and data assimilation schemes. Validation of remotely sensed soil moisture products has been ongoing using core monitoring sites, sparse monitoring networks, intensive field campaigns, as well as multi-satellite comparison studies. To transfer empirical observations across space and time scales and to develop improved retrieval algorithms at various resolutions, several efforts are underway to associate soil moisture variability dynamics with land surface attributes in various energy- and water-rich environments. We describe the most recent scientific and technological advances in soil moisture remote sensing. We anticipate that remotely sensed soil moisture will find many applications in vadose zone hydrology in the coming decades.*

Molina, J. R., González-Cabán, A., & y Silva, F. R. (2019). Potential effects of climate change on fire behavior, economic susceptibility and suppression costs in Mediterranean ecosystems: Córdoba Province, Spain. *Forests, 10*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070564915&doi=10.3390%2ff10080679&partnerID=40&md5=18cade8b5bc78e19c75105d140b80810. doi:10.3390/f10080679

Research Tags: Economics, Forestry, Weather

Abstract: *The potentially large ecological, economic, and societal impacts of climate change makes it a significant problem of the 21st century. These consequences have led to tremendous development in climate change scenarios and new technologies to increase knowledge on the effect and efficiency of mitigation and adaptation measures. Large fires will occur at a higher rate than currently because of lower fuel moisture content resulting in a lower resistance to burning. This is also evidenced by more extreme fire behavior that contributes to higher economic impacts, suppression difficulties and suppression costs. The economic susceptibility concept integrates a set of economic valuation approaches for valuing timber and non-timber resources, considering the fire behavior, and as a consequence, the net value changes for each resource. Flame length increased by 4.6% to 15.69%, according to the different future climate scenarios. Climate change is expected to cause widespread changes to economic susceptibility and suppression costs because of higher flame length and fire intensity. Therefore, our outcomes show an increase in the economic susceptibility of Córdoba Province in the medium and long term (2041–2070) between 6.05% and 25.99%, respectively. In addition, we have found an increase between 65.67% and 86.73% in suppression costs in the last decade. The digital version of the economic susceptibility model using Geographic Information Systems improves its operational capabilities enhancing also its dynamism and simplicity to accept modifications and predictions revisions.*

Möller, M., Gerstmann, H., Gao, F., Dahms, T. C., & Förster, M. (2017). Coupling of phenological information and simulated vegetation index time series: Limitations and potentials for the assessment and monitoring of soil erosion risk. *Catena, 150*, 192-205. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84998717652&doi=10.1016%2fj.catena.2016.11.016&partnerID=40&md5=e520c1a8000af416fd4bcf09d516c539. doi:10.1016/j.catena.2016.11.016

Research Tags: Soil
Abstract: *Monitoring of soils used for agriculture at frequent intervals is crucial to support decision making and refining soil policies especially in the context of climate change. Along with rainfall erosivity, soil coverage by vegetation or crop residues is the most dynamic factor affecting soil erosion. Parcel-specific soil coverage information can be derived by satellite imagery with high geometric resolution. However, their usable number is mostly, due to cloud cover, not representative for the phenological characteristics of vegetated classes. To overcome temporal constraints, spatial and temporal fusion models, such as STARFM, are increasingly applied to derive high-resolution time series of remotely sensed biophysical parameters, based on fine spatial/coarse temporal resolution imagery, such as Landsat, and coarse spatial/fine temporal resolution imagery, such as MODIS. In this context, the current study introduces an evaluation scheme for simulated vegetation index time series which enables the assessment of their performance during multiple phenological phases. The evaluation scheme is based on Germany-wide available spatial predictions of phenological phases as well as RapidEye imagery and parcel-specific crop-type information. The evaluation results show that the simulation accuracy is basically controlled by the temporal distance between MODIS and Landsat base pairs, as well as the ability of the actual Landsat image to properly represent the phenological phase of the Landsat image simulated by MODIS. In addition, we discuss the potential of simulated index times series and corresponding phenological information for the dynamic (1) definition of temporal windows where soils are potentially covered by no, sparse or dense vegetation or crop residues and (2) parameterization of soil erosion models. The database thus obtained opens up new possibilities for an efficient and dynamic erosion monitoring, which can support soil protection and hazard prevention.*

Monahan, W. B., & Theobald, D. M. (2018). Climate change adaptation benefits of potential conservation partnerships. *PLoS ONE, 13*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042749263&doi=10.1371%2fjournal.pone.0191468&partnerID=40&md5=f18449460341dd811640d0600d915a66. doi:10.1371/journal.pone.0191468
Research Tags: Research
Abstract: *We evaluate the world terrestrial network of protected areas (PAs) for its partnership potential in responding to climate change. That is, if a PA engaged in collaborative, trans-boundary management of species, by investing in conservation partnerships with neighboring areas, what climate change adaptation benefits might accrue? We consider core tenets of conservation biology related to protecting large areas with high environmental heterogeneity and low climate change velocity and ask how a series of biodiversity adaptation indicators change across spatial scales encompassing potential PA and non-PA partners. Less than 1% of current world terrestrial PAs equal or exceed the size of established and successful conservation partnerships. Partnering at this scale would increase the biodiversity adaptation indicators by factors up to two orders of magnitude, compared to a null model in which each PA is isolated. Most partnership area surrounding PAs is comprised of non-PAs (70%), indicating the importance of looking beyond the current network of PAs when promoting climate change adaptation. Given monumental challenges with PA-based species conservation in the face of climate change, partnerships provide a logical and achievable strategy for helping areas adapt. Our findings identify where strategic partnering efforts in highly vulnerable areas of the world may prove critical in safeguarding biodiversity.*

Moni, C., Silvennoinen, H., Kimball, B. A., Fjelldal, E., Brenden, M., Burud, I., . . . Rasse, D. P. (2019). Controlled infrared heating of an artic meadow: Challenge in the vegetation establishment stage. *Plant Methods, 15*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060188447&doi=10.1186%2fs13007-019-0387-y&partnerID=40&md5=8563bedd2a107a35ef043a08e76718f9. doi:10.1186/s13007-019-0387-y
Research Tags: Weather, Grassland, Soil
Abstract: *Global warming is going to affect both agricultural production and carbon storage in soil worldwide. Given the complexity of the soil-plant-atmosphere continuum, in situ experiments of climate warming are necessary to predict responses of plants and emissions of greenhouse gases (GHG) from soils. Arrays of infrared (IR) heaters have been successfully applied in temperate and tropical agro-ecosystems to produce uniform and large increases in canopy surface temperature across research plots. Because this method had not yet been tested in the Arctic where consequences of global warming on GHG emission are expected to be largest, the*

objective of this work was to test hexagonal arrays of IR heaters to simulate a homogenous 3 °C warming of the surface, i.e. canopy and visible bare soil, of five 10.5-m2 plots in an Arctic meadow of northern Norway.

Montagnoli, A., Dumroese, R. K., Terzaghi, M., Pinto, J. R., Fulgaro, N., Scippa, G. S., & Chiatante, D. (2018). Tree seedling response to LED spectra: implications for forest restoration. *Plant Biosystems, 152*(3), 515-523. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041926216&doi=10.1080%2f11263504.2018.1435583&partnerID=40&md5=a58ab0377baeb39ae78853469502db18. doi:10.1080/11263504.2018.1435583
Research Tags: Forestry
Abstract: *We found that different spectra, provided by light-emitting diodes or a fluorescent lamp, caused different photomorphological responses depending on tree seedling type (coniferous or broad-leaved), species, seedling development stage, and seedling fraction (shoot or root). For two conifers (Picea abies and Pinus sylvestris) soon after germination (≤40 days), more seedling growth was related to a lower ratio of red-to-far-red (R:FR) light. As growth continued to 120 days, spectra with a greater complement of blue light yielded more growth. Roots showed more plasticity to light spectra than shoots. In general for the evergreen broad-leaved Quercus ilex, spectra with additional R:FR than for conifers yielded more growth in the first 57 days. Subsequently as seedlings grew, shoot growth appeared to be influenced less by light source than roots, with root length showing the greatest responses. Our results suggest that manipulating light spectra to foster desired seedling traits may be another tool for use in the production of high-quality seedlings as defined through the Target Plant Concept. Such seedlings are needed for restoration of the two billion hectares of degraded forestland, especially on harsh sites such as those found in the Mediterranean region, and to sequester carbon to mitigate climate change.*

Montpellier, E. E., Soulé, P. T., Knapp, P. A., & Shelly, J. S. (2018). Divergent growth rates of alpine larch trees (Larix lyallii Parl.) in response to microenvironmental variability. *Arctic, Antarctic, and Alpine Research, 50*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055273727&doi=10.1080%2f15230430.2017.1415626&partnerID=40&md5=0f7b45aa7db081c1dc82cf9a85740930. doi:10.1080/15230430.2017.1415626
Research Tags: Forestry
Abstract: *In this study we explore radial growth rates and climatic responses of alpine larch trees (Larix lyallii Parl.) growing in high elevations of the northern Rocky Mountains of Montana, USA. We examine responses between two stands of alpine larch that are separated by less than one kilometer and are growing at similar elevations, but with different aspects. Radial growth rates from trees sampled on the southern aspect of Trapper Peak (TPS) were largely controlled by January snow-water equivalent, while summer maximum temperature was the principal radial-growth driver for trees sampled on the northern aspect of Trapper Peak (TPN). Following the coldest summer (1993) in the century-long instrumental climate record, the radial growth at TPN became greater than at TPS and was the reverse of what occurred pre-1993. We posit that an upward trend in maximum summer temperature is preferentially benefitting the trees growing on the north-facing TPN site by extending the growing season and causing earlier snowmelt, and this has caused the growth rate divergence during the past two decades. As such, our study illustrates that the growth-divergence phenomenon noted in other high-elevation species, whereby macroenvironmental changes are eliciting responses at the microenvironmental level, occurs within stands of alpine larch growing in western Montana.*

Montrone, A., Saito, L., Weisberg, P. J., Gosejohan, M., Merriam, K., & Mejia, J. F. (2019). Climate change impacts on vernal pool hydrology and vegetation in northern California. *Journal of Hydrology, 574*, 1003-1013. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065839427&doi=10.1016%2fj.jhydrol.2019.04.076&partnerID=40&md5=1ee768d1734a7e9a119b4bed4807f1bb. doi:10.1016/j.jhydrol.2019.04.076
Research Tags: Water
Abstract: *Vernal pools are seasonal wetlands that have a high diversity of endemic and native plant species, yet they are threatened by agricultural conversion and urban development and face threats posed by climate change resulting from altered precipitation and temperature regimes. We developed an approach to investigate the potential impacts of climate change on hydrology and vegetation communities of vernal pools by creating*

a mass-balance hydrologic model that is coupled to a statistical model of plant community distribution. The hydrologic and vegetative models were calibrated using field measurements from a vernal pool in northeastern California that experiences snow-dominated hydrology and is larger than vernal pools in more studied areas like Central California, but representative of other northern California vernal pools. Using downscaled data from global climate models, the coupled model suggests that warmer conditions will lead to the pool being inundated for a shorter time, but with little change in maximum depth. Reduced hydroperiods suggest possible declines in vernal pool specialist species with future climate change. The coupled model is an integrated approach for understanding the impact of altered environmental conditions on unique hydrology and plant community composition of vernal pool ecosystems, but the model approach could be improved with longer term data and by applying it at more sites to broaden the applicability of the approach and to enable better process representation.

Mora, C., Spirandelli, D., Franklin, E. C., Lynham, J., Kantar, M. B., Miles, W., . . . Hunter, C. L. (2018). Broad threat to humanity from cumulative climate hazards intensified by greenhouse gas emissions. *Nature Climate Change, 8*(12), 1062-1071. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057020893&doi=10.1038%2fs41558-018-0315-6&partnerID=40&md5=c71d9d87a673d75c72e278000bfecc67. doi:10.1038/s41558-018-0315-6

Research Tags: Emissions

Abstract: *The ongoing emission of greenhouse gases (GHGs) is triggering changes in many climate hazards that can impact humanity. We found traceable evidence for 467 pathways by which human health, water, food, economy, infrastructure and security have been recently impacted by climate hazards such as warming, heatwaves, precipitation, drought, floods, fires, storms, sea-level rise and changes in natural land cover and ocean chemistry. By 2100, the world's population will be exposed concurrently to the equivalent of the largest magnitude in one of these hazards if emmisions are aggressively reduced, or three if they are not, with some tropical coastal areas facing up to six simultaneous hazards. These findings highlight the fact that GHG emissions pose a broad threat to humanity by intensifying multiple hazards to which humanity is vulnerable.*

Moreno-de las Heras, M., Bochet, E., Monleón, V., Espigares, T., Nicolau, J. M., Molina, M. J., & García-Fayos, P. (2018). Aridity Induces Nonlinear Effects of Human Disturbance on Precipitation-Use Efficiency of Iberian Woodlands. *Ecosystems, 21*(7), 1295-1305. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040565212&doi=10.1007%2fs10021-017-0219-8&partnerID=40&md5=a66719c4057d89dd7c685e37a8dd2bf9. doi:10.1007/s10021-017-0219-8

Research Tags: Forestry, Weather

Abstract: *The effects of ecosystem degradation are pervasive worldwide and increasingly concerning under the present context of global changes in climate and land use. Theoretical studies and empirical evidence increasingly suggest that drylands are particularly prone to develop nonlinear functional changes in response to climate variations and human disturbance. Precipitation-use efficiency (PUE) represents the ratio of vegetation production to precipitation and provides a tool for evaluating human and climate impacts on landscape functionality. Holm oak (Quercus ilex) woodlands are one of the most conspicuous dry forest ecosystems in the western Mediterranean basin and present a variety of degraded states, due to their long history of human use. We studied the response of Iberian holm oak woodlands to human disturbance along an aridity gradient (that is, semi-arid, dry-transition and sub-humid conditions) using PUE estimations from enhanced vegetation index (EVI) observations of the Moderate-Resolution Imaging Spectroradiometer (MODIS). Our results indicated that PUE decreased linearly with disturbance intensity in sub-humid holm oak woodlands, but showed accelerated, nonlinear reductions with increased disturbance intensity in semi-arid and dry-transition holm oak sites. The impact of disturbance on PUE was larger for dry years than for wet years, and these differences increased with aridity from sub-humid to dry-transition and semi-arid holm oak woodlands. Therefore, aridity may also interact with ecosystem degradation in holm oak woodlands by reducing the landscape ability to buffer large changes in vegetation production caused by climate variability.*

Moriasi, D. N., Steiner, J. L., Duke, S. E., Starks, P. J., & Verser, A. J. (2018). Reservoir Sedimentation Rates in the Little Washita River Experimental Watershed, Oklahoma: Measurement and Controlling Factors. *Journal of the American Water Resources Association, 54*(5), 1011-1023. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054183275&doi=10.1111%2f1752-1688.12658&partnerID=40&md5=6c8da5c3980fd777798915f236af8fac. doi:10.1111/1752-1688.12658

Research Tags: Water

Abstract: *Forty-five flood control reservoirs, authorized in the Watershed Protection and Flood Prevention Act 1954, were installed by United States Department of Agriculture (USDA) between 1969 and 1982 in the Little Washita River Experimental Watershed (LWREW), located in central Oklahoma. Over time, these reservoirs have lost sediment and flood storage capacity due to sedimentation, with rates dependent on upstream land use and climate variability. In this study, sedimentation rates for 12 reservoirs representing three major land use categories within LWREW were measured based on bathymetric surveys that used acoustic profiling system. Physiographic and climate attributes of drainage area of surveyed reservoirs were extracted from publicly available data sources including topographic maps, digital elevation models, USDA Natural Resource Conservation Service soils, and weather station databases. Correlation, principal component analysis, and stepwise regression were utilized to analyze the relationship between normalized reservoir sedimentation rates (ReSRa) and the drainage area characteristics to determine the major variables controlling sedimentation within the LWREW. Percent of drainage area with extreme slopes, saturated hydraulic conductivity, and maximum daily rainfall event recorded in spring explained most of the variability in ReSRa. It was also found that percent reduction in reservoir surface area can be used as a surrogate for estimating ReSRa. The implications of the results are discussed.*

Morrow, J. G., Huggins, D. R., & Reganold, J. P. (2017). Climate change predicted to negatively influence surface soil organic matter of dryland cropping systems in the inland pacific Northwest, USA. *Frontiers in Ecology and Evolution, 5*(MAR). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026822385&doi=10.3389%2ffevo.2017.00010&partnerID=40&md5=8e9c6736a228ab1b38f1be96599ac013. doi:10.3389/fevo.2017.00010

Research Tags: Soil

Abstract: *Soil organic matter (SOM) is a key indicator of agricultural productivity and overall soil health. Currently, dryland cropping systems of the inland Pacific Northwest (iPNW) span a large gradient in mean annual temperature (MAT) and precipitation (MAP). These climatic drivers are major determinants of surface SOM dynamics and storage characteristics. Future climate change projections through 2070 indicate significant shifts in MAT and MAP for the iPNW. We assessed surface (0–10 cm) soil organic C and N as well as active and recalcitrant fractions of SOM within long-term experiments representing different tillage regimes and cropping intensities across the current climatic gradient of the iPNW. We discovered that current levels of soil C and N as well as various SOM fractions were positively correlated with MAP and negatively correlated with MAT. Furthermore, these climatic drivers were more influential than either tillage regime or cropping intensity in determining SOM levels and characteristics. Soil organic C and total N as well as the hydrolyzable and non-hydrolyzable fractions were negatively correlated with the current ratio of MAT to MAP, called the climate ratio. Future climate projections (2030 and 2070) forecast an increase of the climate ratio, thus predicting declines in surface SOM and associated soil health across the iPNW.*

Morton, L. W., Roesch-McNally, G., & Wilke, A. K. (2017). Upper midwest farmer perceptions: Too much uncertainty about impacts of climate change to justify changing current agricultural practices. *Journal of Soil and Water Conservation, 72*(3), 215-225. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019925485&doi=10.2489%2fjswc.72.3.215&partnerID=40&md5=2ea07d2f019dee53b86630883093e2f8. doi:10.2489/jswc.72.3.215

Research Tags: Economics, Research

Abstract: *To be uncertain is to be unsure or have doubt. Results from a random sample survey show the majority (89.5%) of farmers in the Upper Midwest perceived there was too much uncertainty about the impacts of climate to justify changing their agricultural practices and strategies, despite scientific evidence regarding the causes and potential consequences of climate change. This study uses random sample survey data (n = 4,778) and in-depth interviews (n = 159) of Upper Midwest farmers to better understand factors that underlie their uncertainty and reluctance to take adaptive action. Results reveal that farmers' uncertainty about projected climate change impacts on their production systems is influenced by their beliefs about climate change, experiences with drought, concern about heat stress on crops, and agricultural information networks.*

Findings suggest a combination of insufficient information and normative influences on climate beliefs are influencing farmer uncertainty. In cases where uncertainty is caused by insufficient information, improved farmer access to and use of historical crop and local climate records, as well as decision support tools that simulate different climate scenarios and their impacts on production, could improve estimates of future risks. However, more information may be insufficient to address claims of uncertainty when differing political and cultural norms contest the parameters of climate change. This suggests that scientific knowledge must be linked to social values and beliefs and trusted agricultural networks for widespread adaptive management to a changing climate to occur.

Mosier, S. L., Kane, E. S., Richter, D. L., Lilleskov, E. A., Jurgensen, M. F., Burton, A. J., & Resh, S. C. (2017). Interactive effects of climate change and fungal communities on wood-derived carbon in forest soils. *Soil Biology and Biochemistry, 115*, 297-309. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028918075&doi=10.1016%2fj.soilbio.2017.08.028&partnerID=40&md5=96fd4196742979c1289c730ada5f7158. doi:10.1016/j.soilbio.2017.08.028

Research Tags: Forestry, Soil

Abstract: *Although wood makes up the majority of forest biomass, the importance of wood contributions to stable soil carbon (C) pools is uncertain. Complex interactions among climate, soil physical properties, intrinsic properties of woody residues, and biological processes all exert dynamic controls over the stabilization, destabilization and transport of wood-derived C in soils. Many studies have demonstrated the strong physical controls on decomposition rates in soils, but little work has been done to relate these to changes in decomposer community composition and how this influences the fate of wood-derived C in soils. Here, we examine the effects of initial fungal inoculation, temperature, soil texture, Free Air CO_2 Enrichment (FACE) wood type, and location of wood residue in the soil, with an experiment investigating the fate of wood-derived C from soils in the first two years following clear-cut harvest in aspen (Populus tremuloides Michx.) forests. We applied 13C-depleted aspen wood chips in 168 experimental plots across six sites in northern Michigan, USA, and tracked the depleted 13C signature through the mineral soil as DOC and from the soil surface as CO_2. Wood residue location had the largest impact on soil CO_2 efflux, with surface wood treatments having more than twice as much wood-derived soil CO_2 efflux as buried wood treatments (1.20 g CO_2 m^{-2} h^{-1} versus 0.49 g CO_2 m^{-2} h^{-1}, respectively; $p < 0.001$). Initial fungal decomposers had a significant effect on DOC quantity and quality, with higher wood-derived DOC concentrations, levels of humification, and tannin content for white-rot treatments compared with brown-rot treatments. Buried chip treatments within open-top chambers had one-third higher wood-derived soil CO_2 efflux than buried chips in ambient temperature treatments ($p < 0.002$). FACE wood type also influenced soil C fluxes from the decomposing wood chips. The average wood-derived soil CO_2 efflux and the average percentage of wood-derived soil CO_2 efflux were significantly greater from wood grown under elevated CO_2 than wood grown under elevated CO_2 + O_3 ($p = 0.002$ and $p = 0.004$, respectively). Furthermore, wood grown under elevated CO_2 had increased DOC aromaticity relative to wood grown in ambient conditions. Taken together, these results show that wood-derived C sources and the decomposers that process them are significant determinants of C fluxes from and transformations within the soil following harvest in aspen forests.*

Moss, R. H., Avery, S., Baja, K., Burkett, M., Chischilly, A. M., Dell, J., . . . Zimmerman, R. (2019). A framework for sustained climate assessment in the United States. *Bulletin of the American Meteorological Society, 100*(5), 897-907. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067863046&doi=10.1175%2fBAMS-D-19-0130&partnerID=40&md5=593d5744e30ba9876be8b752932d2053. doi:10.1175/BAMS-D-19-0130

Research Tags: Research

Abstract: *The recent Fourth National Climate Assessment (NCA4) (USGCRP 2017a, 2018a) shows that extensive changes in climate have been observed in all regions of the country. The report states that climate change "creates new risks and exacerbates existing vulnerabilities…presenting growing challenges to human health and safety, quality of life, and the rate of economic growth." And it concludes that without additional large reductions in emissions, "substantial net damage to the US economy [will occur] throughout this century…" As a result of growing public concern (Leiserowitz et al. 2018), efforts to reduce human contributions to climate change ("mitigation") and to adjust systems and practices to uncertain future climate conditions*

("adaptation") are gaining traction. These efforts notwithstanding, multiple assessments have concluded that mitigation is not taking place nearly rapidly enough to stabilize atmospheric GHG concentrations at safe levels (e.g., IPCC 2014, 2018). Assessments of the state of adaptation have found that adaptation is progressing, but not fast enough (e.g., Hansen et al. 2012; Bierbaum et al. 2014; Vogel et al. 2016).
Practitioners are making long-term plans and investments without consideration of future climate changes and impacts likely to affect the lives and livelihoods of U.S. citizens. To better meet Americans' needs to increase preparedness and resilience in the face of climate change, in 2016 the National Oceanic and Atmospheric Administration (NOAA) and the Office of Science and Technology Policy of the White House convened a Federal Advisory Committee (FAC) to develop recommendations on how to accelerate development of a sustained national climate assessment. The basic idea of a sustained NCA (Buizer et al. 2013) is to better inform decision-making by providing access to knowledge of climate change and its potential impacts in a more flexible and ongoing way than through a series of reports. The FAC was addressing how to advance implementation of the sustained assessment when, in August 2017, NOAA announced it would not be continued. However, most FAC members reconvened and joined with eight additional experts in early 2018 as the Independent Advisory Committee on Applied Climate Assessment (IAC) to complete their report.
The complete report, available in Weather, Climate, and Society (Moss et al. 2019) is summarized here. IAC members (the main authors of the report) consulted broadly with practitioners, researchers, professionals, and science translators and received inputs from a number of related efforts including a "Science to Action" collaborative of some 100 organizations and individuals. The IAC's report presents an ambitious agenda of ideas and initiatives addressed to the full range of stakeholders interested in improving climate change resilience and preparedness. These include federal agencies, state/local/tribal governments, the research sector including universities, professional associations, non-governmental organizations, and philanthropies. The IAC sunsets at the completion of this report, but as described below, with a broader coalition of groups it calls for establishing a new civilsociety-based consortium for climate assessment to work towards implementation of these ideas.

Moss, R. H., Avery, S., Baja, K., Burkett, M., Chischilly, A. M., Dell, J., . . . Zimmerman, R. (2019). Evaluating knowledge to support climate action: A framework for sustained assessment. Report of an independent advisory committee on applied climate assessment. *Weather, Climate, and Society, 11*(3), 465-487. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067844306&doi=10.1175%2fWCAS-D-18-0134.1&partnerID=40&md5=8d048cc2050f1114afe4d0ebda3b062c. doi:10.1175/WCAS-D-18-0134.1
Research Tags: Economics, Research
Abstract: *As states, cities, tribes, and private interests cope with climate damages and seek to increase preparedness and resilience, they will need to navigate myriad choices and options available to them. Making these choices in ways that identify pathways for climate action that support their development objectives will require constructive public dialogue, community participation, and flexible and ongoing access to science- and experience-based knowledge. In 2016, a Federal Advisory Committee (FAC) was convened to recommend how to conduct a sustained National Climate Assessment (NCA) to increase the relevance and usability of assessments for informing action. The FAC was disbanded in 2017, but members and additional experts reconvened to complete the report that is presented here. A key recommendation is establishing a new nonfederal "climate assessment consortium" to increase the role of state/local/tribal government and civil society in assessments. The expanded process would 1) focus on applied problems faced by practitioners, 2) organize sustained partnerships for collaborative learning across similar projects and case studies to identify effective tested practices, and 3) assess and improve knowledge-based methods for project implementation. Specific recommendations include evaluating climate models and data using user-defined metrics; improving benefit–cost assessment and supporting decision-making under uncertainty; and accelerating application of tools and methods such as citizen science, artificial intelligence, indicators, and geospatial analysis. The recommendations are the result of broad consultation and present an ambitious agenda for federal agencies, state/local/tribal jurisdictions, universities and the research sector, professional associations, nongovernmental and community-based organizations, and private-sector firms.*

Motew, M., Chen, X., Booth, E. G., Carpenter, S. R., Pinkas, P., Zipper, S. C., . . . Kucharik, C. J. (2017). The Influence of Legacy P on Lake Water Quality in a Midwestern Agricultural Watershed. *Ecosystems, 20*(8), 1468-1482.

Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014787359&doi=10.1007%2fs10021-017-0125-0&partnerID=40&md5=d40425ffb57d125ffcb418c60fc78ad0. doi:10.1007/s10021-017-0125-0
Research Tags: Water
Abstract: *Decades of fertilizer and manure applications have led to a buildup of phosphorus (P) in agricultural soils and sediments, commonly referred to as legacy P. Legacy P can provide a long-term source of P to surface waters where it causes eutrophication. Using a suite of numerical models, we investigated the influence of legacy P on water quality in the Yahara Watershed of southern Wisconsin, USA. The suite included Agro-IBIS, a terrestrial ecosystem model; THMB, a hydrologic and nutrient routing model; and the Yahara Water Quality Model which estimates water quality indicators in the Yahara chain of lakes. Using five alternative scenarios of antecedent P storage (legacy P) in soils and channels under historical climate conditions, we simulated outcomes of P yield from the landscape, lake P loading, and three lake water quality indicators. Legacy P had a significant effect on lake loads and water quality. Across the five scenarios for Lake Mendota, the largest and most upstream lake, average P yield (kg ha−1) varied by −41 to +22%, P load (kg y−1) by −35 to +14%, summer total P (TP) concentration (mg l−1) by −25 to +12%, Secchi depth (m) by −7 to +3%, and the probability of hypereutrophy by −67 to +34%, relative to baseline conditions. The minimum storage scenario showed that a 35% reduction in present-day loads to Lake Mendota corresponded with a 25% reduction in summer TP and smaller reductions in the downstream lakes. Water quality was more vulnerable to heavy rainfall events at higher amounts of P storage and less so at lower amounts. Increases in heavy precipitation are expected with climate change; therefore, water quality could be protected by decreasing P reserves.*

Motew, M., Chen, X., Carpenter, S. R., Booth, E. G., Seifert, J., Qiu, J., . . . Kucharik, C. J. (2019). Comparing the effects of climate and land use on surface water quality using future watershed scenarios. *Science of the Total Environment, 693*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069835235&doi=10.1016%2fj.scitotenv.2019.07.290&partnerID=40&md5=1da24c53ac5be432320ef43d6896fa92. doi:10.1016/j.scitotenv.2019.07.290
Research Tags: Water
Abstract: *Eutrophication of freshwaters occurs in watersheds with excessive pollution of phosphorus (P). Factors that affect P cycling and transport, including climate and land use, are changing rapidly and can have legacy effects, making future freshwater quality uncertain. Focusing on the Yahara Watershed (YW) of southern Wisconsin, USA, an intensive agricultural landscape, we explored the relative influence of land use and climate on three indicators of water quality over a span of 57 years (2014–2070). The indicators included watershed-averaged P yield from the land surface, direct drainage P loads to a lake, and average summertime lake P concentration. Using biophysical model simulations of future watershed scenarios, we found that climate exerted a stronger influence than land use on all three indicators, yet land use had an important role in influencing long term outcomes for each. Variations in P yield due to land use exceeded those due to climate in 36 of 57 years, whereas variations in load and lake total P concentration due to climate exceeded those due to land use in 54 of 57 years, and 52 of 57 years, respectively. The effect of land use was thus strongest for P yield off the landscape and attenuated in the stream and lake aquatic systems where the influence of weather variability was greater. Overall these findings underscore the dominant role of climate in driving inter-annual nutrient fluxes within the hydrologic network and suggest a challenge for land use to influence water quality within streams and lakes over timescales less than a decade. Over longer timescales, reducing applications of P throughout the watershed was an effective management strategy under all four climates investigated, even during decades with wetter conditions and more frequent extreme precipitation events.*

Mueller, K. E., LeCain, D. R., McCormack, M. L., Pendall, E., Carlson, M., & Blumenthal, D. M. (2018). Root responses to elevated CO<inf>2</inf>, warming and irrigation in a semi-arid grassland: Integrating biomass, length and life span in a 5-year field experiment. *Journal of Ecology, 106*(6), 2176-2189. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046614219&doi=10.1111%2f1365-2745.12993&partnerID=40&md5=65d28a175e29c42f3e9eeec1a1693975. doi:10.1111/1365-2745.12993
Research Tags: Grassland
Abstract: *Plant roots mediate the impacts of environmental change on ecosystems, yet knowledge of root responses to environmental change is limited because few experiments evaluate multiple environmental factors*

and their interactions. Inferences about root functions are also limited because root length dynamics are rarely measured.
Using a 5-year experiment in a mixed-grass prairie, we report the responses of root biomass, length and life span to elevated carbon dioxide (CO2), warming, elevated CO2 and warming combined, and irrigation. Root biomass was quantified using soil cores and root length dynamics were assessed using minirhizotrons. By comparing root dynamics with published results for soil resources and above-ground productivity, we provide mechanistic insights into how climate change might impact grassland ecosystems.
In the upper soil layer, 0–15 cm depth, both irrigation and elevated CO2 alone increased total root length by twofold, but irrigation decreased root biomass and elevated CO2 had only small positive effects on root biomass. The large positive effects of irrigation and elevated CO2 alone on total root length were due to increases in both root length production and root life span. The increased total root length and life span under irrigation and elevated CO2 coincided with apparent shifts from water limitation of plant growth to nitrogen limitation. Warming alone had minimal effects on root biomass, length and life span in this shallow soil layer. Warming and elevated CO2 combined increased root biomass and total root length by c. 25%, but total root length in this treatment was lower than expected if the effects of CO2 and warming alone were additive. Treatment effects on total root length and root life span varied with soil depth and root diameter.
Synthesis. Sub-additive effects of CO2 and warming suggest studies of elevated CO2 alone might overestimate the future capacity of grassland root systems to acquire resources. In this mixed-grass prairie, elevated CO2 with warming stimulated total root length and root life span in deeper soils, likely enhancing plant access to more stable pools of growth-limiting resources, including water and phosphorus. Thus, these root responses help explain previous observations of higher, and more stable, above-ground productivity in these projected climate conditions.

Muhammad, I., Sainju, U. M., Zhao, F., Khan, A., Ghimire, R., Fu, X., & Wang, J. (2019). Regulation of soil CO<inf>2</inf> and N<inf>2</inf>O emissions by cover crops: A meta-analysis. *Soil and Tillage Research, 192*, 103-112. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065550774&doi=10.1016%2fj.still.2019.04.020&partnerID=40&md5=8be0e087b26d82c337b510ba33a2c808. doi:10.1016/j.still.2019.04.020
Research Tags: Soil, Emissions, Crops
Abstract: *Cover crops provide multiple agronomic and environmental benefits, such as enhanced soil carbon sequestration, aggregation, water infiltration, and reduced erosion and nutrient leaching compared with no cover crop. However, little is known regarding the effect of cover crop species, biomass quality and quantity, and method of residue placement on greenhouse gas (GHG) emissions. Using meta-analysis, this study examined the effect of cover crop species, quality and quantity of biomass, and residue management on response ratios (RRs) of cover crops to no cover crop on CO2 and N2O emissions following cash crops. All cover crop species increased CO2 emissions, but reduced N2O emissions compared with no cover crop, except legumes which increased N2O emissions. Cover crop biomass explained 63% of variability in increased CO2 emissions and 55% of variability in decreased N2O emissions. Both CO2 and N2O emissions decreased polynomially with increased cover crop biomass C/N ratio, with greater rate of decline for legumes than nonlegumes. Cover crop residue incorporated into the soil increased CO2 and N2O emissions compared with the residue placed at surface or removed from the soil. Cover crops emitted lower CO2 and N2O emissions than no cover crops in silty loam and sandy clay loam soils, respectively, compared to clay loam and silty clay loam soils. Both soil organic carbon and total nitrogen increased with cover crop compared to no cover crop. Although CO2 and N2O emissions varied with cover crop species, using legume and nonlegume cover crop mixture to enhance residue C/N ratio compared to legumes and placing the residue at the surface instead of incorporating into the soil can reduce GHG emissions. Because of enhanced soil C and N storage and other known benefits, improvement in soil health and environmental quality due to cover crop may outweigh CO2 emissions compared to no cover crop.*

Munson, S. M., & Long, A. L. (2017). Climate drives shifts in grass reproductive phenology across the western USA. *New Phytologist, 213*(4), 1945-1955. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006036378&doi=10.1111%2fnph.14327&partnerID=40&md5=9007a0b92c97083f14fecf3663fb074a. doi:10.1111/nph.14327

Research Tags: Grassland
Abstract: *The capacity of grass species to alter their reproductive timing across space and through time can indicate their ability to cope with environmental variability and help predict their future performance under climate change.*
We determined the long-term (1895–2013) relationship between flowering times of grass species and climate in space and time using herbarium records across ecoregions of the western USA.
There was widespread concordance of C3 grasses accelerating flowering time and general delays for C4 grasses with increasing mean annual temperature, with the largest changes for annuals and individuals occurring in more northerly, wetter ecoregions. Flowering time was delayed for most grass species with increasing mean annual precipitation across space, while phenology–precipitation relationships through time were more mixed. Our results suggest that the phenology of most grass species has the capacity to respond to increases in temperature and altered precipitation expected with climate change, but weak relationships for some species in time suggest that climate tracking via migration or adaptation may be required. Divergence in phenological responses among grass functional types, species, and ecoregions suggests that climate change will have unequal effects across the western USA.

Murdiyarso, D., Lilleskov, E., & Kolka, R. (2019). Tropical peatlands under siege: the need for evidence-based policies and strategies. *Mitigation and Adaptation Strategies for Global Change, 24*(4), 493-505. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061192812&doi=10.1007%2fs11027-019-9844-1&partnerID=40&md5=f82bc15ec2b7c87f511c54baf2f66e81. doi:10.1007/s11027-019-9844-1
Research Tags: Soil
Abstract: *It is widely known that tropical peatlands, including peat swamp forests (PSFs), provide numerous ecosystem services in both spatial and temporal dimensions. These include their role as large stores for organic carbon, which when not managed well could be released as carbon dioxide and methane, accelerating climate warming. Massive destruction and conversion of peatlands occur at an alarming rate in some regions. We hope that the lessons learned from those regions currently under siege from conversion can inform other regions that are at the precipice of mass conversion to agriculture. Much has been learned about high latitude, northern hemisphere peatlands but less is known about tropical peatlands. We collate, analyze, and synthesize the evidence revealed from the set of articles in this special issue. This special issue is a step forward, presenting new information generated from a considerable amount of field data collected from peatlands across the tropics in Asia, Africa, and Latin America. The hard data collected using comparable scientific methodologies are analyzed and compared with existing published data to form a larger dataset as scientific evidence. The synthesis is then interpreted to generate new knowledge to inform the policy community on how to strategize the sustainable management of tropical peatlands. Carbon (C) stocks in tropical peatland ecosystems can be as large as 3000 Mg C ha−1, but the rate of loss is also phenomenal, causing substantial emissions of greenhouse gases of more than 20 Mg C ha−1 year−1. These losses have mainly taken place in Southeast Asia, particularly Indonesia, where peatland development for oil palm and pulpwood has accelerated over the past few decades. Although peatlands in the Amazon and Congo Basin are less developed, it is possible that the same unsustainable pathway would be followed in these regions, if lessons from the dire situation in Southeast Asia are not learned. Strong policies to halt further loss of tropical peatlands may be drawn up and combined with incentives that promote a global agenda under the United Nations Framework Convention on Climate Change 21st Conference of the Parties, Paris, France, Agreement. However, we also propose a framework to address national and local agendas that can be implemented under the nationally determined contributions (NDCs) by balancing conversion/development and conservation/restoration objectives.*

Murphy, D. J., Yung, L., Wyborn, C., & Williams, D. R. (2017). Rethinking climate change adaptation and place through a situated pathways framework: A case study from the Big Hole Valley, USA. *Landscape and Urban Planning, 167*, 441-450. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027571313&doi=10.1016%2fj.landurbplan.2017.07.016&partnerID=40&md5=7de90b34683b6b39e99d8016947c3942. doi:10.1016/j.landurbplan.2017.07.016
Research Tags: Research
Abstract: *This paper critically examines the temporal and spatial dynamics of adaptation in climate change science and explores how dynamic notions of 'place' elucidate novel ways of understanding community*

vulnerability and adaptation. Using data gathered from a narrative scenario-building process carried out among communities of the Big Hole Valley in Montana, the paper describes the role of 'place-making' and the 'politics of place' in shaping divergent future climate adaptation pathways. Drawing on a situated adaptation pathways framework and employing an iterative scenario building process, this article demonstrates how 'place' contextualizes future imagined trajectories of social and ecological change so that key impacts and decisions articulate as elements of place-making and place politics. By examining these key 'moments' of future change, participants illuminate the complex linkages between place and governance that are integral to understanding community adaptation and planning for an uncertain future.

Mushinski, R. M., Boutton, T. W., & Scott, D. A. (2017). Decadal-scale changes in forest soil carbon and nitrogen storage are influenced by organic matter removal during timber harvest. *Journal of Geophysical Research: Biogeosciences, 122*(4), 846-862. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018535752&doi=10.1002%2f2016JG003738&partnerID=40&md5=210844964a92fa5c6b8d2838673fc98a. doi:10.1002/2016JG003738
Research Tags: Forest, Soil
Abstract: *This study investigates whether different intensities of organic matter removal associated with timber harvest influence decadal-scale storage of soil organic carbon (SOC) and total nitrogen (TN) in the top 1 m of mineral soil 18 years postharvest in a Pinus taeda L. forest in the Gulf Coastal Plain. We quantified forest harvest-related changes in SOC, TN, microbial biomass carbon (MBC), and nitrogen (MBN) pools (0–100 cm) in unharvested control stands and in two organic matter removal treatment stands subjected to either (i) merchantable bole/stem-only harvest or (ii) whole-tree harvest + forest floor removal. In addition, δ13C of SOC and δ15N of TN were measured in mineral soil to provide insights regarding mechanisms that might explain changes in SOC and TN pool sizes. Soils were sampled seasonally for 1 year. Increasing organic matter removal intensity reduced SOC, TN, MBC, and MBN relative to the unharvested control. Furthermore, soils from whole-tree harvest + forest floor removal stands had lower δ13C and higher δ15N values, suggesting that increasing organic matter removal may decrease heterotrophic activity as well as increase rates of N loss. Seasonal variabilities in SOC and TN were correlated to changes in forest biological properties such as root biomass and forest floor mass. These results indicate that more intensive harvest methods may lead to decade-scale decreases in SOC and TN storage in surface and subsurface soils which could influence rates of biogeochemical processes, the availability of soil nutrients, and potential forest productivity.*

Mutiibwa, D., Fleisher, D. H., Resop, J. P., Timlin, D., & Reddy, V. R. (2018). Regional food production and land redistribution as adaptation to climate change in the U.S. Northeast Seaboard. *Computers and Electronics in Agriculture, 154*, 54-70. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052992739&doi=10.1016%2fj.compag.2018.08.026&partnerID=40&md5=91145def86e5fd3512617ffa7bb852f3. doi:10.1016/j.compag.2018.08.026
Research Tags: Crops
Abstract: *Potential corn and winter-wheat grain, and potato crop yields in the United States Northeastern Seaboard Region (NESR) were simulated under current and future climate scenarios and two water management regimes to evaluate production shifts and land-based adaptation methods. Geospatial data consisting of historical climate, land use, soil, and crop management were coupled with a weather generator, three explanatory crop models, and spatially and temporally downscaled mid-century climate change scenarios to conduct the simulations at sub-county spatial resolution. Unadapted winter wheat yield increased 48% in response to mid-century projected climate changes, but corn grain declined 19% and potato 42% across the NESR, resulting in a net loss in caloric production. The contribution of the three crops to regional food production with respect to historical and mid-century climate conditions was evaluated on the basis of caloric content as a measure of yield capacity. The caloric content declined by 7 to 15% across the three commodities when averaged among all states in the region if no adaptation changes were implemented. Two land redistribution schemes were derived to compensate for this loss by re-allocating the existing land-base within each county to specific crops based on model predicted changes in productivity along with identifying additional increments of additional potential land. These approaches showed that less than 1.6% of the potentially available agricultural land base in the region would be needed to compensate for calorie losses due to climate change. These results qualify land redistribution as a pragmatic and direct adaptation strategy to the*

threat of climate change on regional food security.

Næsset, E., Gobakken, T., & McRoberts, R. E. (2019). A model-dependent method for monitoring subtle changes in vegetation height in the boreal-alpine ecotone using bi-temporal, three dimensional point data from airborne laser scanning. *Remote Sensing, 11*(15). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070445839&doi=10.3390%2frs11151804&partnerID=40&md5=963db1cf7f7f481fe78f9744432e240d. doi:10.3390/rs11151804
Research Tags: Forestry, Research
Abstract: *The boreal tree line is in many places expected to advance upwards into the mountains due to climate change. This study aimed to develop a general method for estimation of vegetation height change in general, and change in tree height more specifically, for small geographical domains utilizing bi-temporal airborne laser scanner (ALS) data. The domains subject to estimation may subsequently be used to monitor vegetation and tree height change with detailed temporal and geographical resolutions. A method was developed with particular focus on statistically rigorous estimators of uncertainty for change estimates. The method employed model-dependent statistical inference. The method was demonstrated in a 12 ha study site in a boreal–alpine tree line in southeastern Norway, in which 316 trees were measured on the ground in 2006 and 2012 and ALS data were acquired in two temporally coincident campaigns. The trees ranged from 0.11 m to 5.20 m in height. Average growth in height was 0.19 m. Regression models were used to predict and estimate change. By following the area-based approach, predictions were produced for every individual 2 m2 population element that tessellated the study area. Two demonstrations of the method are provided in which separate height change estimates were calculated for domains of size 1.5 ha or greater. Differences in height change estimates among such small domains illustrate how change patterns may vary over the landscape. Model-dependent mean square error estimates for the height change estimators that accounted for (1) model parameter uncertainty, (2) residual variance, and (3) residual covariance are provided. Findings suggested that the two latter sources of uncertainty could be ignored in the uncertainty analysis. The proposed estimators are likely to work well for estimation of differences in height change along a gradient of small monitoring units, like the 1.5 ha cells used for demonstration purposes, and thus may potentially be used to monitor tree line migration over time.*

Nagel, L. M., Palik, B. J., Battaglia, M. A., D'Amato, A. W., Guldin, J. M., Swanston, C. W., . . . Roske, M. R. (2017). Adaptive silviculture for climate change: A national experiment in manager-scientist partnerships to apply an adaptation framework. *Journal of Forestry, 115*(3), 167-178. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019423917&doi=10.5849%2fjof.16-039&partnerID=40&md5=d798563550d76c0402803179a49a521f. doi:10.5849/jof.16-039
Research Tags: Forestry
Abstract: *Forest managers in the United States must respond to the need for climate-adaptive strategies in the face of observed and projected climatic changes. However, there is a lack of on-the-ground forest adaptation research to indicate what adaptation measures or tactics might be effective in preparing forest ecosystems to deal with climate change. Natural resource managers in many areas are also challenged by scant locally or regionally relevant information on climate projections and potential impacts. The Adaptive Silviculture for Climate Change (ASCC) project was designed to respond to these barriers to operationalizing climate adaptation strategies by providing a multiregion network of replicated operational-scale research sites testing ecosystem-specific climate change adaptation treatments across a gradient of adaptive approaches, and introducing conceptual tools and processes to integrate climate change considerations into management and silvicultural decisionmaking. Here we present the framework of the ASCC project, highlight the implementation process at two of the study sites, and discuss the contributions of this collaborative science-management partnership.*
Management and Policy Implications The shortage of scientifically robust, replicated, operational-scale research on forest adaptation to climate change has left forest and natural resource managers with little information on and few examples of on-the-ground adaptation approaches that could work for their forest ecosystems. The Adaptive Silviculture for Climate Change (ASCC) project is establishing a national network of long-term silvicultural research sites across multiple regions and a diversity of forest types to test a range of adaptation approaches and to provide managers with the tangible demonstrations needed to inform

climate-adaptive decisionmaking in their forest management. Furthermore, the ASCC project provides managers and scientists with training on integrating climate change considerations into planning processes and identifying locally appropriate adaptation approaches and tactics. The main goals of the ASCC project ultimately serve to advance understanding within the forest management community of how management can foster adaptive responses to the impacts of uncertain climate futures. The science-management partnerships built through this project help inform the relevance of the research, as well as advance communication on climate change adaptation at a national scale.

Nagy, L. G., Riley, R., Bergmann, P. J., Krizsan, K., Martin, F. M., Grigoriev, I. V., . . . Hibbett, D. S. (2017). Genetic bases of fungal white rot wood decay predicted by phylogenomic analysis of correlated gene-phenotype evolution. *Molecular Biology and Evolution, 34*(1), 35-44. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014882706&doi=10.1093%2fmolbev%2fmsw238&partnerID=40&md5=21414db572fa9bdf47c3e40c20ebe4bd. doi:10.1093/molbev/msw238
Research Tags: Forestry, Emissions
Abstract: *Fungal decomposition of plant cell walls (PCW) is a complex process that has diverse industrial applications and huge impacts on the carbon cycle. White rot (WR) is a powerful mode of PCW decay in which lignin and carbohydrates are both degraded. Mechanistic studies of decay coupled with comparative genomic analyses have provided clues to the enzymatic components of WR systems and their evolutionary origins, but the complete suite of genes necessary for WR remains undetermined. Here, we use phylogenomic comparative methods, which we validate through simulations, to identify shifts in gene family diversification rates that are correlated with evolution of WR, using data from 62 fungal genomes. We detected 409 gene families that appear to be evolutionarily correlated with WR. The identified gene families encode well-characterized decay enzymes, e.g., fungal class II peroxidases and cellobiohydrolases, and enzymes involved in import and detoxification pathways, as well as 73 gene families that have no functional annotation. About 310 of the 409 identified gene families are present in the genome of the model WR fungus Phanerochaete chrysosporium and 192 of these (62%) have been shown to be upregulated under ligninolytic culture conditions, which corroborates the phylogeny-based functional inferences. These results illuminate the complexity of WR and suggest that its evolution has involved a general elaboration of the decay apparatus, including numerous gene families with as-yet unknown exact functions.*

Nakamura, F., Seo, J. I., Akasaka, T., & Swanson, F. J. (2017). Large wood, sediment, and flow regimes: Their interactions and temporal changes caused by human impacts in Japan. *Geomorphology, 279*, 176-187. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84994741635&doi=10.1016%2fj.geomorph.2016.09.001&partnerID=40&md5=4425cfd489c255eb83902161e27a45e3. doi:10.1016/j.geomorph.2016.09.001
Research Tags: Forestry, Water
Abstract: *Water, sediment, and large wood (LW) are the three key components of dynamic river-floodplain ecosystems. We examined variations in sediment and LW discharge with respect to precipitation, the presence of dams, land and river use change, and related channel incision and forest expansion on gravel bars and floodplains across Japan. The results indicated that unit sediment discharge and unit LW discharge were smaller in southern Japan where precipitation intensity is generally much greater. Effective precipitation, an index that takes current and antecedent precipitation into account, was a strong predictor of discharge in small watersheds, but not in larger watersheds. However, precipitation intensities related to unit sediment discharge in intermediate and large watersheds were smaller than those associated with unit LW discharge, which we attribute to differences in particle shape and size and also transport mechanisms. The relationship between river flow and discharge of sediment and LW lead us to posit that discharges of these components are supply limited in southern Japan and transport limited in northern Japan. The cross-sectional mean low-flow bed elevation of gravel-bed and sand-bed rivers in Japan decreased by ~ 0.71 and 0.74 m on average, respectively, over the period 1960–2000. Forest expansion on bars and floodplains has been prominent since the 1990s, and trees apparently began to colonize gravel bars ~ 10 to 20 years after riverbed degradation began. Forest recovery in headwater basins, dam construction, gravel mining, and channelization over the past half century are likely the dominant factors that significantly reduced downstream sediment delivery, thereby promoting channel incision and forest expansion. Changes in rivers and floodplains associated with channel incision and forest expansion alter the assemblages of aquatic and terrestrial organisms in riverine landscapes of Japan, and*

climate change may contribute to this change by intensified precipitation. Additionally, regime shifts of water, sediment, and LW may continue or they may reach a dynamic state of quasi-equilibrium in the future. Continued monitoring of these three components, taking into account their geographic variation, is critical for anticipating and managing future changes in river-floodplain systems in Japan and around the world.

Nam, W. H., Kim, T., Hong, E. M., & Choi, J. Y. (2017). Regional climate change impacts on irrigation vulnerable season shifts in agricultural water availability for South Korea. *Water (Switzerland), 9*(10). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030161408&doi=10.3390%2fw9100735&partnerID=40&md5=ba809a9d14d32e2d844e5a487b04ec86. doi:10.3390/w9100735

Research Tags: Water, Crops

Abstract: *Reservoirs are principal water resources that supply irrigation water to paddy fields and play an important role in water resources management in South Korea. For optimal irrigation reservoir operation and management, it is necessary to determine the duration of irrigation water shortages. Management of reservoir operation and irrigation scheduling should take into consideration essential variables that include the water supply in a reservoir and the water demand in the associated irrigation district. The agricultural water supply and demand show different patterns based on the variability and uncertainty of meteorological and hydrological phenomena. The duration of excessive water supply can be quantitatively determined through analysis of deviations and changes in the timing of agricultural water supply and demand. In this study, we introduce an approach to assess the vulnerable seasons of paddy irrigation to enable more effective operation and management of reservoirs. The vulnerable seasons were evaluated through comparison of the potential water supply capacity and irrigation water requirements based on water budget analysis via a time series change analysis. We have assessed the changing in the total duration and duration shifts of the vulnerable irrigation seasons for four agricultural reservoirs using past observed data (1981–2010) from meteorological stations maintained by the Korea Meteorological Administration (KMA) and projected climate change scenarios (2011–2100) as depicted by the Representative Concentration Pathways (RCPs) emission scenarios. For irrigation vulnerable seasons under both the RCP 4.5 and RCP 8.5 scenarios, the results showed periods of significant increases in which total vulnerable seasons compared to the historical period; the longest duration of vulnerability occurred during the 2071–2100 period under the RCP 8.5. Identification of the vulnerable seasons for paddy irrigation can be applied in agricultural water management to more effectively manage reservoir operation during irrigation periods with climate changes.*

Nash, P. R., Gollany, H. T., Liebig, M. A., Halvorson, J. J., Archer, D. W., & Tanaka, D. L. (2018). Simulated soil organic carbon responses to crop rotation, tillage, and climate change in North Dakota. *Journal of Environmental Quality, 47*(4), 654-662. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049474619&doi=10.2134%2fjeq2017.04.0161&partnerID=40&md5=f1f048f1392a2cefe935e7d61445254e. doi:10.2134/jeq2017.04.0161

Research Tags: Soil, Crops

Abstract: *Understanding how agricultural management and climate change affect soil organic carbon (SOC) stocks is particularly important for dryland agriculture regions that have been losing SOC over time due to fallow and tillage practices, and it can lead to development of agricultural practice(s) that reduce the impact of climate change on crop production. The objectives of this study were: (i) to simulate SOC dynamics in the top 30 cm of soil during a 20-yr (1993–2012) field study using CQESTR, a process-based C model; (ii) to predict the impact of changes in management, crop production, and climate change from 2013 to 2032; and (iii) to identify the best dryland cropping systems to maintain or increase SOC stocks under projected climate change in central North Dakota. Intensifying crop rotations was predicted to have a greater impact on SOC stocks than tillage (minimum tillage [MT], no-till [NT]) during 2013 to 2032, as SOC was highly correlated to biomass input (r = 0.91, P = 0.00053). Converting from a MT spring wheat (SW, Triticum aestivum L.)–fallow rotation to a NT continuous SW rotation increased annualized biomass additions by 2.77 Mg ha−1 (82%) and SOC by 0.22 Mg C ha−1 yr−1. Under the assumption that crop production will stay at the 1993 to 2012 average, climate change is predicted to have a minor impact on SOC (approximately −6.5%) relative to crop rotation management. The CQESTR model predicted that the addition of another SW or rye (Secale cereale L.) crop would have a greater effect on SOC stocks (0- to 30-cm depth) than conversion from MT to NT or climate change from 2013 to 2032.*

Nash, P. R., Gollany, H. T., Novak, J. M., Bauer, P. J., Hunt, P. G., & Karlen, D. L. (2018). Simulated soil organic carbon response to tillage, yield, and climate change in the southeastern Coastal Plains. *Journal of Environmental Quality, 47*(4), 663-673. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049448188&doi=10.2134%2fjeq2017.05.0190&partnerID=40&md5=1bd1f85aaeae9f0a41e5cf01bf2d5134. doi:10.2134/jeq2017.05.0190

Research Tags: Soil, Crops

Abstract: *Intensive tillage, low-residue crops, and a warm, humid climate have contributed to soil organic carbon (SOC) loss in the southeastern Coastal Plains region. Conservation (CnT) tillage and winter cover cropping are current management practices to rebuild SOC; however, there is sparse long-term field data showing how these management practices perform under variable climate conditions. The objectives of this study were to use CQESTR, a process-based C model, to simulate SOC in the top 15 cm of a loamy sand soil (fine-loamy, kaolinitic, thermic Typic Kandiudult) under conventional (CvT) or CnT tillage to elucidate the impact of projected climate change and crop yields on SOC relative to management and recommend the best agriculture management to increase SOC. Conservation tillage was predicted to increase SOC by 0.10 to 0.64 Mg C ha−1 for six of eight crop rotations compared with CvT by 2033. The addition of a winter crop [rye (Secale cereale L.) or winter wheat (Triticum aestivum L.)] to a corn (Zea mays L.)–cotton (Gossypium hirsutum L.) or corn–soybean [Glycine max (L.) Merr.] rotation increased SOC by 1.47 to 2.55 Mg C ha−1. A continued increase in crop yields following historical trends could increase SOC by 0.28 Mg C ha−1, whereas climate change is unlikely to have a significant impact on SOC except in the corn–cotton or corn–soybean rotations where SOC decreased up to 0.15 Mg C ha−1 by 2033. The adoption of CnT and cover crop management with high-residue-producing corn will likely increase SOC accretion in loamy sand soils. Simulation results indicate that soil C saturation may be reached in high-residue rotations, and increasing SOC deeper in the soil profile will be required for long-term SOC accretion beyond 2030.*

Nash, P. R., Gollany, H. T., & Sainju, U. M. (2018). CQESTR-simulated response of soil organic carbon to management, yield, and climate change in the Northern Great Plains Region. *Journal of Environmental Quality, 47*(4), 674-683. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049486150&doi=10.2134%2fjeq2017.07.0273&partnerID=40&md5=c0dffe53bb5286f4f82cfc8fa87a7ed9. doi:10.2134/jeq2017.07.0273

Research Tags: Crops, Soil

Abstract: *Traditional dryland crop management includes fallow and intensive tillage, which have reduced soil organic carbon (SOC) over the past century, raising concerns regarding soil health and sustainability. The objectives of this study were: (i) to use CQESTR, a process-based C model, to simulate SOC dynamics from 2006 to 2011 and to predict relative SOC trends in cropping sequences that included barley (Hordeum vulgare L.), pea (Pisum sativum L.), and fallow under conventional tillage or no-till, and N fertilization rates through 2045; and (ii) to identify best dryland cropping systems to increase SOC and reduce CO2 emissions under projected climate change in eastern Montana. Cropping sequences were conventional-till barley–fallow (CTB-F), no-till barley–fallow (NTB-F), no-till continuous barley (NTCB), and no-till barley–pea (NTB-P), with 0 and 80 kg N ha−1 applied to barley. Under current crop production, climatic conditions, and averaged N rates, SOC at the 0- to 10-cm depth was predicted to increase by 1.74, 1.79, 2.96, and 4.57 Mg C ha−1 by 2045 for CTB-F, NTB-F, NTB-P, and NTCB, respectively. When projected climate change and the current positive US barley yield trend were accounted for in the simulations, SOC accretion was projected to increase by 0.69 to 0.92 Mg C ha−1 and 0.41 to 0.47 Mg C ha−1, respectively. According to the model simulations, adoption of NT, elimination of fallow years, and N fertilizer management will likely have the greatest impact on SOC stocks in the top soil as of 2045 in the Northern Great Plains.*

Naujokaitis-Lewis, I., Pomara, L. Y., & Zuckerberg, B. (2018). Delaying conservation actions matters for species vulnerable to climate change. *Journal of Applied Ecology, 55*(6), 2843-2853. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052487196&doi=10.1111%2f1365-2664.13241&partnerID=40&md5=0c8c30db5252fa373f9fdcf78a458854. doi:10.1111/1365-2664.13241

Research Tags: Wildlife

Abstract: *Climate change vulnerability assessments are commonly used to identify species or populations at*

risk from global climate change, but few translate impact assessments to climate change adaptation actions. Furthermore, most climate change adaptation efforts emphasize where to implement management actions, whereas timing remains largely overlooked. The rate of modern climate change introduces urgency in evaluating whether delaying conservation actions compromises their efficacy for reaching important conservation targets.
We evaluated the importance of multiple climate change adaptation strategies including timing of actions on preventing extinctions for a threatened climate-sensitive species, the Eastern Massasauga rattlesnake (Sistrurus catenatus). We parameterized a range-wide population viability analysis model that related demographic sensitivities to drought events and human-modified land cover to assess vulnerability to future climate change. Using simulations, we assessed the efficacy and trade-offs associated with alternative climate adaptation strategies aimed at maximizing the number of future populations including when to initiate conservation actions, duration of management, number of managed populations, and local management effectiveness. Population-level projections under future climate change scenarios revealed a broad-scale pattern of range contraction in the southwestern portion of the current range. Along the extinction gradient, we identified demographic strongholds and refugia critical for population persistence under climate change as well as populations at high risk of extinction and candidates for climate change adaptation actions.
In the context of future climate change, the timing of conservation actions was crucial; acting earlier maximized chances of achieving conservation targets. Even considering uncertainty in climate change projections, delaying actions was less efficient and introduced undesirable trade-offs including the need to implement conservation actions for longer or targeting more populations to achieve a similar conservation target.
Synthesis and applications. Our findings highlight how acting quickly reduces risk and improves outcomes for a highly vulnerable species under future climate change. Climate change vulnerability assessments require translation of model-based outputs into tractable information for climate change adaptation planning. Quantifying trade-offs associated with the multidimensional decision space related to species conservation and recovery planning is a critical step in climate change adaptation.

Nave, L. E., Domke, G. M., Hofmeister, K. L., Mishra, U., Perry, C. H., Walters, B. F., & Swanston, C. W. (2018). Reforestation can sequester two petagrams of carbon in US topsoils in a century. *Proceedings of the National Academy of Sciences of the United States of America, 115*(11), 2776-2781. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043786481&doi=10.1073%2fpnas.1719685115&partnerID=40&md5=fb0c8223b66bd35bcb6b95da16b62aa9. doi:10.1073/pnas.1719685115
Research Tags: Forestry, Soil
Abstract: *Soils are Earth's largest terrestrial carbon (C) pool, and their responsiveness to land use and management make them appealing targets for strategies to enhance C sequestration. Numerous studies have identified practices that increase soil C, but their inferences are often based on limited data extrapolated over large areas. Here, we combine 15,000 observations from two national-level databases with remote sensing information to address the impacts of reforestation on the sequestration of C in topsoils (uppermost mineral soil horizons). We quantify C stocks in cultivated, reforesting, and natural forest topsoils; rates of C accumulation in reforesting topsoils; and their contribution to the US forest C sink. Our results indicate that reforestation increases topsoil C storage, and that reforesting lands, currently occupying >500,000 km2 in the United States, will sequester a cumulative 1.3–2.1 Pg C within a century (13–21 Tg C·y−1). Annually, these C gains constitute 10% of the US forest sector C sink and offset 1% of all US greenhouse gas emissions.*

Nave, L. E., Drevnick, P. E., Heckman, K. A., Hofmeister, K. L., Veverica, T. J., & Swanston, C. W. (2017). Soil hydrology, physical and chemical properties and the distribution of carbon and mercury in a postglacial lake-plain wetland. *Geoderma, 305*, 40-52. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019653385&doi=10.1016%2fj.geoderma.2017.05.035&partnerID=40&md5=39621b44e1fdc8d26a7b2122e8b1d8fb. doi:10.1016/j.geoderma.2017.05.035
Research Tags: Water
Abstract: *Northern wetland soils hold globally significant carbon (C) and mercury (Hg) stocks whose cycling feeds back to atmospheric pollution, climate change, and the trophic dynamics of adjacent aquatic ecosystems. At a more local level, patterns of variation in the hydrologic, physical and chemical properties of wetland soils inform the appreciation of these ecosystems in their own right; describing patterns of variation, their potential*

drivers and consequences is a key step towards placing wetland soils in the context of broader landscape-level processes, such as C and Hg export to aquatic ecosystems. In this case study, we investigated a 10 ha, 3000 year old lake-plain wetland in the Great Lakes region (U.S.A.), located at the interface between a 120 ha, first-order watershed and a 6700 ha inland lake. We monitored water tables, measured soil morphology and physical characteristics, applied interpolation and mapping to model hydrologic flowpaths and spatial variation in soil depth, morphology, total C and Hg stocks, and used chemical analyses (elemental concentrations and isotope signatures, UV–Vis and FTIR spectroscopy) to quantify relationships between soil C and Hg pools, organic matter composition, and C cycling rates. Key findings from this site include: 1) whole-profile soil C and Hg stocks are readily predicted from soil depth; 2) soil saturation is semipermanent but spatially and temporally variable; 3) accumulated organic soil materials are dominated by aromatic moieties, but possess considerable amounts of labile polysaccharides; 4) subtle, topography- mediated hydrologic flowpaths create profiles of interbedded organic and mucky sand horizons with sharp discontinuities in their C and Hg concentrations. Compared to peatlands across the region and North America, soil depths and C stocks are rather low, averaging 84 cm and 394 Mg ha^{-1}, respectively. On the contrary, total Hg concentrations of organic soil materials (137 and 191 ng g^{-1} for fibric vs. sapric, respectively) are at the high end for wetlands of the Great Lakes region, and more representative of those observed in areas of the eastern U.S. with historically elevated atmospheric deposition. Given past and potentially increased future variation in hydrologic regimes due to climate change, the presence of banded (sandy) profiles that may act as preferential flowpaths, and the large quantities of Hg and labile C held in these soils, they may act as significant sources of C and Hg to the atmosphere or adjacent aquatic ecosystems.

Nave, L. E., Gough, C. M., Perry, C. H., Hofmeister, K. L., Le Moine, J. M., Domke, G. M., . . . Nadelhoffer, K. J. (2017). Physiographic factors underlie rates of biomass production during succession in Great Lakes forest landscapes. *Forest Ecology and Management, 397*, 157-173. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018768995&doi=10.1016%2fj.foreco.2017.04.040&partnerID=40&md5=2ab2d81f0d8bd44d41f31714d58addcf. doi:10.1016/j.foreco.2017.04.040

Research Tags: Forestry

Abstract: *Biomass production in living trees is the basis of numerous forest ecosystem functions and services. However, rates of and controls on biomass production vary widely across temperate forests, particularly over successional timescales of decades and centuries. Biomass production in temperate forests is most often interpreted within the context of biotic or top-down controls, such as species composition or disturbance. However, there is need to investigate how bottom-up physiographic factors, such as landform attributes, drainage, and soil properties mediate biomass production. In order to investigate patterns, controls, and potentials for biomass production across spatial levels ranging from individual ecosystems, to landscapes, to entire regions, we synthesized long-term forest inventory datasets from the United States Great Lakes region, placed them in the context of a hierarchical ecological unit classification, and tested the influence of physiographic factors on biomass production rates and temporal trajectories across ecological levels. Key findings include: 1) At nearly all ecological levels, physiographic controls (e.g., soil texture, drainage class, water table depth) on soil moisture status are significant predictors of variation in biomass production rates, with mesic sites accumulating biomass more rapidly than xeric sites, which, in turn accumulate biomass more rapidly than hydric sites. 2) Aboveground live biomass can apparently continue to accumulate through 2–3 centuries of succession, exceeding 300–400 Mg ha^{-1} on mesic sites throughout the region. 3) Stand age distributions indicate that hydric sites are harvested least often, while the high production rates of mesic sites suggest they are most appropriate for frequent harvesting. 4) Median, 1st-quartile, and 3rd-quartile growth rates of individual ecosystems, landscapes, and ecoregional subsections and sections reveal ecological units in which forests may vary in their potential for increases or decreases in biomass production, e.g., due to management interventions, climate change, or disturbances. Specifically, some units have tightly constrained distributions, suggesting little capacity for change in production rates relative to observed medians, while other units have wide variation in biomass production rates, indicating the potential for relatively large increases or decreases in production. Altogether, the results of this analysis show that physiography exerts widespread, bottom-up controls on biomass production across the region of study, and can be used in spatially explicit frameworks to understand ecosystem functioning and inform scientific forest management.*

Nave, L. E., Walters, B. F., Hofmeister, K. L., Perry, C. H., Mishra, U., Domke, G. M., & Swanston, C. W. (2019). The role of reforestation in carbon sequestration. *New Forests, 50*(1), 115-137. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049655732&doi=10.1007%2fs11056-018-9655-3&partnerID=40&md5=46687c7ea1d63873084281cc6a0e3ed4. doi:10.1007/s11056-018-9655-3

Research Tags: Forestry

Abstract: *In the United States (U.S.), the maintenance of forest cover is a legal mandate for federally managed forest lands. More broadly, reforestation following harvesting, recent or historic disturbances can enhance numerous carbon (C)-based ecosystem services and functions. These include production of woody biomass for forest products, and mitigation of atmospheric CO2 pollution and climate change by sequestering C into ecosystem pools where it can be stored for long timescales. Nonetheless, a range of assessments and analyses indicate that reforestation in the U.S. lags behind its potential, with the continuation of ecosystem services and functions at risk if reforestation is not increased. In this context, there is need for multiple independent analyses that quantify the role of reforestation in C sequestration, from ecosystems up to regional and national levels. Here, we describe the methods and report the findings of a large-scale data synthesis aimed at four objectives: (1) estimate C storage in major ecosystem pools in forest and other land cover types; (2) quantify sources of variation in ecosystem C pools; (3) compare the impacts of reforestation and afforestation on C pools; (4) assess whether these results hold or diverge across ecoregions. The results of our synthesis support four overarching inferences regarding reforestation and other land use impacts on C sequestration. First, in the bigger picture, soils are the dominant C pool in all ecosystems and land cover types in the U.S., and soil C pool sizes vary less by land cover than by other factors, such as spatial variation or soil wetness. Second, where historically cultivated lands are being reforested, topsoils are sequestering significant amounts of C, with the majority of reforested lands yet to reach their capacity relative to the potential indicated by natural forest soils. Third, the establishment of woody vegetation delivers immediate to multi-decadal C sequestration benefits in aboveground woody biomass and coarse woody debris pools, with two- to three-fold C sequestration benefits in biomass during the first several decades following planting. Fourth, opportunities to enhance C sequestration through reforestation vary among the ecoregions, according to current levels of planting, typical forest growth rates, and past land uses (especially cultivation). Altogether, our results suggest that an immediate, but phased and spatially targeted approach to reforestation can enhance C sequestration in forest biomass and soils in the U.S. for decades to centuries to come.*

Neaves, C. M., Aust, W. M., Bolding, M. C., Barrett, S. M., Trettin, C. C., & Vance, E. (2017). Soil properties in site prepared loblolly pine (Pinus taeda L.) stands 25 years after wet weather harvesting in the lower Atlantic coastal plain. *Forest Ecology and Management, 404*, 344-353. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029306355&doi=10.1016%2fj.foreco.2017.08.015&partnerID=40&md5=1b900b1fecccc386c18ebe620a0a36da. doi:10.1016/j.foreco.2017.08.015

Research Tags: Forestry, Soil

Abstract: *Harvesting traffic may alter soil properties and reduce forest productivity if soil disturbances are not mitigated. Logging operations were conducted during high soil moisture conditions on the South Carolina, USA coast to salvage timber and reduce wildfire potential following Hurricane Hugo in 1989. Long term study sites were established on wet pine flats to evaluate effects of primary skid trails and site preparation on soil properties and loblolly pine productivity. The experiment was analyzed as a split-plot within an unbalanced randomized complete block design having 12 blocks, two levels of traffic (primary skid trail (On), no obvious traffic (Off)) and four levels of site preparation (bedding (Bed), disking with bedding (D/B), disking (Disk), no site preparation (None)). Remeasurement of the study was conducted in 2015 at 25 years after salvage logging (stand age 23 years). Bed and D/B treatments had greater saturated hydraulic conductivity ($p = 0.0567$) and macroporosity ($p = 0.0071$) and lower bulk density ($p = 0.0226$) values than Disk and None treatments. Macroporosity benefits were evident two years after site preparation installation, but bulk density and saturated hydraulic conductivity were not, suggesting these two measurements were affected over time by differences in rooting activity influenced by initial aeration benefits. Depth to iron depletion ($p = 0.0055$) was significantly greater and soil carbon ($p < 0.0001$) was significantly lower in Bed and D/B treatments due to bed elevation above the water table and improved drainage. This implies greater aeration for roots, but trade-offs in above-ground biomass and soil carbon storage. However, above and below ground carbon differences balanced one another between treatments so that combined carbon storage in soil and above ground loblolly pine* *biomass was not significantly different by site preparation treatment (p = 0.1127). Bed and D/B resulted in approximately double the stand biomass (p < 0.0001) and stand density (p < 0.0001) than Disk and None. Bed and D/B generally created more favorable soil properties and enhanced long term loblolly pine stand productivity. Differences in soil properties and stand productivity between traffic levels, with and without site preparation, were negligible suggesting natural soil recovery mechanisms were mitigated effects of wet site harvesting over 25 years.*

Negm, A., Jabro, J., & Provenzano, G. (2017). Assessing the suitability of American National Aeronautics and Space Administration (NASA) agro-climatology archive to predict daily meteorological variables and reference evapotranspiration in Sicily, Italy. *Agricultural and Forest Meteorology, 244-245*, 111-121. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020422909&doi=10.1016%2fj.agrformet.2017.05.022&partnerID=40&md5=7f5055ce6177828eba013da5de58d6de. doi:10.1016/j.agrformet.2017.05.022

Research Tags: Research, Weather

Abstract: *For decades, the importance of evapotranspiration processes has been recognized in many disciplines, including hydrologic and drainage studies, irrigation systems design and management.*
In this research, the suitability of the Prediction Of Worldwide Energy Resource database published by the American National Aeronautics and Space Administration (POWER-NASA), to estimate daily meteorological variables and ET0 was assessed in Sicily, Italy, for the period 2006–2014, based on ground data measured by a network of climate stations belonging to the regional Agro-meteorological Information Service (SIAS). After comparing the climate data (minimum, Tmin, maximum, Tmax, and average, Tavg, air temperature, relative air humidity, RH, global solar radiation, Rs and wind speed, u) available in both databases, a statistical comparison was carried out on ET0 values estimated according to the Penman Monteith equation in the version proposed by the Food and Agriculture Organization (FAO-56 PM).
The analysis showed that correlations between air temperature and relative air humidity from both databases are affected by elevation of the weather stations and the distance from the sea. In addition, ET0 values estimated with POWER-NASA database were generally comparable to those obtained by using the SIAS records, with RMSE values ranging between 0.68 and 1.27 mm d−1 and MBE varying between −0.39 and 0.73 mm d−1. The greatest differences in ET0 values are due to the resolution of POWER-NASA archive (1° latitude by 1° longitude), that cannot detect the actual spatial variability observed on ground, as well as to inaccurate estimations of relative air humidity occurring for the coastal weather stations as well as of the air temperature for those inland stations characterized by high elevations. However, the achieved results support the possibility of obtaining suitable estimates of daily ET0 based on the POWER-NASA agro-climatology archive, even to other Mediterranean countries where most of the climate variables are not measured.

Negro, F., & Bergman, R. (2019). Carbon stored by furnishing wood-based products: An Italian case study. *Maderas: Ciencia y Tecnologia, 21*(1), 65-76. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061453521&doi=10.4067%2fS0718-221X2019005000106&partnerID=40&md5=c132777fe3183d2fd47b74984b0648eb. doi:10.4067/S0718-221X2019005000106

Research Tags: Economics, Forestry

Abstract: *The concentration of atmospheric carbon dioxide is constantly rising, with severe effects on global climate change. To mitigate impacts of climate change, the role of forest in terms of carbon sequestration are well-known as trees naturally pull CO2 from the atmosphere as they grow. Contrarily, only recently the carbon mitigation value of wood-based products in buildings has been recognized.*
Buildings are a fundamental sector for wood-based products, both in terms of volume and service life length. In particular, furnishings in housing include high quantities of wood-based products; they are usually made, partly or entirely, by solid wood or by wood-based panels such as plywood, particleboard and medium density fiberboard. These wood furnishings store biogenic carbon during their service life.
In this context, the present study investigated the amount of carbon stored by furnishing wood-based products for an apartment in Torino, Italy. The overall amount, determined according to European Standard, resulted in 3531 kg of CO2-equivalents stored. This corresponds to 45,8 kg per m2 of indoor walkable area; simulating lower and higher intensity usages of wood-based products provided carbon storage values of 35,1 and 55,3 kg/m2, respectively.

On the whole, the present study gave an order of magnitude of the role played in carbon storage by furnishing wood-based products in building and illustrates their relevance in mitigating climate change.

Negrón, J. F. (2018). Biological aspects of mountain pine beetle in lodgepole pine stands of different densities in Colorado, USA. *Forests, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059375965&doi=10.3390%2ff10010018&partnerID=40&md5=349e3ae61da96309c9394c398f6bae56. doi:10.3390/f10010018

Research Tags: Wildlife, Forestry

Abstract: *Research Highlights: The biology of mountain pine beetle (MPB), Dendroctonus ponderosae Hopkins, in Colorado's lodgepole pine forests exhibits similarities and differences to other parts of its range. Brood emergence was not influenced by stand density nor related to tree diameter. The probability of individual tree attack is influenced by stocking and tree size. Findings have implications for understanding MPB as a disturbance agent and for developing management strategies. Background and Objectives: MPB causes extensive tree mortality of lodgepole pine, Pinus contorta Douglas ex Loudon, across the western US and Canada and is probably the most studied bark beetle in North America. However, most of the current knowledge on the biology and ecology of MPB in lodgepole pine comes from the Intermountain Region of the US and western Canada. Little information is available from Colorado. This is the first study addressing effects of stand stocking levels on the biology of MPB and quantifying phloem consumption. In addition, although data are available on the conditions that foster stand infestation, this is the first study estimating the probability of individual tree attack among stands of known different stocking. Materials and Methods: Studies were conducted in managed lodgepole pine stands in Colorado. Unbaited traps were used to monitor MPB flight across stands of different densities. Cages were used to monitor emergence and bark samples to determine attack densities, and phloem consumption in trees growing under different stocking. Beetle collections were used to determine emergence across the growing season. Tree mortality data from plots of different densities were used to examine the probability of individual tree infestation. Results: More beetles were caught flying through higher density stands. More attacks were observed in lower stocking stands but there were no differences in the number of insects emerging nor phloem consumption. There was no relationship between tree size and beetle emergence. Peak flight occurred in early to mid-August and only one peak of beetle emergence occurred. The probability of tree attack was influenced by stand stocking and tree diameter. Conclusions: In general, aspects of the biology of MPB in Colorado exhibit similarities and differences with other regions. The data suggest the need to more closely examine how MPB functions in stands of different stocking and how the distribution of tree sizes influence the probability of infestation and extent of mortality in stands. Biological characteristics of MPB in Colorado need further examination, particularly as climate change continues to manifest. Baseline information will be critical to refine management approaches, and extend the understanding of how MPB contributes to shape forest composition and structure in Colorado.*

Nelson, L., Blumenthal, D. M., Williams, D. G., & Pendall, E. (2017). Digging into the roots of belowground carbon cycling following seven years of Prairie Heating and CO<inf>2</inf> Enrichment (PHACE), Wyoming USA. *Soil Biology and Biochemistry, 115*, 169-177. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028726006&doi=10.1016%2fj.soilbio.2017.08.022&partnerID=40&md5=253a5f2ddf16d566e68c515ed11a0a6a. doi:10.1016/j.soilbio.2017.08.022

Research Tags: Grassland, Soil

Abstract: *Grassland soils are significant carbon (C) sinks as more than half of grassland plant biomass is belowground and roots are the main source of soil C. It is uncertain if grassland soils will continue as C sinks in the future because climate change may affect the dynamic, belowground relationships among crown and root biomass, root chemistry and morphology, and root and soil decomposition, all of which influence C sequestration potential. To better understand future belowground C cycling in semiarid grasslands we analyzed three native species (Bouteloua gracilis, Carex eleocharis, and Pascopyrum smithii) and mixed-grass community crown and root biomass, root chemistry, morphology, and decomposability, and soil organic carbon (SOC) priming following seven years of simulated climate change at the Prairie Heating and CO2 Enrichment (PHACE) experiment in Wyoming, USA. We found that individual species and the community respond uniquely to the climate change field treatments, indicating that species composition is important when analyzing climate change effects on grassland C cycling. Root biomass in the C3 sedge, C. eleocharis, increased under elevated*

CO2, especially when combined with warming. Decomposition rates of roots from warming plots were higher than those from ambient plots for B. gracilis and P. smithii. Across species, root decomposition rates increased with C and N concentrations. Root morphology was altered as well: B. gracilis root diameter increased under warming, and P. smithii specific root length and surface area increased under elevated CO2. P. smthii roots induced short-term, negative SOC priming across all field treatments. Together, our results indicate that grass roots may play a critical role in maintaining soil C stocks in grasslands in the future.

Nepal, P., Korhonen, J., Prestemon, J. P., & Cubbage, F. W. (2019). Projecting global and regional forest area under the shared socioeconomic pathways using an updated Environmental Kuznets Curve model. *Forests, 10*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066820921&doi=10.3390%2ff10050387&partnerID=40&md5=3e8886a3d289f4ff4c878bddbd3648d4. doi:10.3390/f10050387
Research Tags: Research, Forestry, Economics
Abstract: *Forest resources are critical to environmental, economic, and social development, and there is substantial interest in understanding how global forest area will evolve in the future. Using an Environmental Kuznets Curve (EKC) model of total forest area that we updated using more recent data sets, we projected forest area through 2100 in 168 countries using variables including income, rural population density, and the size of the labor force under different world visions drawn from alternative Intergovernmental Panel on Climate Change socioeconomic pathways (SSPs). Results provided support for the existence of an EKC for total forest area, with rural population density negatively affecting forest area and labor force size positively affecting forest area. The projections showed modest and continuous increases in global forest area in all the SSPs, but varying trends for major world regions, which is consistent with the projected trends from the explanatory variables in each country. Aggregate global forest area is projected to increase by 7% as of 2100 relative to 2015 levels in SSP3, which predicts a future with the lowest rate of economic growth, and by 36% in SSP5, which is a future with the highest rate of economic growth and greater economic equality across countries. The results show how projections driven only by income produce biased results compared to the projections made with an EKC that includes rural population density and labor force variables.*

Nepal, P., Korhonen, J., Prestemon, J. P., & Cubbage, F. W. (2019). Projecting global planted forest area developments and the associated impacts on global forest product markets. *Journal of Environmental Management, 240*, 421-430. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064169571&doi=10.1016%2fj.jenvman.2019.03.126&partnerID=40&md5=5a95b5d50129e2a1a0ded89d39416fac. doi:10.1016/j.jenvman.2019.03.126
Research Tags: Research, Forestry
Abstract: *Planted forests are a rising share of total forests globally and an increasingly important source of timber product output, affecting national and global markets. We estimated econometric models of planted forest area by OECD and non-OECD country groups that control for economic, institutional and environmental policies likely to influence future changes in planted forest area. The models are then used to project planted forest area over next 55 years for 180 countries under five alternative scenarios of global socio-economic changes, represented in shared socioeconomic pathways (SSPs), adjunct products emerging from the Fifth Assessment of the Intergovernmental Panel on Climate Change (IPCC). By embedding key features of the SSP projections into a global forest sector model, we evaluate how planted forests lead to different global forest product market outcomes for each SSP, compared to corresponding outcomes where planted forests are not considered separately. Projected global planted forest area in 2070 ranges from 379 million ha (Mha) for SSP3 (a relatively poor and unequal world) to 475 Mha under SSP5 (a relatively wealthier and more equal world), representing respective increases of 46% and 66% compared to 2015. SSPs with the highest planted forest area increases have the lowest product prices (down by 12% by 2070, compared to SSP5 without planted forests) and higher global forest products production and consumption quantities (by as much as 3.3% by 2070, compared to SSP5 without planted forests). However, production does not increase in all countries by similar amounts, due to changes in relative advantages in production brought about by reduced product prices.*

Nesmith, J. C. B., Wright, M., Jules, E. S., & McKinney, S. T. (2019). Whitebark and foxtail pine in Yosemite, Sequoia, and Kings Canyon national parks: Initial assessment of stand structure and condition. *Forests, 10*(1). Retrieved

from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059647277&doi=10.3390%2ff10010035&partnerID=40&md5=295e6f60393ed350e383be1785d8e283. doi:10.3390/f10010035
Research Tags: Forestry
Abstract: *The Inventory & Monitoring Division of the U.S. National Park Service conducts long-term monitoring to provide park managers information on the status and trends in biological and environmental attributes including white pines. White pines are foundational species in many subalpine ecosystems and are currently experiencing population declines. Here we present results on the status of whitebark and foxtail pine in the southern Sierra Nevada of California, an area understudied relative to other parts of their ranges. We selected random plot locations in Yosemite, Sequoia, and Kings Canyon national parks using an equal probability spatially-balanced approach. Tree- and plot-level data were collected on forest structure, composition, demography, cone production, crown mortality, and incidence of white pine blister rust and mountain pine beetle. We measured 7899 whitebark pine, 1112 foxtail pine, and 6085 other trees from 2012–2017. All factors for both species were spatially highly variable. Whitebark pine occurred in nearly-pure krummholz stands at or near treeline and as a minor component of mixed species forests. Ovulate cones were observed on 25% of whitebark pine and 69% of foxtail pine. Whitebark pine seedlings were recorded in 58% of plots, and foxtail pine seedlings in only 21% of plots. Crown mortality (8% in whitebark, 6% in foxtail) was low and significantly higher in 2017 compared to previous years. Less than 1% of whitebark and zero foxtail pine were infected with white pine blister rust and <1% of whitebark and foxtail pine displayed symptoms of mountain pine beetle attack. High elevation white pines in the southern Sierra Nevada are healthy compared to other portions of their range where population declines are significant and well documented. However, increasing white pine blister rust and mountain pine beetle occurrence, coupled with climate change projections, portend future declines for these species, underscoring the need for broad-scale collaborative monitoring.*

Neven, L. G., Kumar, S., Yee, W. L., & Wakie, T. (2018). Current and future potential risk of establishment of grapholita molesta (Lepidoptera: Tortricidae) in Washington State. *Environmental Entomology, 47*(2), 448-456. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052150656&doi=10.1093%2fee%2fnvx203&partnerID=40&md5=6a86fd18ad0efc577b0414ebf70a0bf9. doi:10.1093/ee/nvx203
Research Tags: Wildlife, Crops
Abstract: *The oriental fruit moth, Grapholita molesta (Busck) (Lepidoptera: Tortricidae), is a primary pest of stone fruits that cause significant economic damage. Larvae, which enter the host plant through shoot tips, damage shoots, and ripe fruits. Native to Asia, this pest now occurs in many fruit-growing countries, including the United States and Canada. Though the pest was previously reported from many states within the United States, its current distribution and the environmental variables that influence its distribution are not properly identified. The objectives of this study were to 1) identify the environmental factors associated with G. molesta current distribution, 2) predict the current distribution of G. molesta in Washington State (WA) using Maxent and Climex models, 3) identify those areas within WA best suited for establishment of pest free zones, areas of low pest prevalence, and pest free production areas, and 4) identify regions most at risk for further expansion of G. molesta populations as a function of climate change. The current models predicted a small portion of central WA is suitable to support G. molesta, which is consistent with observed distributions. However, climate change models predict that more areas will become suitable for the pest. These results indicate that action should be taken to monitor and reduce current populations of G. molesta to stem its potential expansion into the major commercial tree fruit production areas in the state.*

Neven, L. G., & Yee, W. L. (2017). Impact of prolonged absence of low temperature on adult eclosion patterns of western cherry fruit fly (diptera: Tephritidae). *Environmental Entomology, 46*(3), 708-713. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020883280&doi=10.1093%2fee%2fnvx064&partnerID=40&md5=aef24b31b0ae49323406a0585fc967cc. doi:10.1093/ee/nvx064
Research Tags: Weather, Wildlife, Crops
Abstract: *Western cherry fruit fly, Rhagoletis indifferens (Curran) (Diptera: Tephritidae), is a serious pest of cherries (Prunus spp.) in the Pacific Northwest of the United States. Previous research suggests that R.*

indifferens is unlikely to establish in commercial cherry production areas in California and in tropical export markets because cold temperatures, below 5 °C, in those regions appear insufficient to complete diapause. However, it is unclear how prolonged absence of cold exposure affects diapause termination in R. indifferens. Here, we examined this question by exposing R. indifferens pupae for 40 wk to simulated temperate and tropical conditions of 23 or 26 °C, 40 or 80% RH, and a photoperiod of 16:8 or 12:12 (L:D) h. Eclosion patterns among fly groups in the four conditions did not differ. For all groups, fly eclosion from pupae not exposed to cold exhibited a bimodal distribution. The first major peak, comprising 3.2% of the total fly emergence, occurred at 1–10 wk. The second major peak, comprising the remaining 96.8%, occurred at a mode of ~30 wk. Based on responses to no cold and cold (3 ± 1.5 °C) exposures, there were three distinct pupal diapause groups: the first eclosion group was likely nondiapausing pupae; the second eclosion group was likely diapausing pupae; a third group that remained viable but did not produce adults after 40 wk may represent prolonged dormancy pupae. We suggest that eclosion of adults after prolonged absence of cold exposure needs to be incorporated into models for potential fly establishment in warm climates.

Ngo, H., Latona, R., Sarker, M. I., Yee, W., Hums, M., & Moreau, R. A. (2019). A process to convert sunflower oil into a value added branched chain oil with unique properties. *Industrial crops and products, 139*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067671252&doi=10.1016%2fj.indcrop.2019.06.020&partnerID=40&md5=a6eb1b58cd96e5b14da6c01958b3d971. doi:10.1016/j.indcrop.2019.06.020
Research Tags: Crops, Economics, Energy
Abstract: *The global interest in reducing the use of petroleum resources to mitigate climate change has created a need for the continuing demand for environmentally friendly systems from renewable resources to produce clean and sustainable technology. One promising approach involves the development of catalysts and process improvements to increase the efficiency of the chemical modification reactions. In this study, sunflower oil was used in the skeletal isomerization reaction to introduce methyl branching at the alkyl fatty acid chain of the oil (methyl-branched-chain triglycerides (MBC-TG)) in the presence of a modified H+-BETA zeolite catalyst. Such modification of the oil is proposed to improve its low temperature fluidity, by preventing precipitation at low temperatures. The modified catalyst was easy to handle and separate from the reaction products. The products were thoroughly characterized by common analytical instruments. To evaluate the practicality of this environmentally friendly process, a techno-economic model was constructed to estimate the production cost.*

Nikolic, J., Zhong, S., Pei, L., Bian, X., Heilman, W. E., & Charney, J. J. (2019). Sensitivity of low-level jets to land-use and land- cover change over the continental U.S. *Atmosphere, 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064076123&doi=10.3390%2fatmos10040174&partnerID=40&md5=657df43b58ea40b2d081fbebf6e20dbe. doi:10.3390/atmos10040174
Research Tags: Weather
Abstract: *Lower-tropospheric wind maxima, known as low-level jets (LLJs), play a vital role in weather and climate around the world. In this study, two 10-year (2006–2015) regional climate simulations using current (2011) and future (2100) land-use/land-cover (LULC) patterns over the continental United States (CONUS) are used to assess the sensitivity of LLJ properties, including jet occurrence, maximum speed, and the elevation of the maximum, to changes in LULC. The three simulated LLJ properties exhibit greater sensitivity in summer than in winter. Summertime jets are projected to increase in frequency in the central CONUS, where cropland replaces grassland, and decrease in parts of the Ohio-River Valley and the Southeast, particularly Florida, where urban expansion occurs. Little change is projected for wintertime jet frequency. Larger modifications to jet speed and elevations are projected in parts of the Ohio River Valley, the upper Southeast, and the Intermountain West. While there is some evidence of weaker, more elevated jets with urban expansion, the connection between changes in jet speed and elevation and changes in LULC patterns at a given location is weak. This result suggests that LULC will primarily affect the large-scale atmospheric conditions that contribute to the formation of LLJs, particularly in winter*

Niles, M. T., Wiener, S., Schattman, R. E., Roesch-Mcnally, G., & Reyes, J. (2019). Seeing is not always believing: Crop loss and climate change perceptions among farm advisors. *Environmental Research Letters, 14*(4). Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069688550&doi=10.1088%2f1748-9326%2faafbb6

&partnerID=40&md5=5b31176be3871e4f4944893a6aeeace5. doi:10.1088/1748-9326/aafbb6
Research Tags: Crops, Weather, Research, Economics
Abstract: *As climate change is expected to significantly affect agricultural systems globally, agricultural farm advisors have been increasingly recognized as an important resource in helping farmers address these challenges. While there have been many studies exploring the climate change belief and risk perceptions as well as behaviors of both farmers and agricultural farm advisors, there are very few studies that have explored how these perceptions relate to actual climate impacts in agriculture. Here we couple survey data from United States Department of Agriculture farm service employees (n = 6, 514) with historical crop loss data across the United States to explore the relationship of actual climate-related crop losses on farm to farm advisor perceptions of climate change and future farmer needs. Using structural equation modelling we find that among farm advisors that work directly with farms on disaster and crop loss issues, there is a significant positive relationship between crop loss and perceived weather variability changes, while across all farm advisors crop loss is associated with reduced likelihood to believe in anthropogenic climate change. Further, we find that weather variability perceptions are the most consistently and highly correlated with farm advisors' perceptions about the need for farm adaptation and future farmer needs. These results suggest that seeing crop loss may not lead to climate change belief, but may drive weather variability perceptions, which in turn affect farm adaptation perceptions. This lends further evidence to the debate over terminology in climate change communication and outreach, suggesting that weather variability may be the most salient among agricultural advisors.*

North, M. P., Stevens, J. T., Greene, D. F., Coppoletta, M., Knapp, E. E., Latimer, A. M., . . . Wyrsch, P. (2019). Tamm Review: Reforestation for resilience in dry western U.S. forests. *Forest Ecology and Management, 432*, 209-224. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053769929&doi=10.1016%2fj.foreco.2018.09.007&partnerID=40&md5=d976c72bdd28a4fc795bb5d9ad8cfecf. doi:10.1016/j.foreco.2018.09.007
Research Tags: Forestry
Abstract: *The increasing frequency and severity of fire and drought events have negatively impacted the capacity and success of reforestation efforts in many dry, western U.S. forests. Challenges to reforestation include the cost and safety concerns of replanting large areas of standing dead trees, and high seedling and sapling mortality rates due to water stress, competing vegetation, and repeat fires that burn young plantations. Standard reforestation practices have emphasized establishing dense conifer cover with gridded planting, sometimes called 'pines in lines', followed by shrub control and pre-commercial thinning. Resources for such intensive management are increasingly limited, reducing the capacity for young plantations to develop early resilience to fire and drought. This paper summarizes recent research on the conditions under which current standard reforestation practices in the western U.S. may need adjustment, and suggests how these practices might be modified to improve their success. In particular we examine where and when plantations with regular tree spacing elevate the risk of future mortality, and how planting density, spatial arrangement, and species composition might be modified to increase seedling and sapling survival through recurring drought and fire events. Within large areas of contiguous mortality, we suggest a "three zone" approach to reforestation following a major disturbance that includes; (a) working with natural recruitment within a peripheral zone near live tree seed sources; (b) in a second zone, beyond effective seed dispersal range but in accessible areas, planting a combination of clustered and regularly spaced seedlings that varies with microsite water availability and potential fire behavior; and (c) a final zone defined by remote, steep terrain that in practice limits reforestation efforts to the establishment of founder stands. We also emphasize the early use of prescribed fire to build resilience in developing stands subject to increasingly common wildfires and drought events. Finally, we highlight limits to our current understanding of how young stands may respond and develop under these proposed planting and silvicultural practices, and identify areas where new research could help refine them.*

Northrup, J. M., Rivers, J. W., Yang, Z., & Betts, M. G. (2019). Synergistic effects of climate and land-use change influence broad-scale avian population declines. *Global Change Biology, 25*(5), 1561-1575. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062340906&doi=10.1111%2fgcb.14571&partnerID=40&md5=d58e853b03add395fba09ab4e6036c09. doi:10.1111/gcb.14571
Research Tags: Wildlife

Abstract: *Climate and land-use changes are expected to be the primary drivers of future global biodiversity loss. Although theory suggests that these factors impact species synergistically, past studies have either focused on only one in isolation or have substituted space for time, which often results in confounding between drivers. Tests of synergistic effects require congruent time series on animal populations, climate change and land-use change replicated across landscapes that span the gradient of correlations between the drivers of change. Using a unique time series of high-resolution climate (measured as temperature and precipitation) and land-use change (measured as forest change) data, we show that these drivers of global change act synergistically to influence forest bird population declines over 29 years in the Pacific Northwest of the United States. Nearly half of the species examined had declined over this time. Populations declined most in response to loss of early seral and mature forest, with responses to loss of early seral forest amplified in landscapes that had warmed over time. In addition, birds declined more in response to loss of mature forest in areas that had dried over time. Climate change did not appear to impact populations in landscapes with limited habitat loss, except when those landscapes were initially warmer than the average landscape. Our results provide some of the first empirical evidence of synergistic effects of climate and land-use change on animal population dynamics, suggesting accelerated loss of biodiversity in areas under pressure from multiple global change drivers. Furthermore, our findings suggest strong spatial variability in the impacts of climate change and highlight the need for future studies to evaluate multiple drivers simultaneously to avoid potential misattribution of effects.*

Norton, S. L., Khoury, C. K., Sosa, C. C., Castañeda-Álvarez, N. P., Achicanoy, H. A., & Sotelo, S. (2017). Priorities for enhancing the ex situ conservation and use of Australian crop wild relatives. *Australian Journal of Botany, 65*(8), 638-645. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042123998&doi=10.1071%2fBT16236&partnerID=40&md5=5ed8e774348353596effc52f21f9316b. doi:10.1071/BT16236

Research Tags: Crops

Abstract: *Crop wild relatives – the wild cousins of cultivated plants – are increasingly recognised for their potential to contribute to the productivity, nutritional quality and sustainability of agricultural crops. However, the use of these genetic resources is dependent upon their conservation in genebanks and consequent availability to plant breeders, the status of which has not been comprehensively analysed in Australia. Such conservation assessments are given urgency by reports of increasing threats to natural populations due to habitat destruction, climate change, and invasive species, among other causes. Here we document Australian wild plants related to important food crops, and outline their priorities for ex situ conservation. Given that no major domesticated food plants originated in the country, Australia's native flora of crop wild relatives is surprisingly rich, including potentially valuable cousins of banana, eggplant, melon, mung bean, pigeonpea, rice, sorghum, sweetpotato, soybean and yam. Species richness of the wild relatives of major food crops is concentrated in the northern and north-eastern tropical regions, in the Northern Territory, Western Australia, and Queensland. Geographic priorities for collecting of these taxa for ex situ conservation, due to the limited representation of their populations in genebanks, largely align with areas of high species richness. Proposed dam building and agricultural expansion in northern Australia make conservation action for these species more urgent. We outline key steps needed for enhancing the ex situ conservation of Australia's heritage of major food crop wild relatives, and discuss the critical activities required to increase their use.*

Nourani, V., Fard, A. F., Gupta, H. V., Goodrich, D. C., & Niazi, F. (2017). Hydrological model parameterization using NDVI values to account for the effects of land cover change on the rainfall-runoff response. *Hydrology Research, 48*(6), 1455-1473. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031997901&doi=10.2166%2fnh.2017.249&partnerID=40&md5=8a0976747f9b15278ddc30fab922420a. doi:10.2166/nh.2017.249

Research Tags: Water, Weather

Abstract: *Classic rainfall–runoff models usually use historical data to estimate model parameters and mean values of parameters are considered for predictions. However, due to climate changes and human effects, model parameters change temporally. To overcome this problem, normalized difference vegetation index (NDVI) derived from remotely sensed data was used in this study to investigate the effect of land cover variations on hydrological response of watersheds using a conceptual rainfall–runoff model. The study area consists of two sub-watersheds (Hervi and Lighvan) with varied land cover conditions. Obtained results show*

that the one-parameter model generates runoff forecasts with acceptable level of the considered criteria. Remote sensing data were employed to relate land cover properties of the watershed to the model parameter. While a power form of the regression equation could be best fitted to the parameter values using available images of Hervi sub-watershed, for the Lighvan sub-watershed the fitted equation shows somewhat lower correlation due to higher fluctuations of the model parameter. The average values of the Nash–Sutcliffe efficiency criterion of the model were obtained as 0.87 and 0.55, respectively, for Hervi and Lighvan sub-watersheds. Applying this methodology, the model's parameters might be determined using temporal NDVI values.

Novick, K. A., Biederman, J. A., Desai, A. R., Litvak, M. E., Moore, D. J. P., Scott, R. L., & Torn, M. S. (2018). The AmeriFlux network: A coalition of the willing. *Agricultural and Forest Meteorology, 249*, 444-456. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031912398&doi=10.1016%2fj.agrformet.2017.10.009&partnerID=40&md5=07be0712f476b4790968044426db82c0. doi:10.1016/j.agrformet.2017.10.009

Research Tags: Research

Abstract: *AmeriFlux scientists were early adopters of a network-enabled approach to ecosystem science that continues to transform the study of land-atmosphere interactions. In the 20 years since its formation, AmeriFlux has grown to include more than 260 flux tower sites in the Americas that support continuous observation of ecosystem carbon, water, and energy fluxes. Many of these sites are co-located within a similar climate regime, and more than 50 have data records that exceed 10 years in length. In this prospective assessment of AmeriFlux's strengths in a new era of network-enabled ecosystem science, we discuss how the longevity and spatial distribution of AmeriFlux data make them exceptionally well suited for disentangling ecosystem response to slowly evolving changes in climate and land-cover, and to rare events like droughts and biological disturbances. More recently, flux towers have also been integrated into environmental observation networks that have broader scientific goals; in North America these include the National Ecological Observatory Network (NEON), Critical Zone Observatory network (CZO), and Long-Term Ecological Research network (LTER). AmeriFlux stands apart from these other networks in its reliance on voluntary participation of individual sites, which receive funding from diverse sources to pursue a wide, transdisciplinary array of research topics. This diffuse, grassroots approach fosters methodological and theoretical innovation, but also challenges network-level data synthesis and data sharing to the network. While AmeriFlux has had strong ties to other regional flux networks and FLUXNET, better integration with networks like NEON, CZO and LTER provides opportunities for new types of cooperation and synergies that could strengthen the scientific output of all these networks.*

Nowak, D. J., & Greenfield, E. J. (2018). US urban forest statistics, values, and projections. *Journal of Forestry, 116*(2), 164-177. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049137409&doi=10.1093%2fjofore%2ffvx004&partnerID=40&md5=a1227050719071b327ff374eafa36430. doi:10.1093/jofore/fvx004

Research Tags: Forestry

Abstract: *U.S. urban land increased from 2.6% (57.9 million acres) in 2000 to 3.0% (68.0 million acres) in 2010. States with the greatest amount of urban growth were in the South/Southeast (TX, FL, NC, GA and SC). Between 2010 and 2060, urban land is projected to increase another 95.5 million acres to 163.1 million acres (8.6%) with 18 states projected to have an increase of over 2 million acres. Overall, there are an estimated 5.5 billion trees (39.4% tree cover) in urban areas nationally that contain 127 million acres of leaf area and 44 million tons of dry-weight leaf biomass. Annually, these trees produce a total of $18.3 billion in value related to air pollution removal ($5.4 billion), reduced building energy use ($5.4 billion), carbon sequestration ($4.8 billion) and avoided pollutant emissions ($2.7 billion). States with greatest annual urban forest values were: Florida ($1.9 billion), California ($1.4 billion), Pennsylvania ($1.1 billion), New York ($1.0 billion) and Ohio ($971 million).*

Nowak, D. J., Hirabayashi, S., Doyle, M., McGovern, M., & Pasher, J. (2018). Air pollution removal by urban forests in Canada and its effect on air quality and human health. *Urban Forestry and Urban Greening, 29*, 40-48. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033404278&doi=10.1016%2fj.ufug.2017.10.019&partnerID=40&md5=8bfd5b89ebed5d281294ebbc229e1017. doi:10.1016/j.ufug.2017.10.019

Research Tags: Forestry
Abstract: *Urban trees perform a number of ecosystem services including air pollution removal, carbon sequestration, cooling air temperatures and providing aesthetic beauty to the urban landscape. Trees remove air pollution by intercepting particulate matter on plant surfaces and absorbing gaseous pollutants through the leaf stomata. Computer simulations with local environmental data reveal that trees in 86 Canadian cities removed 16,500 tonnes (t) of air pollution in 2010 (range: 7500–21,100 t), with human health effects valued at 227.2 million Canadian dollars (range: $52.5–402.6 million). Annual pollution removal varied among cities and ranged up to 1740 t in Vancouver, British Columbia. Overall health impacts included the avoidance of 30 incidences of human mortality (range: 7–54) and 22,000 incidences of acute respiratory symptoms (range: 7900–31,100) across these cities.*

Nyelele, C., Kroll, C. N., & Nowak, D. J. (2019). Present and future ecosystem services of trees in the Bronx, NY. *Urban Forestry and Urban Greening, 42*, 10-20. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065791697&doi=10.1016%2fj.ufug.2019.04.018&partnerID=40&md5=bd1c7d083cc18541213c82cf1b534446. doi:10.1016/j.ufug.2019.04.018
Research Tags: Forestry
Abstract: *Trees provide ecosystem services such as air pollutant removal, carbon storage and sequestration, urban heat island reduction, stormwater runoff reduction as well as other socio-economic benefits. Large-scale tree plantings are occurring in many cities to increase tree canopy coverage as well as the health, economic and environmental benefits that come with trees. Thus, there is a need to assess the extent to which trees provide these ecosystem services, where services are realized, and most importantly to improve methods of determining future planting locations. Using a new spatially distributed implementation of the i-Tree suite of ecosystem service models and mapping tools, we estimate the current and future ecosystem services and benefits of a recent tree planting initiative within each census block group of the Bronx, NY for 2010 and for three 2030 tree cover scenarios (assuming no tree mortality, 4% and 8% annual mortality). Land cover and tree canopy estimates for 2010 are derived from a high-resolution land cover dataset. A grow-out scenario based on urban tree database information and allometric equations is used to predict future canopy cover. Change analysis is carried out at the census block group level to determine the magnitude and direction of change for each service and benefit over time. The monetary value of trees in the Bronx in 2010 is estimated to be $37.6 million, and this value is estimated to range from $40.7 million to $43.9 million in 2030 if the current canopy is maintained and newly planted trees grow to maturity.*

O'Geen, A. T., Safeeq, M., Wagenbrenner, J., Stacy, E., Hartsough, P., Devine, S., . . . Bales, R. (2018). Southern sierra critical zone observatory and kings river experimental watersheds: A synthesis of measurements, new insights, and future directions. *Vadose Zone Journal, 17*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058448026&doi=10.2136%2fvzj2018.04.0081&partnerID=40&md5=93b3c6f487b8702ff3628ab15aa3423d. doi:10.2136/vzj2018.04.0081
Research Tags: Research, Water
Abstract: *Sensor networks within the Southern Sierra Critical Zone Observatory (SSCZO) and Kings River Experimental Watersheds (KREW) document changes in the water cycle spanning the west slope of the southern Sierra Nevada in California. The networks were established to document water dynamics throughout the critical zone spanning profile, hillslope, catchment, and watershed scales at key locations that reflect systematic differences in bioclimatic conditions imposed by a strong elevation gradient. The critical zone observatory attempts to constrain the hydrologic budget via representative measurements of streamflow, eddy flux covariance, snow depth, meteorological conditions, and water content and water potential in soil and deep regolith. These measurements reveal the complexity of interactions among all aspects of the water balance (runoff, storage, evapotranspiration [ET], and precipitation) through daily, seasonal, and annual timescales. Multiyear drought, catastrophic wildfires, insect outbreaks, and disease have caused widespread tree mortality in the Sierra Nevada. These disturbances offer a window into the future for this region, which is expected to undergo significant change in response to global warming. This hydrological observatory provides valuable hydrometric attributes and fluxes across the stream–groundwater–vadose zone–soil–vegetation–atmosphere continuum.*

O'Connor, C. D., Falk, D. A., Lynch, A. M., Swetnam, T. W., & Wilcox, C. P. (2017). Disturbance and productivity interactions mediate stability of forest composition and structure. *Ecological Applications, 27*(3), 900-915. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017180144&doi=10.1002%2feap.1492&partnerID=40&md5=8f677d61dfbac782adb86d4fc2a6526b. doi:10.1002/eap.1492

Research Tags: Forestry, Weather

Abstract: *Fire is returning to many conifer-dominated forests where species composition and structure have been altered by fire exclusion. Ecological effects of these fires are influenced strongly by the degree of forest change during the fire-free period. Response of fire-adapted species assemblages to extended fire-free intervals is highly variable, even in communities with similar historical fire regimes. This variability in plant community response to fire exclusion is not well understood; however, ecological mechanisms such as individual species' adaptations to disturbance or competition and underlying site characteristics that facilitate or impede establishment and growth have been proposed as potential drivers of assemblage response. We used spatially explicit dendrochronological reconstruction of tree population dynamics and fire regimes to examine the influence of historical disturbance frequency (a proxy for adaptation to disturbance or competition), and potential site productivity (a proxy for underlying site characteristics) on the stability of forest composition and structure along a continuous ecological gradient of pine, dry mixed-conifer, mesic mixed-conifer, and spruce–fir forests following fire exclusion. While average structural density increased in all forests, species composition was relatively stable in the lowest productivity pine-dominated and highest productivity spruce–fir-dominated sites immediately following fire exclusion and for the next 100 years, suggesting site productivity as a primary control on species composition and structure in forests with very different historical fire regimes. Species composition was least stable on intermediate productivity sites dominated by mixed-conifer forests, shifting from primarily fire-adapted species to competition-adapted, fire-sensitive species within 20 years of fire exclusion. Rapid changes to species composition and stand densities have been interpreted by some as evidence of high-severity fire. We demonstrate that the very different ecological process of fire exclusion can produce similar changes by shifting selective pressures from disturbance-mediated to productivity-mediated controls. Restoring disturbance-adapted species composition and structure to intermediate productivity forests may help to buffer them against projected increasing temperatures, lengthening fire seasons, and more frequent and prolonged moisture stress. Fewer management options are available to promote adaptation in forest assemblages historically constrained by underlying site productivity.*

Ogle, S. M., Domke, G., Kurz, W. A., Rocha, M. T., Huffman, T., Swan, A., . . . Krug, T. (2018). Delineating managed land for reporting national greenhouse gas emissions and removals to the United Nations framework convention on climate change. *Carbon Balance and Management, 13*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047845030&doi=10.1186%2fs13021-018-0095-3&partnerID=40&md5=3e249bbdc891a69eec3e61fe307fbb09. doi:10.1186/s13021-018-0095-3

Research Tags: Emissions

Abstract: *Land use and management activities have a substantial impact on carbon stocks and associated greenhouse gas emissions and removals. However, it is challenging to discriminate between anthropogenic and non-anthropogenic sources and sinks from land. To address this problem, the Intergovernmental Panel on Climate Change developed a managed land proxy to determine which lands are contributing anthropogenic greenhouse gas emissions and removals. Governments report all emissions and removals from managed land to the United Nations Framework Convention on Climate Change based on this proxy, and policy interventions to reduce emissions from land use are expected to focus on managed lands. Our objective was to review the use of the managed land proxy, and summarize the criteria that governments have applied to classify land as managed and unmanaged. We found that the large majority of governments are not reporting on their application of the managed land proxy. Among the governments that do provide information, most have assigned all area in specific land uses as managed, while designating all remaining lands as unmanaged. This designation as managed land is intuitive for croplands and settlements, which would not exist without management interventions, but a portion of forest land, grassland, and wetlands may not be managed in a country. Consequently, Brazil, Canada and the United States have taken the concept further and delineated managed and unmanaged forest land, grassland and wetlands, using additional criteria such as functional use of the land and accessibility of the land to anthropogenic activity. The managed land proxy is imperfect*

because reported emissions from any area can include non-anthropogenic sources, such as natural disturbances. However, the managed land proxy does make reporting of GHG emissions and removals from land use more tractable and comparable by excluding fluxes from areas that are not directly influenced by anthropogenic activity. Moreover, application of the managed land proxy can be improved by incorporating additional criteria that allow for further discrimination between managed and unmanaged land.

Ohno, T., Heckman, K. A., Plante, A. F., Fernandez, I. J., & Parr, T. B. (2017). 14C mean residence time and its relationship with thermal stability and molecular composition of soil organic matter: A case study of deciduous and coniferous forest types. *Geoderma, 308*, 1-8. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027563233&doi=10.1016%2fj.geoderma.2017.08.023&partnerID=40&md5=b4a6d18b57efcdc02e96d7919e004c10. doi:10.1016/j.geoderma.2017.08.023
Research Tags: Research, Soil
Abstract: *Soil organic matter (SOM) plays a critical role in the global terrestrial carbon cycle, and a better understanding of soil processes involved in SOM stability is essential to determine how projected climate-driven changes in soil processes will influence carbon dynamics. We used 14C signature, analytical thermal analysis, and ultrahigh resolution mass spectrometry to determine the influence of deciduous and coniferous forest vegetation type and soil depth on the stability of soil C. The 14C mean residence time (MRT) of the illuvial B horizon soils averaged 1350 years for the deciduous soils and 795 years for the coniferous soils. The difference of MRT between mineral soils by forest type may be due to the saturation of extractable Fe and Al minerals binding sites by SOM in the coniferous soils, allowing greater transport of modern SOM from the O horizon down the soil profile, as compared with the non-saturated minerals in the deciduous soil profile. The molecular mass distribution of the deciduous water-extractable aromatic SOM fraction was shifted to a lower mass range in the lower portion of B horizon soil compared with the upper portion, indicating preferential sorption of the higher mass aromatic fraction. The shift in the mass distribution of the aromatic fraction in the coniferous soil was much less than in the deciduous soil, which supports the view that the extractable metal minerals had reached saturation. We conclude that greater transport of modern O horizon SOM to the lower mineral B horizons in the coniferous soil profile resulted in its radiocarbon enrichment and shorter estimated MRT. Our findings highlight the importance of forest vegetation type, soil depth and transport mechanisms on SOM stability, and suggest important ecological implications for changes in forest composition on the terrestrial C cycle.*

Oishi, A. C., Miniat, C. F., Novick, K. A., Brantley, S. T., Vose, J. M., & Walker, J. T. (2018). Warmer temperatures reduce net carbon uptake, but do not affect water use, in a mature southern Appalachian forest. *Agricultural and Forest Meteorology, 252*, 269-282. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041472796&doi=10.1016%2fj.agrformet.2018.01.011&partnerID=40&md5=cc941f7f4a6d6940ccdc4010eacefc2a. doi:10.1016/j.agrformet.2018.01.011
Research Tags: Forestry, Weather, Water
Abstract: *Increasing air temperature is expected to extend growing season length in temperate, broadleaf forests, leading to potential increases in evapotranspiration and net carbon uptake. However, other key processes affecting water and carbon cycles are also highly temperature-dependent. Warmer temperatures may result in higher ecosystem carbon loss through respiration and higher potential evapotranspiration through increased atmospheric demand for water. Thus, the net effects of a warming planet are uncertain and highly dependent on local climate and vegetation. We analyzed five years of data from the Coweeta eddy covariance tower in the southern Appalachian Mountains of western North Carolina, USA, a highly productive region that has historically been underrepresented in flux observation networks. We examined how leaf phenology and climate affect water and carbon cycling in a mature forest in one of the wettest biomes in North America. Warm temperatures in early 2012 caused leaf-out to occur two weeks earlier than in cooler years and led to higher seasonal carbon uptake. However, these warmer temperatures also drove higher winter ecosystem respiration, offsetting much of the springtime carbon gain. Interannual variability in net carbon uptake was high (147 to 364 g C m−2 y−1), but unrelated to growing season length. Instead, years with warmer growing seasons had 10% higher respiration and sequestered ~40% less carbon than cooler years. In contrast, annual evapotranspiration was relatively consistent among years (coefficient of variation = 4%) despite large differences in precipitation (17%, range = 800 mm). Transpiration by the evergreen understory likely helped to*

compensate for phenologically-driven differences in canopy transpiration. The increasing frequency of high summer temperatures is expected to have a greater effect on respiration than growing season length, reducing forest carbon storage.

Olefeldt, D., Euskirchen, E. S., Harden, J., Kane, E., McGuire, A. D., Waldrop, M. P., & Turetsky, M. R. (2017). A decade of boreal rich fen greenhouse gas fluxes in response to natural and experimental water table variability. *Global Change Biology, 23*(6), 2428-2440. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011275746&doi=10.1111%2fgcb.13612&partnerID=40&md5=b3dad6170473ccc1fca8d83a0af196a1. doi:10.1111/gcb.13612

Research Tags: Soil, Emissions, Weather, Water

Abstract: *Rich fens are common boreal ecosystems with distinct hydrology, biogeochemistry and ecology that influence their carbon (C) balance. We present growing season soil chamber methane emission (FCH4), ecosystem respiration (ER), net ecosystem exchange (NEE) and gross primary production (GPP) fluxes from a 9-years water table manipulation experiment in an Alaskan rich fen. The study included major flood and drought years, where wetting and drying treatments further modified the severity of droughts. Results support previous findings from peatlands that drought causes reduced magnitude of growing season FCH4, GPP and NEE, thus reducing or reversing their C sink function. Experimentally exacerbated droughts further reduced the capacity for the fen to act as a C sink by causing shifts in vegetation and thus reducing magnitude of maximum growing season GPP in subsequent flood years by ~15% compared to control plots. Conversely, water table position had only a weak influence on ER, but dominant contribution to ER switched from autotrophic respiration in wet years to heterotrophic in dry years. Droughts did not cause inter-annual lag effects on ER in this rich fen, as has been observed in several nutrient-poor peatlands. While ER was dependent on soil temperatures at 2 cm depth, FCH4 was linked to soil temperatures at 25 cm. Inter-annual variability of deep soil temperatures was in turn dependent on wetness rather than air temperature, and higher FCH4 in flooded years was thus equally due to increased methane production at depth and decreased methane oxidation near the surface. Short-term fluctuations in wetness caused significant lag effects on FCH4, but droughts caused no inter-annual lag effects on FCH4. Our results show that frequency and severity of droughts and floods can have characteristic effects on the exchange of greenhouse gases, and emphasize the need to project future hydrological regimes in rich fens.*

Oles, K. M., Weixelman, D. A., Lile, D. F., Tate, K. W., Snell, L. K., & Roche, L. M. (2017). Riparian Meadow Response to Modern Conservation Grazing Management. *Environmental Management, 60*(3), 383-395. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020137033&doi=10.1007%2fs00267-017-0897-1&partnerID=40&md5=4ad837bee1357c61e9824398d598bf37. doi:10.1007/s00267-017-0897-1

Research Tags: Grassland, Water, Livestock

Abstract: *Riparian meadows occupy a small proportion of the public lands in the western United States but they provide numerous ecosystem services, including the production of high-quality forage for livestock grazing. Modern conservation management strategies (e.g., reductions in livestock stocking rates and adoption of new riparian grazing standards) have been implemented to better balance riparian conservation and livestock production objectives on publicly managed lands. We examined potential relationships between long-term changes in plant community, livestock grazing pressure and environmental conditions at two spatial scales in meadows grazed under conservation management strategies. Changes in plant community were not associated with either livestock stocking rate or precipitation at the grazing allotment (i.e., administrative) scale. Alternatively, both grazing pressure and precipitation had significant, albeit modest, associations with changes in plant community at the meadow (i.e., ecological site) scale. These results suggest that reductions in stocking rate have improved the balance between riparian conservation and livestock production goals. However, associations between elevation, site wetness, precipitation, and changes in plant community suggest that changing climate conditions (e.g., reduced snowpack and changes in timing of snowmelt) could trigger shifts in plant communities, potentially impacting both conservation and agricultural services (e.g., livestock and forage production). Therefore, adaptive, site-specific management strategies are required to meet grazing pressure limits and safeguard ecosystem services within individual meadows, especially under more variable climate conditions.*

Olguin, M., Wayson, C., Fellows, M., Birdsey, R., Smyth, C. E., Magnan, M., . . . Kurz, W. A. (2018). Applying a systems approach to assess carbon emission reductions from climate change mitigation in Mexico's forest sector. *Environmental Research Letters, 13*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048284791&doi=10.1088%2f1748-9326%2faaaa03&partnerID=40&md5=9b98fb8f62646a7d4b5d3f1f3eea5cf6. doi:10.1088/1748-9326/aaaa03

Research Tags: Emissions, Forestry

Abstract: *The Paris Agreement of the United Nation Framework Convention on Climate Change calls for a balance of anthropogenic greenhouse emissions and removals in the latter part of this century. Mexico indicated in its Intended Nationally Determined Contribution and its Climate Change Mid-Century Strategy that the land sector will contribute to meeting GHG emission reduction goals. Since 2012, the Mexican government through its National Forestry Commission, with international financial and technical support, has been developing carbon dynamics models to explore climate change mitigation options in the forest sector. Following a systems approach, here we assess the biophysical mitigation potential of forest ecosystems, harvested wood products and their substitution benefits (i.e. the change in emissions resulting from substitution of wood for more emissions-intensive products and fossil fuels), for policy alternatives considered by the Mexican government, such as a net zero deforestation rate and sustainable forest management. We used available analytical frameworks (Carbon Budget Model of the Canadian Forest Sector and a harvested wood products model), parameterized with local input data in two contrasting Mexican states. Using information from the National Forest Monitoring System (e.g. forest inventories, remote sensing, disturbance data), we demonstrate that activities aimed at reaching a net-zero deforestation rate can yield significant CO2e mitigation benefits by 2030 and 2050 relative to a baseline scenario ('business as usual'), but if combined with increasing forest harvest to produce long-lived products and substitute more energy-intensive materials, emissions reductions could also provide other co-benefits (e.g. jobs, illegal logging reduction). We concluded that the relative impact of mitigation activities is locally dependent, suggesting that mitigation strategies should be designed and implemented at sub-national scales. We were also encouraged about the ability of the modeling framework to effectively use Mexico's data, and showed the need to include multiple sectors and types of collaborators (scientific and policy-maker communities) to design more comprehensive portfolios for climate change mitigation.*

Olk, D. C., Dinnes, D. L., Rene Scoresby, J., Callaway, C. R., & Darlington, J. W. (2018). Humic products in agriculture: potential benefits and research challenges—a review. *Journal of Soils and Sediments, 18*(8), 2881-2891. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040932066&doi=10.1007%2fs11368-018-1916-4&partnerID=40&md5=e2f1ef33b5f0b9d2518fc15b6792209a. doi:10.1007/s11368-018-1916-4

Research Tags: Soil, Crops

Abstract: *Humic products have been used in cropland agriculture for several decades, but lack of widespread credibility has restricted their use to small proportions of farmers. To improve the credibility of humic products, we identify four knowledge gaps and propose pathways of future action to close these gaps. First, while the capacity of humic products to improve plant growth has been proven in greenhouse and growth chambers, more such work is needed in field conditions, especially to determine the modifying effects on humic product efficacy of environmental and management factors, including crop type, annual weather patterns, soil type, and fertility management. Many of the published field studies fail to address any of these factors. Second, full acceptance of humic products by the research community may first require a mechanistic explanation for plant responses to humic products. Some research groups are exploring plant-based mechanisms, but almost entirely in controlled conditions, not in field conditions. Industry often attributes yield responses to enhancement of soil nutrient availability without citing adequate evidence. Microbial-based explanations are also possible. Third, consumer trust in available humic products would be strengthened through industry-wide measures for quality control of humic product production and sale, including standard procedures for measuring their humic and fulvic acid contents and rapid bio-assays for distinguishing effective products from inert frauds. Finally, humic products are widely presumed to promote root growth, which offers the potential to increase soil C inputs and thereby improve soil health. Yet virtually, no such evidence has been presented, in part due to the absence of long-term field trials. Humic product companies in North America have organized a trade association to promote a more knowledge-based industry. To acquire a database that will support these objectives, we* *propose establishment of a global network of field sites that would measure crop responses to humic products across ranges of humic products, crop types, soil types, and climates. Plant and soil samples would be analyzed by cooperating specialists in advanced laboratories to identify mechanistic processes and benefits to both plant production and soil health. We believe the industry will indeed become more knowledge-based and the credibility of humic products will improve as (i) we learn more about their field efficacy across ranges of field conditions for improving crop yield and soil health, (ii) we gain further insights into possible mechanistic explanations, and (iii) the consumer gains the ability to discern genuine products from fraudulent materials.*

Olson, D. H., & Van Horne, B. (2017). *People, forests, and change: Lessons from the pacific northwest*.
Research Tags: Forestry, Economics
Abstract (Book): *In this volume, the editors have assembled an expert panel of social and forest scientists to consider the nature of forests in flux and how to best balance the needs of forests and the rural communities closely tied to them. The book considers the temperate moist-coniferous forests of the US Pacific Northwest, but many of the concepts apply broadly to challenges in forest management in other regions and countries. In the US northwest, forest ecosystem management has been underway for two decades, and key lessons are emerging. The text is divided into four parts that set the stage for forests and rural forest economies, describe dynamic forest systems at work, consider new science in forest ecology and management, and ponder the future for these coniferous forests under different scenarios.*

Olson, L. E., Squires, J. R., Oakleaf, R. J., Wallace, Z. P., & Kennedy, P. L. (2017). Predicting above-ground density and distribution of small mammal prey species at large spatial scales. *PLoS ONE, 12*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019833559&doi=10.1371%2fjournal.pone.0177165&partnerID=40&md5=cb113dde2fee4b3f3a4786ce80bbde6e. doi:10.1371/journal.pone.0177165
Research Tags: Wildlife, Grassland
Abstract: *Grassland and shrub-steppe ecosystems are increasingly threatened by anthropogenic activities. Loss of native habitats may negatively impact important small mammal prey species. Little information, however, is available on the impact of habitat variability on density of small mammal prey species at broad spatial scales. We examined the relationship between small mammal density and remotely-sensed environmental covariates in shrub-steppe and grassland ecosystems in Wyoming, USA. We sampled four sciurid and leporid species groups using line transect methods, and used hierarchical distance-sampling to model density in response to variation in vegetation, climate, topographic, and anthropogenic variables, while accounting for variation in detection probability. We created spatial predictions of each species' density and distribution. Sciurid and leporid species exhibited mixed responses to vegetation, such that changes to native habitat will likely affect prey species differently. Density of white-tailed prairie dogs (Cynomys leucurus), Wyoming ground squirrels (Urocitellus elegans), and leporids correlated negatively with proportion of shrub or sagebrush cover and positively with herbaceous cover or bare ground, whereas least chipmunks showed a positive correlation with shrub cover and a negative correlation with herbaceous cover. Spatial predictions from our models provide a landscape-scale metric of above-ground prey density, which will facilitate the development of conservation plans for these taxa and their predators at spatial scales relevant to management.*

Olson, M. G., Knapp, B. O., & Kabrick, J. M. (2017). Dynamics of a temperate deciduous forest under landscape-scale management: Implications for adaptability to climate change. *Forest Ecology and Management, 387*, 73-85. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84979747669&doi=10.1016%2fj.foreco.2016.07.033&partnerID=40&md5=6f20c01af77e27ea18aa25b75764f34c. doi:10.1016/j.foreco.2016.07.033
Research Tags: Forestry
Abstract: *Landscape forest management is an approach to meeting diverse objectives that collectively span multiple spatial scales. It is critical that we understand the long-term effects of landscape management on the structure and composition of forest tree communities to ensure that these practices are sustainable. Furthermore, it is increasingly important to also consider effects of our management within the context of anticipated environmental changes, especially future climate. This study investigated two decades of tree community dynamics within a long-term, landscape-scale management experiment located in a temperate deciduous forest in southeastern Missouri, USA. This experiment tests three alternative landscape management*

systems: even-aged management (EAM), uneven-aged management (UAM), and no-harvest management (NHM). Specifically, we evaluated effects of landscape management alternatives on: (1) structural and compositional dynamics of the tree communities and (2) adaptability of the tree communities to projected climate change. Changes in the abundance of dominant species under these landscape management systems suggested a prevailing successional trend on these relatively xeric, oak-dominated landscapes. In the overstory layer, there was a decrease in the abundance of red oak species (Section Lobatae), mainly black oak (Quercus velutina Lam.) and scarlet oak (Quercus coccinea Muenchh.), and an increase in white oak (Quercus alba L.) suggesting a shift to white oak dominance is underway. In the midstory and understory layers, flowering dogwood (Cornus florida L.) abundance declined substantially, while maples (Acer spp. L.) and several minor species increased. Declines in shortleaf pine populations indicated that regeneration harvesting is not regenerating this species. Experiment-wide changes in tree community composition suggest that adaptability to projected future climate may have increased over the first two decades of the MOFEP experiment under all management systems and that diverse management objectives can be realized through active management, including adaptation to climate change. However, future research is needed to test this working hypothesis and to more fully evaluate the impacts of silviculture treatments within the context of projected climate.

Ontl, T. A., Swanston, C., Brandt, L. A., Butler, P. R., D'Amato, A. W., Handler, S. D., . . . Shannon, P. D. (2018). Adaptation pathways: ecoregion and land ownership influences on climate adaptation decision-making in forest management. *Climatic Change, 146*(1-2), 75-88. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041310760&doi=10.1007%2fs10584-017-1983-3&partnerID=40&md5=427224f66fc92f88199e9bd433be5ff5. doi:10.1007/s10584-017-1983-3

Research Tags: Forestry

Abstract: *Climate adaptation planning and implementation are likely to increase rapidly within the forest sector not only as climate continues to change but also as we intentionally learn from real-world examples. We sought to better understand how adaptation is being incorporated in land management decision-making across diverse land ownership types in the Midwest by evaluating project-level adaptation plans from a suite of forest management projects developed through the Climate Change Response Framework. We used quantitative content analysis to evaluate 44 adaptation-planning documents developed through the Framework's Adaptation Workbook within two ecoregional provinces of the Midwest. This approach was used to assess the components of adaptation planning, including the resources that adaptation actions targeted within planning documents, the climate changes and impacts of concern, and the adaptation strategies managers identified. Analyses of adaptation plans show that the most frequent climate changes and impacts of concern included alterations in the amount and timing of precipitation, increased vegetation moisture stress, and forest pest and pathogen impacts. Individual projects identified a diversity of adaptation options, rather than focusing singly on actions that aimed to resist climate impacts, enhance resilience, or transition systems. Multivariate analyses indicate that ecoregion and land ownership influenced adaptation planning, while the type of resources and the climate change impacts managers were concerned with were significantly correlated with the adaptation strategies selected during planning. This finding reinforces the idea that one-size-fits-all guidance on adaptation will be insufficient for land managers. Perceptions of relevant climate impacts differ based on regional and ownership contexts, which naturally leads to differences in preferred adaptation actions.*

Orlemann, A., Flinders, S. H., & Allphin, L. (2017). The Discovery of Great Basin Bristlecone Pine, Pinus Longaeva, in the Tushar Mountains of the Fishlake National Forest in Central Utah, USA. *Western North American Naturalist, 77*(1), 111-117. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018873830&doi=10.3398%2f064.077.0112&partnerID=40&md5=22d0ad4ccacd0dcbe2ea8e21a5e08c0c. doi:10.3398/064.077.0112

Research Tags: Forestry

Abstract: *In this paper, we provide the first documented evidence of Pinus longaeva from the Tushar Mountain range in central Utah. The P. longaeva trees, initially noticed at the end of September, and further surveyed during the first week of October 2016 are present on 6 small sites on the north-facing slopes of the North Fork of North Creek in the Tushar Mountains of the Fishlake National Forest. We estimate that there are currently up to 179 live individuals that range in age from seedlings to approximately 1400 years. Our data indicate these are particularly slow-growing specimens on very steep sites, in soil of igneous origin. Though many of the* *trees are infested with dwarf mistletoe, there is little indication that the population is currently at risk from fire, bark beetle attack, or many other common pathogens characteristic of other Pinus species. Nonetheless, there may be reasons for concern associated with future changes to the climate of southern Utah, as well as the impact of invasive species such as white pine blister rust (Cronartium ribicola). We see opportunities for additional research on this unique population and its associated plant community. We also see the need for management strategies to conserve these P. longaeva stands, as well as a possible need to preserve its seeds and/or other genetic materials.*

Ortiz-Colón, G., Fain, S. J., Parés, I. K., Curbelo-Rodríguez, J., Jiménez-Cabán, E., Pagán-Morales, M., & Gould, W. A. (2018). Assessing climate vulnerabilities and adaptive strategies for resilient beef and dairy operations in the tropics. *Climatic Change, 146*(1-2), 47-58. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040934968&doi=10.1007%2fs10584-017-2110-1&partnerID=40&md5=c74fccf5526671ceade03d22bb8a7c23. doi:10.1007/s10584-017-2110-1
Research Tags: Livestock, Crops
Abstract: *Cattle ranchers and dairy farmers operating throughout many tropical regions are experiencing major challenges associated with climate change such as higher incidence of heat stress and drought. These effects can result in reduced productivity of rangeland, shortage of nutritional feed, increased heat stress on animals, and high energy costs for cooling. High temperatures and resultant heat stress reduce animal productivity and increase the proliferation and survival of parasites and disease pathogens. Warming reduces the ability of dairy cattle to produce milk and gain weight and can also lower conception rates. This paper reviews research from the Caribbean on heat tolerant traits in bovine and presents evidence that introducing a "slick hair" gene into Holstein cows by crossbreeding with Senepols may increase thermo-tolerance and productivity. As in other parts of the tropics, principal cattle breeds in Puerto Rico and the US Virgin Islands have been largely introduced from temperate regions. Research indicates these animals may be poorly adapted to rising temperatures, leaving them increasingly vulnerable to chronic heat stress and reduced productivity. Adaptive practices have been developed in breeding and pasture management programs including selection for more heat-resistant genotypes, silvopasturing and crop diversification in forage production, and optimizing facilities and practices to reduce heat stress. Given the nature of climate vulnerability, an integrated approach to adaptation will likely have the greatest success in reducing future risk for producers.*

Oswald, E. M., Pontius, J., Rayback, S. A., Schaberg, P. G., Wilmot, S. H., & Dupigny-Giroux, L. A. (2018). The complex relationship between climate and sugar maple health: Climate change implications in Vermont for a key northern hardwood species. *Forest Ecology and Management, 422*, 303-312. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046337220&doi=10.1016%2fj.foreco.2018.04.014&partnerID=40&md5=69ef8e06f75bf435464db2ba3dbde515. doi:10.1016/j.foreco.2018.04.014
Research Tags: Crops, Forestry
Abstract: *This study compared 141 ecologically relevant climate metrics to field assessments of sugar maple (Acer saccharum Marsh.) canopy condition across Vermont, USA from 1988 to 2012. After removing the influence of disturbance events during this time period to isolate the impact of climate, we identified five climate metrics that were significantly related to sugar maple crown condition. While three of these are monthly summary metrics commonly used in climate analyses (minimum April, August and October temperatures), two are novel metrics designed to capture extreme climate events (periods of unusual warmth in January and August). The proportion of climate-driven variability in canopy condition is comparable to the proportion accounted for by defoliating pests and other disturbance events. This indicates that climate conditions, though rarely included in sugar maple decline studies, may be of equal importance as more traditionally studied stress agents. Modeled across the state, results indicate that changes in historical climatic conditions have negatively impacted sugar maple health over the 25 year study period, and are likely to degrade further over time. Climate projections under a low emissions scenario indicated that by 2071 55% of sugar maple across the state would likely experience moderate to severe climate-driven stress relative to historic baselines, increasing to 84% under a high emissions scenario. However, geographic variability in projected climate impacts indicates that while conditions for sugar maple will likely deteriorate across the state, climate refugia should also be available to maintain sugar maple in spite of changing climatic conditions. Considering the predominant role of sugar maple in Vermont's economy and culture, managing this resource*

into the future could pose a considerable challenge.

Ouimette, A. P., Ollinger, S. V., Richardson, A. D., Hollinger, D. Y., Keenan, T. F., Lepine, L. C., & Vadeboncoeur, M. A. (2018). Carbon fluxes and interannual drivers in a temperate forest ecosystem assessed through comparison of top-down and bottom-up approaches. *Agricultural and Forest Meteorology, 256-257*, 420-430. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045074540&doi=10.1016%2fj.agrformet.2018.03.017&partnerID=40&md5=045ce9bf8cddb09f89a780a044db02df. doi:10.1016/j.agrformet.2018.03.017
Research Tags: Forestry
Abstract: *Despite decades of research, gaining a comprehensive understanding of carbon (C) cycling in forests remains a considerable challenge. Uncertainties stem from persistent methodological limitations and the difficulty of resolving top-down estimates of ecosystem C exchange with bottom-up measurements of individual pools and fluxes. To address this, we derived estimates and associated uncertainties of ecosystem C fluxes for a 100–125 year old mixed temperate forest stand at the Bartlett Experimental Forest, New Hampshire, USA, using three different approaches: (1) tower-based eddy covariance, (2) a biometric approach involving C flux measurements of individual ecosystem subcomponents, and (3) an inventory approach involving changes in major C stocks over time. Our analysis made use of 13 years of data, collected over the period from 2004 to 2016.*
Estimates of mean annual net ecosystem production (NEP) ranged from 120 to 133 g C m−2, demonstrating strong agreement among methods and suggesting that this aging forest acts as a moderate C sink. The use of multiple approaches to measure C fluxes and their uncertainties helped place constraints on difficult-to-measure processes such as aboveground contributions to ecosystem respiration and belowground allocation to mycorrhizal fungal biomass (which was estimated at 20% of net primary production).
Analysis of interannual variability in C fluxes revealed a decoupling between annual wood growth and either current year or lagged NEP or GPP, suggesting that source limitation (C supply) is likely not controlling rates of wood production, at least on an interannual scale. Results also demonstrated a strong association between the maximum rate of C uptake during the growing season (Amax) and the length of the vernal window, defined as the period of time between soil thaw and the onset of photosynthesis. This suggests an important, but poorly understood, influence of winter and spring climate on mid-summer canopy physiology. Efforts to resolve the mechanisms responsible should be prioritized in light of ongoing and predicted changes in climate for the northeastern U.S. region, particularly during the winter and winter-spring transition period.

Ouyang, Y., Parajuli, P. B., Feng, G., Leininger, T. D., Wan, Y., & Dash, P. (2018). Application of Climate Assessment Tool (CAT) to estimate climate variability impacts on nutrient loading from local watersheds. *Journal of Hydrology, 563*, 363-371. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048328491&doi=10.1016%2fj.jhydrol.2018.06.017&partnerID=40&md5=bf4612a5a6435f145a79efffb4f5a895. doi:10.1016/j.jhydrol.2018.06.017
Research Tags: Water
Abstract: *A vast amount of future climate scenario datasets, created by climate models such as general circulation models (GCMs), have been used in conjunction with watershed models to project future climate variability impact on hydrological processes and water quality. However, these low spatial-temporal resolution datasets are often difficult to downscale spatially and disaggregate temporarily, and they may not be accurate for local watersheds (i.e., state level or smaller watersheds). This study applied the US-EPA (Environmental Protection Agency)'s Climate Assessment Tool (CAT) to create future climate variability scenarios based on historical measured data for local watersheds. As a case demonstration, CAT was employed in conjunction with HSPF (Hydrological Simulation Program-FORTRAN) model to assess the impacts of the potential future extreme rainfall events and air temperature increases upon nitrate-nitrogen (NO3-N) and orthophosphate (PO4) loads in the Lower Yazoo River Watershed (LYRW), a local watershed in Mississippi, USA. Results showed that the 10 and 20% increases in rainfall rate, respectively, increased NO3-N load by 9.1 and 18% and PO4 load by 12 and 24% over a 10-year simulation period. In contrast, simultaneous increases in air temperature by 1.0 °C and rainfall rate by 10% as well as air temperature by 2.0 °C and rainfall rate by 20% increased NO3-N load by 12% and 20%, and PO4 load by 14 and 26%, respectively. A summer extreme rainfall scenario was created if a 10% increase in rainfall rate increased the total volume of rainwater for that summer by 10% or more. When*

this event occurred, it could increase the monthly loads of NO3-N and PO4, by 31 and 41%, respectively, for that summer. Therefore, the extreme rainfall events had tremendous impacts on the NO3-N and PO4 loads. It is apparent that CAT is a flexible and useful tool to modify historical rainfall and air temperature data to predict climate variability impacts on water quality for local watersheds.

Ouyang, Y., Parajuli, P. B., Li, Y., Leininger, T. D., & Feng, G. (2017). Identify temporal trend of air temperature and its impact on forest stream flow in Lower Mississippi River Alluvial Valley using wavelet analysis. *Journal of Environmental Management, 198*, 21-31. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018929739&doi=10.1016%2fj.jenvman.2017.05.014&partnerID=40&md5=3de63b00556d746a9b99d1f8ed2d14aa. doi:10.1016/j.jenvman.2017.05.014

Research Tags: Water, Weather

Abstract: *Characterization of stream flow is essential to water resource management, water supply planning, environmental protection, and ecological restoration; while air temperature variation due to climate change can exacerbate stream flow and add instability to the flow. In this study, the wavelet analysis technique was employed to identify temporal trend of air temperature and its impact upon forest stream flows in Lower Mississippi River Alluvial Valley (LMRAV). Four surface water monitoring stations, which locate near the headwater areas with very few land use disturbances and the long-term data records (60–90 years) in the LMRAV, were selected to obtain stream discharge and air temperature data. The wavelet analysis showed that air temperature had an increasing temporal trend around its mean value during the past several decades in the LMRAV, whereas stream flow had a decreasing temporal trend around its average value at the same time period in the same region. Results of this study demonstrated that the climate in the LMRAV did get warmer as time elapsed and the streams were drier as a result of warmer air temperature. This study further revealed that the best way to estimate the temporal trends of air temperature and stream flow was to perform the wavelet transformation around their mean values.*

Owen, S. M., Sieg, C. H., Sánchez Meador, A. J., Fulé, P. Z., Iniguez, J. M., Baggett, L. S., . . . Battaglia, M. A. (2017). Spatial patterns of ponderosa pine regeneration in high-severity burn patches. *Forest Ecology and Management, 405*, 134-149. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029575989&doi=10.1016%2fj.foreco.2017.09.005&partnerID=40&md5=228fcadb0bcdb015ebb1a289cc1e1961. doi:10.1016/j.foreco.2017.09.005

Research Tags: Forestry, Weather

Abstract: *Contemporary wildfires in southwestern US ponderosa pine forests can leave uncharacteristically large patches of tree mortality, raising concerns about the lack of seed-producing trees, which can prevent or significantly delay ponderosa pine regeneration. We established 4-ha plots in high-severity burn patches in two Arizona wildfires, the 2000 Pumpkin and 2002 Rodeo-Chediski Fires, to determine if: (1) distance from forest edge influences the density and spatial patterns of regenerating ponderosa pine and sprouting tree species, (2) interactions with re-sprouting trees affect spatial patterns of ponderosa pine regeneration, and (3) distance from forest edge and species competition affect regenerating ponderosa pine height. Plots were located in high-severity burn patches (defined as 100% tree mortality) and either adjacent to residual live forest edges (edge plots), or >200 m from any residual live trees (interior plots). We found higher ponderosa pine regeneration densities in the edge plots (13–154 (median = 69) stems ha−1) than the interior plots (12–124 (median = 29) stems ha−1) on both wildfires, but no differences in spatial patterns between edge and interior plots. Ponderosa pine regeneration displayed patterns of small-scale spatial aggregation in all plots, except one edge and one interior plot on the Pumpkin Fire, which displayed random distributions. These patterns suggest both short- and long-distance dispersal play important roles in ponderosa pine regeneration in high-severity burn patches. Sprouting trees dominated tree regeneration on the Rodeo-Chediski Fire, but they were spatially independent of ponderosa pine and did not influence ponderosa pine height. Regenerating ponderosa pine height was positively correlated with neighboring ponderosa pine densities and height, suggesting that intraspecific facilitation or similar habitat preferences occur in high-severity burn patches. Collectively, these results indicate that ponderosa pines are re-establishing with heterogeneous spatial patterns in large high-severity burn patches, but often with low densities. Also, ponderosa pine regeneration could be more strongly influenced by intraspecific facilitation than interspecific competition from dense sprouting species. Future forest spatial patterns and composition are still unclear, but at this stage of development, these* *heterogeneous patches, characterized by drought-tolerant sprouting species or low pine densities, could be more resilient to climate change and severe wildfires than the overly-dense ponderosa pine forests that were present before the wildfires.*

Page-Dumroese, D. S., Busse, M. D., Archuleta, J. G., McAvoy, D., & Roussel, E. (2017). Methods to Reduce Forest Residue Volume after Timber Harvesting and Produce Black Carbon. *Scientifica, 2017*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019143603&doi=10.1155%2f2017%2f2745764&partnerID=40&md5=20baf8412f250697bd568053647429f9. doi:10.1155/2017/2745764
Research Tags: Forestry
Abstract: *Forest restoration often includes thinning to reduce tree density and improve ecosystem processes and function while also reducing the risk of wildfire or insect and disease outbreaks. However, one drawback of these restoration treatments is that slash is often burned in piles that may damage the soil and require further restoration activities. Pile burning is currently used on many forest sites as the preferred method for residue disposal because piles can be burned at various times of the year and are usually more controlled than broadcast burns. In many cases, fire can be beneficial to site conditions and soil properties, but slash piles, with a large concentration of wood, needles, forest floor, and sometimes mineral soil, can cause long-term damage. We describe several alternative methods for reducing nonmerchantable forest residues that will help remove excess woody biomass, minimize detrimental soil impacts, and create charcoal for improving soil organic matter and carbon sequestration.*

Pagès, N., & Cohnstaedt, L. W. (2018) Mosquito-borne diseases in the livestock industry. In*: Vol. 5. Ecology and Control of Vector-Borne Diseases* (pp. 195-220).
Research Tags: Livestock
Abstract: *Mosquito bites may result in increased stress and pain, which reduces livestock fitness, weight gain, and animal welfare. Furthermore, mosquito feeding may also result in pathogen transmission between livestock reservoirs (epizootics) and incidentally humans (zoonotic diseases). Not all mosquito species are disease vectors and not all individuals within a species will become infected post exposure and these important differences between mosquito genera and species are discussed. The epidemiology (hosts, environment, pathogen, and mosquito vectors) of most significant and frequent pathogens are explained, with particular emphasis on the viruses Rift Valley fever, Japanese encephalitis, West Nile, and the equine encephalitis (Western equine, Eastern equine, and Venezuelan equine). Increased globalization and anthropogenic landscape modification has resulted in widespread emergence and re-emergence of pathogens in old and new habitats. Furthermore, viral adaptation and global climate change will place more animal and human populations at risk of these pathogens.*

Palik, B. J., & D'Amato, A. W. (2019). Variable retention harvesting in Great Lakes mixed-pine forests: emulating a natural model in managed ecosystems. *Ecological Processes, 8*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066279183&doi=10.1186%2fs13717-019-0171-y&partnerID=40&md5=b84dcf53341d53b190dcb411bcfef05b. doi:10.1186/s13717-019-0171-y
Research Tags: Forestry
Abstract: *Variable retention harvesting (VRH) systems have gained wide use in many different forest types across the globe, but largely have been implemented in forests characterized by severe, infrequent disturbance regimes. There has been less attention given to developing VRH approaches in forests that are characterized as having a mixed-severity disturbance regime that often results in only partial mortality of canopy trees in spatially heterogeneous patterns. One example of such a forest type is red pine (Pinus resinosa Ait.)-dominated ecosystem of the western Great Lakes region of North America. The purpose of this review is to provide a conceptual foundation for developing VRH approaches in red pine ecosystems that are based on a mixed-severity disturbance regime. Our contention is that red pine forests managed following a natural model are more resilient to disturbances and external threats such as climate change.*
For the red pine ecosystem, VRH application should reflect the often severe, but partial canopy removal from natural disturbance that is characteristic of this ecosystem and that results in more than trivial numbers of surviving overstory trees across a range of spatial configurations in regenerating stands. Retained live trees should span a range of diameters, but favor the larger end of the diameter distribution, as this reflects the likely

pattern of survival after natural disturbance and is often a key structural element lacking from managed areas. VRH should be applied in ways that vary the spatial pattern of legacy trees in and among stands, but largely in ways that reflect the pattern of spatially patchy canopy structure, with large openings surrounded by a less disturbed matrix, as occurs with a natural disturbance regime. Legacy trees and deadwood structures should reflect the composition of the pre-disturbance forest, including species in addition to dominant red pine. Finally, retained structures should be viewed as dynamic entities that grow, die, and decay and that need to be documented and accounted for over time.
While more organizations are incorporating some form of VRH into policy and practice for red pine-dominated ecosystems, this application is not always based on a comprehensive understanding of the actual natural model of development, which reflects a mixed-severity disturbance regime. Our goal is to review the ecological evidence for this disturbance regime and interpret the structural and compositional outcomes of the disturbance model, so as to advance VRH approaches that better emulate the actual disturbance and development model for this regionally important ecosystem.

Paliyath, G., Mattoo, A. K., Handa, A. K., Shetty, K., & Wilson, C. L. (2018). Enhancing food security through postharvest technology: Current and future perspectives. In *Postharvest Biology and Nanotechnology of Fruits, Vegetables and Flowers* (pp. 1-13).
Research Tags: Crops
Abstract: *This chapter focuses on some key causes of the lack of food security and how these causes may be averted, since many are anthropogenic in origin. Recent studies suggest that children in advanced countries experience allergies and immune system-related problems while those living in underdeveloped countries rarely have food allergies and are resistant to bacterial infection. The challenges to global food security have changed and solutions must address both the need to provide sufficient macronutrients and micronutrients to counter the overall malnutrition. Global warming and other added pressures on the food supply are the results of uncontrolled anthropogenic activities, without due consideration to the unified nature of the earth. Fruits, vegetables, and flowers are highly perishable entities, and several technologies are employed to enhance shelf-life and quality. Regulation of ethylene action is one of the common strategies in postharvest technologies. Employing controlled atmosphere storage has been successful for enhancing the shelf-life of fruits and vegetables.*

Palmquist, E. C., Ralston, B. E., Merritt, D. M., & Shafroth, P. B. (2018). Landscape-scale processes influence riparian plant composition along a regulated river. *Journal of Arid Environments, 148*, 54-64. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031817577&doi=10.1016%2fj.jaridenv.2017.10.001&partnerID=40&md5=5a8868368cdcd5e90a124ae328a0dac6. doi:10.1016/j.jaridenv.2017.10.001
Research Tags: Water
Abstract: *Hierarchical frameworks are useful constructs when exploring landscape- and local-scale factors affecting patterns of vegetation in riparian areas. In drylands, which have steep environmental gradients and high habitat heterogeneity, landscape-scale variables, such as climate, can change rapidly along a river's course, affecting the relative influence of environmental variables at different scales. To assess how landscape-scale factors change the structure of riparian vegetation, we measured riparian vegetation composition along the Colorado River through Grand Canyon, determined which factors best explain observed changes, identified how richness and functional diversity vary, and described the implications of our results for river management. Cluster analysis identified three divergent floristic groups that are distributed longitudinally along the river. These groups were distributed along gradients of elevation, temperature and seasonal precipitation, but were not associated with annual precipitation or local-scale factors. Species richness and functional diversity decreased as a function of distance downstream showing that changing landscape-scale factors result in changes to ecosystem characteristics. Species composition and distribution remain closely linked to seasonal precipitation and temperature. These patterns in floristic composition in a semiarid system inform management and provide insights into potential future changes as a result of shifts in climate and changes in flow management.*

Palmquist, E. C., Ralston, B. E., Sarr, D., Merritt, D. M., Shafroth, P. B., & Scott, J. A. (2017). Functional Traits and Ecological Affinities of Riparian Plants along the Colorado River in Grand Canyon. *Western North American*

Naturalist, 77(1), 22-30. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018863643&doi=10.3398%2f064.077.0104&partnerID=40&md5=145b06b62a862c84e476c63ac47c2268. doi:10.3398/064.077.0104

Research Tags: Water

Abstract: *Trait-based approaches to vegetation analyses are becoming more prevalent in studies of riparian vegetation dynamics, including responses to flow regulation, groundwater pumping, and climate change. These analyses require species trait data compiled from the literature and floras or original field measurements. Gathering such data makes trait-based research time intensive at best and impracticable in some cases. To support trait-based analysis of vegetation along the Colorado River through Grand Canyon, a data set of 20 biological traits and ecological affinities for 179 species occurring in that study area was compiled. This diverse flora shares species with many riparian areas in the western USA and includes species that occur across a wide moisture gradient. Data were compiled from published scientific papers, unpublished reports, plant fact sheets, existing trait databases, regional floras, and plant guides. Data for ordinal environmental tolerances were more readily available than were quantitative traits. More publicly available data are needed for traits of both common and rare southwestern U.S. plant species to facilitate comprehensive, traitbased research. The trait data set is free to use and can be downloaded from ScienceBase: https://www.sciencebase.gov/catalog/item/58af41dee4b01ccd54f9f2ff and https://dx.doi.org/10.5066/F7QV3JN1*

Palus, J. D., Goebel, P. C., Hix, D. M., & Matthews, S. N. (2018). Structural and compositional shifts in forests undergoing mesophication in the Wayne National Forest, southeastern Ohio. *Forest Ecology and Management, 430*, 413-420. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052195978&doi=10.1016%2fj.foreco.2018.08.030&partnerID=40&md5=29bdeeadc22036f0e8379efac8f1eb1f. doi:10.1016/j.foreco.2018.08.030

Research Tags: Forestry

Abstract: *Mesophication refers to the positive feedback cycle that occurs when fire suppression causes compositional shifts from oak (Quercus spp.) to other, primarily mesophytic, species. Because mesophytic species tend to be associated with relatively high-moisture sites, we sought to understand the extent to which physiographic and edaphic factors influence this process by examining forest successional dynamics over a period of 22 years. In 2016, we resampled a network of permanent plots first sampled in 1994 that were stratified across different landscape positions (e.g., north-facing slopes vs. south-facing slopes) in the Athens Unit of the Wayne National Forest in southeastern Ohio. By studying the changes in forest structure and composition relative to ecological land type, our results suggest little, if any, resistance to mesophication on sites with low moisture availability. For example, the relative density of red maple (Acer rubrum) large saplings on dry ridges increased 25%, while zero oaks were recorded in the large sapling layer on dry ridges in 2016. However, we did observe that American beech (Fagus grandifolia) is becoming substantially more abundant in the understory and may be more influential than red maple in determining the future species composition of these forests. American beech is expected to respond differently than red maple to future scenarios under predicted climate change, and is subject to a suite of novel pathogens that have broad implications for forest management in the region.*

Pan, C., Yang, D., Zhao, X., Jiao, C., Yan, Y., Lamin-Samu, A. T., . . . Lu, G. (2019). Tomato stigma exsertion induced by high temperature is associated with the jasmonate signalling pathway. *Plant Cell and Environment, 42*(4), 1205-1221. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053873917&doi=10.1111%2fpce.13444&partnerID=40&md5=183f090611a96ec882bd483d9fb4c8cd. doi:10.1111/pce.13444

Research Tags: Weather, Crops

Abstract: *High temperature (HT) is becoming an increasingly serious factor in limiting crop production with global climate change. During hot seasons, owing to prevailing HT, cultivated tomatoes are prone to exhibiting stigma exsertion, which hampers pollination and causes fruit set failure. However, the underlying regulatory mechanisms of the HT-induced stigma exsertion remain largely unknown. Here, we demonstrate that stigma exsertion induced by HT in cultivated tomato is caused by more seriously shortened stamens than pistils, which is different from the stigma exsertion observed in wild tomato species. Under the HT condition, the different* *responses of pectin, sugar, expansin, and cyclin cause cell wall remodelling and differentially localized cell division and selective cell enlargement, which further determine the lengths of stamens and pistils. In addition, auxin and jasmonate (JA) are implicated in regulating cell division and cell expansion in stamens and pistils, and exogenous JA instead of auxin treatment can effectively rescue tomato stigma exsertion through regulating the JA/COI1 signalling pathway. Our findings provide a better understanding of stigma exsertions under the HT condition in tomato and uncover a new function of JA in improving plant abiotic stress tolerance.*

Pan, W. L., Schillinger, W. F., Young, F. L., Kirby, E. M., Yorgey, G. G., Borrelli, K. A., . . . Eigenbrode, S. D. (2017). Integrating historic agronomic and policy lessons with new technologies to drive farmer decisions for farm and climate: The case of Inland Pacific Northwestern U.S. *Frontiers in Environmental Science, 5*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040530119&doi=10.3389%2ffenvs.2017.00076&partnerID=40&md5=2e8e1f3e5dbd5683fb5ecb74ea90acb8. doi:10.3389/fenvs.2017.00076

Research Tags: Economics, Crops, Soil

Abstract: *Climate-friendly best management practices for mitigating and adapting to climate change (cfBMPs) include changes in crop rotation, soil management and resource use. Determined largely by precipitation gradients, specific agroecological systems in the inland Pacific Northwestern U.S. (iPNW) feature different practices across the region. Historically, these farming systems have been economically productive, but at the cost of high soil erosion rates and organic matter depletion, making them win-lose situations. Agronomic, sociological, political and economic drivers all influence cropping system innovations. Integrated, holistic conservation systems also need to be identified to address climate change by integrating cfBMPs that provide win-win benefits for farmer and environment. We conclude that systems featuring short-term improvements in farm economics, market diversification, resource efficiency and soil health will be most readily adopted by farmers, thereby simultaneously addressing longer term challenges including climate change. Specific "win-win scenarios" are designed for different iPNW production zones delineated by water availability. The cfBMPs include reduced tillage and residue management, organic carbon (C) recycling, precision nitrogen (N) management and crop rotation diversification and intensification. Current plant breeding technologies have provided new cultivars of canola and pea that can diversify system agronomics and markets. These agronomic improvements require associated shifts in prescriptive, precision N and weed management. The integrated cfBMP systems we describe have the potential for reducing system-wide greenhouse gas (GHG) emissions by increasing soil C storage, N use efficiency (NUE) and by production of biofuels. Novel systems, even if they are economically competitive, can come with increased financial risk to producers, necessitating government support (e.g., subsidized crop insurance) to promote adoption. Other conservation- and climate change-targeted farm policies can also improve adoption. Ultimately, farmers must meet their economic and legacy goals to assure longer-term adoption of mature cfBMP for iPNW production systems.*

Pan, Y., McCullough, K., & Hollinger, D. Y. (2018). Forest biodiversity, relationships to structural and functional attributes, and stability in New England forests. *Forest Ecosystems, 5*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050384647&doi=10.1186%2fs40663-018-0132-4&partnerID=40&md5=1e1786d1e3dd3c3f3d003e7a8b124e7f. doi:10.1186/s40663-018-0132-4

Research Tags: Forestry

Abstract: *Background*

Forest biodiversity is the foundation of many ecosystem services, and the effect of biodiversity on ecosystem functioning and processes (BEF) has been a central issue in biodiversity studies. Although many hypotheses have been developed to interpret global gradients of biodiversity, there has not been complete agreement on mechanisms controlling biodiversity patterns and distributions. Differences may be due to limited observation data and inconsistencies of spatial scales in analysis.

Methods

In this study, we take advantage of USDA Forest Service forest inventory and analysis (FIA) data for exploring regional forest biodiversity and BEF in New England forests. The FIA data provide detailed information of sampled plots and trees for the region, including 6000 FIA plots and more than 33,000 individual trees. Biodiversity models were used to analyze the data.

Results

Tree species diversity increases from the north to the south at a rate about 2–3 species per latitudinal degree. Tree species diversity is better predicted by tree height than forest age or biomass. Very different distribution patterns of two common maple species, sugar maple (Acer saccharum) and red maple (Acer rubrum), highlight the vulnerability of sugar maple and its potential replacement by red maple on New England landscapes. Red maple generally already outperforms sugar maple, and will likely and continuously benefit from a changing climate in New England.
Conclusions
We conclude that forest structure (height) and resources (biomass) are more likely foundational characteristics supporting biodiversity rather than biodiversity determining forest productivity and/or biomass. The potential replacement of red maple for sugar maple in the New England areas could affect biodiversity and stability of forest ecosystem functioning because sugar maple plays important ecological roles distinct from red maple that are beneficial to other tree species in northern hardwood forests. Such a change may not affect forest resilience in terms of forest productivity and biomass as these are similar in red maple and sugar maple, however, it would almost certainly alter forest structure across the landscape.

Panthi, S., Sapkota, A. R., Raspanti, G., Allard, S. M., Bui, A., Craddock, H. A., . . . Sapkota, A. (2019). Pharmaceuticals, herbicides, and disinfectants in agricultural water sources. *Environmental Research*, 1-8. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064461839&doi=10.1016%2fj.envres.2019.04.011&partnerID=40&md5=517df58d34dabf7691f6582b9b68fd7c. doi:10.1016/j.envres.2019.04.011
Research Tags: Water
Abstract: *Agricultural water withdrawals account for the largest proportion of global freshwater use. Increasing municipal water demands and droughts are straining agricultural water supplies. Therefore, alternative solutions to agricultural water crises are urgently needed, including the use of nontraditional water sources such as advanced treated wastewater or reclaimed water, brackish water, return flows, and effluent from produce processing facilities. However, it is critical to ensure that such usage does not compromise soil, crop, and public health. Here, we characterized five different nontraditional water types (n = 357 samples) for the presence of pharmaceuticals, herbicides, and disinfectants using ultra-high-pressure liquid chromatography tandem mass spectrometry based method (UPLC-MS/MS). We then evaluated whether the levels of these contaminants were influenced by season. The highest level of herbicides (atrazine) was detected in untreated pond water (median concentration 135.9 ng/L). Reclaimed water had the highest levels of antibiotics and stimulants including azithromycin (215 ng/L), sulfamethoxazole (232.1 ng/L), and caffeine (89.4 ng/L). Produce processing plant water also tended to have high levels of atrazine (102.7 ng/L) and ciprofloxacin (80.1 ng/L). In addition, we observed seasonal variability across water types, with the highest atrazine concentrations observed during summer months, while the highest median azithromycin concentrations were observed in reclaimed water during the winter season. Further studies are needed to evaluate if economically feasible on-farm water treatment technologies can effectively remove such contaminants from nontraditional irrigation water sources.*

Panyushkina, I. P., Mukhamadiev, N. S., Lynch, A. M., Ashikbaev, N. A., Arizpe, A. H., O'Connor, C. D., . . . Sagitov, A. O. (2017). Wild apple growth and climate Change in southeast Kazakhstan. *Forests, 8*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033464512&doi=10.3390%2ff8110406&partnerID=40&md5=f48830f5899b3d61282c76e2afb57058. doi:10.3390/f8110406
Research Tags: Crops
Abstract: *Wild populations of Malus sieversii [Ldb.] M. Roem are valued genetic and watershed resources in Inner Eurasia. These populations are located in a region that has experienced rapid and on-going climatic change over the past several decades. We assess relationships between climate variables and wild apple radial growth with dendroclimatological techniques to understand the potential of a changing climate to influence apple radial growth. Ring-width chronologies spanning 48 to 129 years were developed from 12 plots in the Trans-Ili Alatau and Jungar Alatau ranges of Tian Shan Mountains, southeastern Kazakhstan. Cluster analysis of the plot-level chronologies suggests different temporal patterns of growth variability over the last century in the two mountain ranges studied. Changes in the periodicity of annual ring-width variability occurred ca. 1970 at both mountain ranges, with decadal-scale variability supplanted by quasi-biennial variation. Seascorr correlation analysis of primary and secondary weather variables identified negative growth associations with spring precipitation and positive associations with cooler fall-winter temperatures, but the relative importance*

of these relationships varied spatially and temporally, with a shift in the relative importance of spring precipitation ca. 1970 at Trans-Ili Alatau. Altered apple tree radial growth patterns correspond to altered climatology in the Lake Balkhash Basin driven by unprecedented intensified Arctic Oscillations after the late 1970s.

Park, I. W., Hooper, J., Flegal, J. M., & Jenerette, G. D. (2018). Impacts of climate, disturbance and topography on distribution of herbaceous cover in Southern California chaparral: Insights from a remote-sensing method. *Diversity and Distributions, 24*(4), 497-508. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043692831&doi=10.1111%2fddi.12693&partnerID=40&md5=0415ddc5d541cfc3148ef7a68b68d5a3. doi:10.1111/ddi.12693

Research Tags: Grassland

Abstract: *Aim*
While chaparral communities have historically been considered resistant to invasion and type conversion into grasslands, interacting global changes such as increased drought and anthropogenic disturbance may have reduced this resistance. Existing monitoring methods are not well-suited to evaluate the distribution of invasive herbs and grasses within chaparral at regional scales. In this study, we determine the extent of invasions by forbs and grasses into formerly chaparral vegetation and evaluate contributions of moisture, disturbance and anthropogenic activity and topography to the distribution of herbaceous cover throughout chaparral-dominated communities.
Location
The Angeles National Forest (ANF), California, USA.
Methods
We developed a remote-sensing method to estimate the distribution of herbaceous cover within chaparral by leveraging intra-annual phenological differences in normalized difference vegetation index (NDVI) between herbaceous forbs and grasses and evergreen shrublands using Landsat remote-sensing imagery. The distribution of herbaceous cover was then related to multiple spatially explicit variables describing individual and interactive effects of local moisture availability and anthropogenic disturbance.
Results
Herbaceous cover represents approximately 31% of the ANF within the elevation range typically dominated by chaparral. Disturbance-related and anthropogenic factors explained 17% of observed variation, while differences in moisture availability explained 47% of observed variation in herbaceous cover and were associated with increased invasive cover.
Main conclusions
Landscapes historically dominated by chaparral may exhibit high degrees of herbaceous cover. While fire frequency and other anthropogenic disturbances are likely the primary catalyst for invasion of chaparral by herbaceous species, this study shows that moisture availability is a more important factor in determining which locations are successfully invaded. These results indicate that chaparral vulnerability to invasion in southern California may increase in the next century due to reduced precipitation associated with projected climate change.

Parker, D. B., Cortus, E. L., Casey, K. D., Marek, G. W., Heflin, K. R., & Waldrip, H. M. (2018). *Empirical model of annual nitrous oxide emissions from open-lot beef cattle feedyard pens in the Southern high plains.* Paper presented at the ASABE 2018 Annual International Meeting.

Research Tags: Emissions, Livestock

Abstract: *Nitrous oxide (N2O) is a greenhouse gas with global warming potential about 300 times that of carbon dioxide. More than seven million beef cattle are finished in feedyards in the semiarid Southern High Plains. Precipitation, feces, and urine deposited directly and continuously on the open-lot pen surfaces contribute to N2O emissions. The objective of this research was to estimate daily and annual N2O emissions from open-lot feedyard pens in the Southern High Plains through the use of an empirical model. Regression equations derived from lab experiments were used to estimate N2O emissions in an Excel spreadsheet based on daily precipitation, manure temperature, and urine and feces deposition over the 22-yr period from 1996 to 2017. Mean annual precipitation ranged from 136 to 658 mm yr-1(mean = 367 mm yr-1). Mean daily manure temperature ranged from -4.9 to 32.8°C (mean = 15.2°C). Urine deposition was estimated at 1.4 mm d-1(511* *mm yr-1) at a cattle density of 15 m2animal-1. Model-simulated daily N2O emissions were best approximated by a lognormal distribution, with range 0.3 to 1,351 mg N2O-N m-2d-1and mean, geometric mean, and median of 71.1, 34.3, and 38.4 mg N2O-N m-2d-1 respectively. The model-simulated mean (±SD) per capita feedyard capacity annual N2O emission rate for the 22-yr period was 0.39 (±0.07) kg N2O-N animal-1yr-1 with range 0.23 to 0.51 kg N2O-N animal-1yr-1. Emissions due to precipitation, urine deposition, and feces deposition on the pen surface accounted for 61.8, 29.7, and 8.5% of overall N2O emissions, respectively. Emissions from June, July, and August accounted for 51.7% of annual emissions. The mean model-simulated emission rate for the 22-yr period compared favorably to three years of measured N2O emission data from two feedyards in Texas. Model-simulated daily emission rates were 1.3 to 13.1-fold higher than measured from two weeks of daily emission data from feedyards in Nebraska and Texas. The model will continue to be refined to better simulate field-measured N2O emission rates, and a sensitivity analysis will be conducted to assess how variability in regression parameters affects model simulations.*

Parker, D. B., Meyer, B., Jennings, T., Jennings, J., Dougherty, H., Cole, N. A., & Casey, K. (2018). Enteric nitrous oxide emissions from beef cattle. *Professional Animal Scientist, 34*(6), 594-607. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057127553&doi=10.15232%2fpas.2018-01769&partnerID=40&md5=68978ecdccae3eac67c8499b69126437. doi:10.15232/pas.2018-01769

Research Tags: Livestock, Emissions

Abstract: *Nitrous oxide (N2O) is a greenhouse gas with a higher global warming potential than carbon dioxide (CO2) or methane (CH4). The objectives of this research were to quantify enteric N2O emissions from beef cattle and determine effects of dietary nitrate (NO3) concentrations. Experiments consisted of one in vitro incubation trial and 2 live animal (LA) trials. During the in vitro trial, gas was collected from 4 forage-based and 5 corn-based diets. During the LA trials, emissions were monitored from steers in respiration chambers. In LA trial 1, 5 measurements of 256 to 720 min were conducted on a single steer within a 48-h period. In LA trial 2, measurements were conducted on 4 steers in the absence of manure. Highest in vitro N2O production was from diets containing added NO3 or alfalfa. In vitro N2O increased with dietary NO3 concentrations (r2 = 0.99), with little correlation to dietary CP (r2 = 0.17). Added NO3 decreased CH4 emissions. Mean N2O emission rates (±SD) from the LA trials were 6.93 ± 2.99 mg of N2O·kg−1 of DMI in trial 1 and 2.20 ± 0.10 mg of N2O·kg−1 of DMI in trial 2. Mean enteric N2O emissions accounted for 0.35% (LA trial 1) and 0.12% (LA trial 2) of CO2 equivalents. Enteric N2O emission rates were 6 to 40 times lower than values cited in earlier publications. Enteric N2O emission rates were also 58 to 108 times lower than manure emissions. Therefore, efforts to reduce greenhouse gas emissions from beef cattle should focus on enteric CH4 and manure N2O as opposed to enteric N2O.*

Parks, S. A., Dobrowski, S. Z., & Panunto, M. H. (2018). What drives low-severity fire in the southwestern USA? *Forests, 9*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044422468&doi=10.3390%2ff9040165&partnerID=40&md5=be931dbc3d0a52994a269977cf60cbc3. doi:10.3390/f9040165

Research Tags: Forestry, Weather

Abstract: *Many dry conifer forests in the southwestern USA and elsewhere historically (prior to the late 1800's) experienced fairly frequent surface fire at intervals ranging from roughly five to 30 years. Due to more than 100 years of successful fire exclusion, however, many of these forests are now denser and more homogenous, and therefore they have a greater probability of experiencing stand-replacing fire compared to prior centuries. Consequently, there is keen interest in restoring such forests to conditions that are conducive to low-severity fire. Yet, there have been no regional assessments in the southwestern USA that have specifically evaluated those factors that promote low-severity fire. Here, we defined low-severity fire using satellite imagery and evaluated the influence of several variables that potentially drive such fire; these variables characterize live fuel, topography, climate (30-year normals), and inter-annual climate variation. We found that live fuel and climate variation (i.e., year-of-fire climate) were the main factors driving low-severity fire; fuel was ~2.4 times more influential than climate variation. Low-severity fire was more likely in settings with lower levels of fuel and in years that were wetter and cooler than average. Surprisingly, the influence of topography and climatic normals was negligible. Our findings elucidate those conditions conducive to low-severity fire and provide valuable information to land managers tasked with restoring forest structures and processes in the southwestern USA*

and other regions dominated by dry forest types

Parks, S. A., Holsinger, L. M., Miller, C., & Parisien, M. A. (2018). Analog-based fire regime and vegetation shifts in mountainous regions of the western US. *Ecography, 41*(6), 910-921. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029362261&doi=10.1111%2fecog.03378&partnerID=40&md5=106130cbe0bc8bd43a8e6b8758f0e443. doi:10.1111/ecog.03378

Research Tags: Weather, Forestry, Grassland

Abstract: *Climate change is expected to result in substantial ecological impacts across the globe. These impacts are uncertain but there is strong consensus that they will almost certainly affect fire regimes and vegetation. In this study, we evaluated how climate change may influence fire frequency, fire severity, and broad classes of vegetation in mountainous ecoregions of the contiguous western US for early, middle, and late 21st century (2025, 2055, and 2085, respectively). To do so, we employed the concept of a climate analog, whereby specific locations with the best climatic match between one time period and a different time period are identified. For each location (i.e. 1-km2 pixel), we evaluated potential changes by comparing the reference period fire regime and vegetation to that of the fire regime and vegetation of the nearest pixels representative of its future climate. For the mountainous regions we investigated, we found no universal increase or decrease in fire frequency or severity. Instead, potential changes depend on the bioclimatic domain. Specifically, wet and cold regions (i.e. mesic and cold forest) generally exhibited increased fire frequency but decreased fire severity, whereas drier, moisture-limited regions (i.e. shrubland/grassland) displayed the opposite trend. Results also indicate the potential for substantial changes in the amount and distribution of some vegetation types, highlighting important interactions and feedbacks among climate, fire, and vegetation. Our findings also shed light on a potential threshold or tipping point at intermediate moisture conditions that suggest shifts in vegetation from forest to shrubland/grassland are possible as the climate becomes warmer and drier. However, our study assumes that fire and vegetation are in a state of equilibrium with climate, and, consequently, natural and human-induced disequilibrium dynamics should be considered when interpreting our findings.*

Parks, S. A., Holsinger, L. M., Panunto, M. H., Jolly, W. M., Dobrowski, S. Z., & Dillon, G. K. (2018). High-severity fire: Evaluating its key drivers and mapping its probability across western US forests. *Environmental Research Letters, 13*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044416347&doi=10.1088%2f1748-9326%2faab791&partnerID=40&md5=2fb7c91a4dfcd89ec2ff5a3c6a166883. doi:10.1088/1748-9326/aab791

Research Tags: Weather, Forestry

Abstract: *Wildland fire is a critical process in forests of the western United States (US). Variation in fire behavior, which is heavily influenced by fuel loading, terrain, weather, and vegetation type, leads to heterogeneity in fire severity across landscapes. The relative influence of these factors in driving fire severity, however, is poorly understood. Here, we explore the drivers of high-severity fire for forested ecoregions in the western US over the period 2002–2015. Fire severity was quantified using a satellite-inferred index of severity, the relativized burn ratio. For each ecoregion, we used boosted regression trees to model high-severity fire as a function of live fuel, topography, climate, and fire weather. We found that live fuel, on average, was the most important factor driving high-severity fire among ecoregions (average relative influence = 53.1%) and was the most important factor in 14 of 19 ecoregions. Fire weather was the second most important factor among ecoregions (average relative influence = 22.9%) and was the most important factor in five ecoregions. Climate (13.7%) and topography (10.3%) were less influential. We also predicted the probability of high-severity fire, were a fire to occur, using recent (2016) satellite imagery to characterize live fuel for a subset of ecoregions in which the model skill was deemed acceptable (n = 13). These 'wall-to-wall' gridded ecoregional maps provide relevant and up-to-date information for scientists and managers who are tasked with managing fuel and wildland fire. Lastly, we provide an example of the predicted likelihood of high-severity fire under moderate and extreme fire weather before and after fuel reduction treatments, thereby demonstrating how our framework and model predictions can potentially serve as a performance metric for land management agencies tasked with reducing hazardous fuel across large landscapes.*

Parks, S. A., Parisien, M. A., Miller, C., Holsinger, L. M., & Baggett, L. S. (2018). Fine-scale spatial climate variation and drought mediate the likelihood of reburning. *Ecological Applications, 28*(2), 573-586. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042727894&doi=10.1002%2feap.1671&partnerID=40&md5=21c23215fa6cbb9c63431c7358c7398b. doi:10.1002/eap.1671

Research Tags: Weather, Forestry

Abstract: *In many forested ecosystems, it is increasingly recognized that the probability of burning is substantially reduced within the footprint of previously burned areas. This self-limiting effect of wildland fire is considered a fundamental emergent property of ecosystems and is partly responsible for structuring landscape heterogeneity (i.e., mosaics of different age classes), thereby reducing the likelihood of uncharacteristically large fires in regions with active fire regimes. However, the strength and longevity of this self-limiting phenomenon is not well understood in most fire-prone ecosystems. In this study, we quantify the self-limiting effect in terms of its strength and longevity for five fire-prone study areas in western North America and investigate how each measure varies along a spatial climatic gradient and according to temporal (i.e., annual) climatic variation. Results indicate that the longevity (i.e., number of years) of the self-limiting effect ranges between 15 yr in the warm and dry study area in the southwestern United States to 33 yr in the cold, northern study areas in located in northwestern Montana and the boreal forest of Canada. We also found that spatial climatic variation has a strong influence on wildland fire's self-limiting capacity. Specifically, the self-limiting effect within each study area was stronger and lasted longer in areas with low mean moisture deficit (i.e., wetter and cooler settings) compared to areas with high mean moisture deficit (warmer and drier settings). Last, our findings show that annual climatic variation influences wildland fire's self-limiting effect: drought conditions weakened the strength and longevity of the self-limiting effect in all study areas, albeit at varying magnitudes. Overall, our study provides support for the idea that wildland fire contributes to spatial heterogeneity in fuel ages that subsequently mediate future fire sizes and effects. However, our findings show that the strength and longevity of the self-limiting effect varies considerably according to spatial and temporal climatic variation, providing land and fire managers relevant information for effective planning and management of fire and highlighting that fire itself is an important factor contributing to fire-free intervals.*

Pastick, N. J., Duffy, P., Genet, H., Rupp, T. S., Wylie, B. K., Johnson, K. D., . . . Knight, J. F. (2017). Historical and projected trends in landscape drivers affecting carbon dynamics in Alaska. *Ecological Applications, 27*(5), 1383-1402. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021787691&doi=10.1002%2feap.1538&partnerID=40&md5=e9a0fd77fb57cfd6b935342eb43143ee. doi:10.1002/eap.1538

Research Tags: Forestry, Soil, Emissions

Abstract: *Modern climate change in Alaska has resulted in widespread thawing of permafrost, increased fire activity, and extensive changes in vegetation characteristics that have significant consequences for socioecological systems. Despite observations of the heightened sensitivity of these systems to change, there has not been a comprehensive assessment of factors that drive ecosystem changes throughout Alaska. Here we present research that improves our understanding of the main drivers of the spatiotemporal patterns of carbon dynamics using in situ observations, remote sensing data, and an array of modeling techniques. In the last 60 yr, Alaska has seen a large increase in mean annual air temperature (1.7°C), with the greatest warming occurring over winter and spring. Warming trends are projected to continue throughout the 21st century and will likely result in landscape-level changes to ecosystem structure and function. Wetlands, mainly bogs and fens, which are currently estimated to cover 12.5% of the landscape, strongly influence exchange of methane between Alaska's ecosystems and the atmosphere and are expected to be affected by thawing permafrost and shifts in hydrology. Simulations suggest the current proportion of near-surface (within 1 m) and deep (within 5 m) permafrost extent will be reduced by 9–74% and 33–55% by the end of the 21st century, respectively. Since 2000, an average of 678 595 ha/yr was burned, more than twice the annual average during 1950–1999. The largest increase in fire activity is projected for the boreal forest, which could result in a reduction in late-successional spruce forest (8–44%) and an increase in early-successional deciduous forest (25–113%) that would mediate future fire activity and weaken permafrost stability in the region. Climate warming will also affect vegetation communities across arctic regions, where the coverage of deciduous forest could increase (223–620%), shrub tundra may increase (4–21%), and graminoid tundra might decrease (10–24%). This study sheds light on the sensitivity of Alaska's ecosystems to change that has the potential to significantly affect local and regional carbon balance, but more research is needed to improve estimates of land-surface and subsurface properties, and to better account for ecosystem dynamics affected by a myriad of biophysical factors and* *interactions.*

Pawlowski, M., Meki, M. N., Kiniry, J. R., & Crow, S. E. (2018). Carbon budgets of potential tropical perennial grass cropping scenarios for bioenergy feedstock production 05 Environmental Sciences 0503 Soil Sciences. *Carbon Balance and Management, 13*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053849727&doi=10.1186%2fs13021-018-0102-8&partnerID=40&md5=3a8a6620de404424944db7d29401f538. doi:10.1186/s13021-018-0102-8

Research Tags: Energy, Crops, Emissions

Abstract: *Background*

The environmental costs of fossil fuel consumption are globally recognized, opening many pathways for the development of regional portfolio solutions for sustainable replacement fuel and energy options. The purpose of this study was to create a baseline carbon (C) budget of a conventionally managed sugarcane (Saccharum officinarum) production system on Maui, Hawaii, and compare it to three different future energy cropping scenarios: (1) conventional sugarcane with a 50% deficit irrigation (sugarcane 50%), (2) ratoon harvested napiergrass (Pennisetum purpureum Schumach.) with 100% irrigation (napier 100%), and (3) ratoon harvested napiergrass with a 50% deficit irrigation (napier 50%).

Results

The differences among cropping scenarios for the fossil fuel-based emissions associated with agricultural inputs and field operations were small compared to the differences associated with pre-harvest burn emissions and soil C stock under ratoon harvest and zero-tillage management. Burn emissions were nearly 2000 kg Ceq ha−1 year−1 in the conventional sugarcane; whereas soil C gains were approximately 4500 kg Ceq ha−1 year−1 in the surface layer of the soil profile for napiergrass. Further, gains in deep soil profile C were nearly three times greater than in the surface layer. Therefore, net global warming potential was greatest for conventional sugarcane and least for napier 50% when deep profile soil C was included. Per unit of biomass yield, the most greenhouse gas (GHG) intensive scenario was sugarcane 50% with a GHG Index (GHGI, positive values imply a climate impact, so a more negative value is preferable for climate change mitigation) of 0.11 and the least intensive was napiergrass 50% when a deep soil profile was included (GHGI = − 0.77).

Conclusion

Future scenarios for energy or fuel production on former sugarcane land across the Pacific Basin or other volcanic islands should concentrate on ratoon-harvested crops that maintain yields under zero-tillage management for long intervals between kill harvest and reduce costs of field operations and agricultural input requirements. For napiergrass on Maui and elsewhere, deficit irrigation maximized climate change mitigation of the system and reduced water use should be part of planning a sustainable, diversified agricultural landscape.

Pawlowski, M. N., Crow, S. E., Meki, M. N., Kiniry, J. R., Taylor, A. D., Ogoshi, R., . . . Nakahata, M. (2017). Field-based estimates of global warming potential in bioenergy systems of Hawaii: Crop choice and deficit irrigation. *PLoS ONE, 12*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008319095&doi=10.1371%2fjournal.pone.0168510&partnerID=40&md5=9b47e4bd3a0afd471481f52826204bfb. doi:10.1371/journal.pone.0168510

Research Tags: Emissions, Energy

Abstract: *Replacing fossil fuel with biofuel is environmentally viable from a climate change perspective only if the net greenhouse gas (GHG) footprint of the system is reduced. The effects of replacing annual arable crops with perennial bioenergy feedstocks on net GHG production and soil carbon (C) stock are critical to the system-level balance. Here, we compared GHG flux, crop yield, root biomass, and soil C stock under two potential tropical, perennial grass biofuel feedstocks: conventional sugarcane and ratoon-harvested, zero-tillage napiergrass. Evaluations were conducted at two irrigation levels, 100% of plantation application and at a 50% deficit. Peaks and troughs of GHG emission followed agronomic events such as ratoon harvest of napiergrass and fertilization. Yet, net GHG flux was dominated by carbon dioxide (CO2), as methane was oxidized and nitrous oxide (N2O) emission was very low even following fertilization. High N2O fluxes that frequently negate other greenhouse gas benefits that come from replacing fossil fuels with agronomic forms of bioenergy were mitigated by efficient water and fertilizer management, including direct injection of fertilizer into buried irrigation lines. From soil intensively cultivated for a century in sugarcane, soil C stock and root* *biomass increased rapidly following cultivation in grasses selected for robust root systems and drought tolerance. The net soil C increase over the two-year crop cycle was three-fold greater than the annualized soil surface CO2 flux. Deficit irrigation reduced yield, but increased soil C accumulation as proportionately more photosynthetic resources were allocated belowground. In the first two years of cultivation napiergrass did not increase net greenhouse warming potential (GWP) compared to sugarcane, and has the advantage of multiple ratoon harvests per year and less negative effects of deficit irrigation to yield.*

Pearson, D. E., Ortega, Y. K., & Maron, J. L. (2017). The tortoise and the hare: reducing resource availability shifts competitive balance between plant species. *Journal of Ecology, 105*(4), 999-1009. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013498008&doi=10.1111%2f1365-2745.12736&partnerID=40&md5=da513c35fb8307fcea627c84bbf0c0da. doi:10.1111/1365-2745.12736

Research Tags: Grassland

Abstract: *Determining how changes in abiotic conditions influence community interactions is a fundamental challenge in ecology. Meeting this challenge is increasingly imperative in the Anthropocene where climate change and exotic species introductions alter abiotic context and biotic composition to reshuffle natural systems.*

We created plant assemblages consisting of monocultures or equal abundance of the native community dominant bluebunch wheatgrass (Pseudoroegneria spicata) and the exotic spotted knapweed (Centaurea stoebe), a co-occurring invasive forb that has overtaken grasslands across the western United States. We subjected these composition treatments to drought (20% of average precipitation vs. average) and herbivory on C. stoebe by its biocontrol agent Cyphocleonus achates to explore how reduced precipitation might influence the effects of competition and biocontrol herbivory on C. stoebe's abundance.

At the end of 7 years, C. stoebe dominated mixed-species plots under normal precipitation conditions, with biomass 50% greater than that of the native P. spicata. However, under drought stress, P. spicata's biomass was >200% greater than C. stoebe's. Interestingly, both species were impervious to drought in monoculture, indicating the importance of the drought by competition interaction. The biocontrol herbivore reduced C. stoebe abundance and indirectly increased P. spicata biomass in mixed-species drought plots, but these effects were only marginally significant and relatively weak. Overall, C. stoebe abundance was primarily driven by the drought by competition interaction, with negatively additive but weak effects of the drought by herbivory interaction.

The response of the exotic to the treatments was driven by rapid changes in population density linked to its fast life-history strategy, while the native's response was driven by changes in per capita plant biomass linked to its slower life-history strategy. Individual plant performance metrics did not predict overall population responses for the invader, indicating the importance of longer term population measures.

Synthesis. These results demonstrate that reduced precipitation inputs linked to climate change can dramatically shift the balance of plant competition, even toggling the advantage from exotic to native dominance. They also illustrate the importance of biotic interactions in predicting species responses to abiotic change.

Pease, L. A., Fausey, N. R., Martin, J. F., & Brown, L. C. (2017). Projected climate change effects on subsurface drainage and the performance of controlled drainage in the Western Lake Erie Basin. *Journal of Soil and Water Conservation, 72*(3), 240-250. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019854509&doi=10.2489%2fjswc.72.3.240&partnerID=40&md5=c8c263a8188fa4db566966b8e615813e. doi:10.2489/jswc.72.3.240

Research Tags: Water

Abstract: *The US Midwest is expected to experience higher intensity rainfall events along with an increased chance of drought during the mid- and late 21st century under projected future climate scenarios. Development of strategies to mitigate the impact of these projected changes on agricultural production and environmental quality is important for ensuring agricultural resiliency to future climate. This study used the DRAINMOD hydrologic model to simulate subsurface drainage discharge at a field site in the headwaters of the Western Lake Erie Basin using future climate patterns projected by 20 general circulation models. Despite projected increases in rainfall, by the late twenty-first century, subsurface discharge was projected to decrease 7% and 11% under representative concentration pathway (RCP) 4.5 and RCP 8.5, respectively. Reductions in subsurface* *discharge were attributed to increased temperature and evapotranspiration. The performance of controlled drainage was not projected to change on an annual basis throughout the next century. The benefits of controlled drainage systems as an agricultural best management practice were still evident under the projected climate change of the next century. The role of controlled drainage as a means to potentially retain more crop available water in the soil profile could become critically important under future climate conditions.*

Peng, D., Zhang, B., Wu, C., Huete, A. R., Gonsamo, A., Lei, L., . . . Wu, Y. (2017). Country-level net primary production distribution and response to drought and land cover change. *Science of the Total Environment, 574*, 65-77. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84986575608&doi=10.1016%2fj.scitotenv.2016.09.033&partnerID=40&md5=79f9666359fef5116d86ff787971f1a4. doi:10.1016/j.scitotenv.2016.09.033

Research Tags: Weather, Research

Abstract: *Carbon sequestration by terrestrial ecosystems can offset emissions and thereby offers an alternative way of achieving the target of reducing the concentration of CO2 in the atmosphere. Net primary production (NPP) is the first step in the sequestration of carbon by terrestrial ecosystems. This study quantifies moderate-resolution imaging spectroradiometer (MODIS) NPP from 2000 to 2014 at the country level along with its response to drought and land cover change. Our results indicate that the combined NPP for 53 countries represents > 90% of global NPP. From 2000 to 2014, 29 of these 53 countries had increasing NPP trends, most notably the Central African Republic (23 g C/m2/y). The top three and top 12 countries accounted for 30% and 60% of total global NPP, respectively, whereas the mean national NPP per unit area in the countries with the 12 lowest values was only around ~ 300 g C/m2/y - the exception to this was Brazil, which had an NPP of 850 g C/m2/y. Large areas of Russia, Argentina, Peru and several countries in southeast Asia showed a marked decrease in NPP (~ 15 g C/m2/y). About 37% of the NPP decrease was caused by drought while ~ 55% of NPP variability was attributed to changes in water availability. Land cover change explained about 20% of the NPP variability. Our findings support the idea that government policies should aim primarily to improve water management in drought-afflicted countries; land use/land cover change policy could also be used as an alternative method of increasing NPP.*

Pereira, C. H., Patino, H. O., Hoshide, A. K., Abreu, D. C., Alan Rotz, C., & Nabinger, C. (2018). Grazing supplementation and crop diversification benefits for southern Brazil beef: A case study. *Agricultural Systems, 162*, 1-9. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043312238&doi=10.1016%2fj.agsy.2018.01.009&partnerID=40&md5=b0bc2627a1a8660cc5734ec941dc6e5b. doi:10.1016/j.agsy.2018.01.009

Research Tags: Livestock, Grassland, Economics

Abstract: *Profitability and environmental benefits of beef cattle raised on natural pasture or combined with soybean in tropical biomes need to be better evaluated. The objective of this research was to simulate and evaluate three common pastured beef grazing systems in southern Brazil, estimating profitability and the environmental impacts of carbon footprint (CF) measured as kg of CO2 equivalent per kg of body weight produced (BWP), water footprint (kg of water used/kg of BWP) and energy footprint (MJ of energy used/kg of BWP) using the Integrated Farm System Model version 4.2. Simulations were run for Angus beef cattle raised on natural pasture (NP), natural pasture with low levels of grain supplementation (NPS), and NPS combined with soybean production (NPSC). Net animal weight produced (kg/ha/year) increased 7.9% for NPS and NPSC when compared with the NP system. Natural pasture production costs per hectare were lower (US$ 114) than that of NPS (US$ 126) and NPSC (US$ 233), while NP had a net return per hectare only 2% greater than NPS. Even though the gross income from animal sales was 5% higher in NPS than NP, the elevated cost of purchased feeds reduced net return per hectare. While costs were higher for NPSC, diversifying with soybean production, a high value commodity for cash sale, was profitable resulting in 44% and 47% greater net return per hectare than NP and NPS, respectively. Natural pasture with low supplementation (NPS) decreased CF by 2% when compared with NP due to faster weight gain from supplementation despite higher emissions from feed production. Furthermore, CF was also 6% lower for natural pasture combined with soybeans (NPSC) compared with NPS. However, the energy and water footprints and erosion increased with the greater use of both purchased feed and inputs required for feed and cash crop production. It can be challenging to increase beef cattle productivity and diversification to lower GHG emissions while minimizing water and energy use and soil* *erosion.*

Perry, R. W. (2018). Migration and recent range expansion of Seminole bats (Lasiurus seminolus) in the United States. *Journal of Mammalogy, 99*(6), 1478-1485. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058777016&doi=10.1093%2fjmammal%2fgyy135&partnerID=40&md5=634990142b081e2510edaa9681884b82. doi:10.1093/jmammal/gyy135
Research Tags: Wildlife, Grassland
Abstract: *Bat species are facing increasing threats due to climate change, large-scale changes in vegetation, wind-power development, and white-nose syndrome, which make research on changes in bat communities essential for conservation planning in North America. The Seminole bat (Lasiurus seminolus) occurs throughout the southeastern United States, and recent evidence suggests they may be expanding their range in North America. I used museum records, publications, and data derived from mist-net surveys conducted by various individuals and organizations to determine changes in the seasonal and historical range of Seminole bats over the past 48 years across eastern North America. Based on records obtained, Seminole bats spend winter along the Gulf Coast, Carolinas, and southern Arkansas, but migrate as far north as Missouri and Kentucky during the summer maternity season. During the autumn juvenile-dispersal period, Seminole bats undergo widespread, long-distance movements and have been recorded in unexpected locations, including the Caribbean, Wisconsin, and New York. Over the past 48 years, the northern edge of their range has advanced 521 km and the western limit of their range has advanced 185 km, at a rate of approximately 11 km/year northward. These data suggest a recent and rapid shift northward, likely in response to climate change, and an expansion westward possibly due to changes in vegetation communities across historic grassland regions.*

Peters, M. P., Iverson, L. R., Prasad, A. M., & Matthews, S. N. (2019). Utilizing the density of inventory samples to define a hybrid lattice for species distribution models: DISTRIB-II for 135 eastern U.S. trees. *Ecology and Evolution, 9*(15), 8876-8899. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070358585&doi=10.1002%2fece3.5445&partnerID=40&md5=588fea442045de4b2c7f895128d2f896. doi:10.1002/ece3.5445
Research Tags: Research
Abstract: *Species distribution models (SDMs) provide useful information about potential presence or absence, and environmental conditions suitable for a species; and high-resolution models across large extents are desirable. A primary feature of SDMs is the underlying spatial resolution, which can be chosen for many reasons, though we propose that a hybrid lattice, in which grid cell sizes vary with the density of forest inventory plots, provides benefits over uniform grids. We examine how the spatial grain size affected overall model performance for the Random Forest-based SDM, DISTRIB, which was updated with recent forest inventories, climate, and soil data, and used a hybrid lattice derived from inventory densities.*
Modeled habitat suitability was compared between a uniform grid of 10 × 10 and a hybrid lattice of 10 × 10 and 20 × 20 km grids to assess potential improvements. The resulting DISTRIB-II models for 125 eastern U.S. tree species provide information on individual habitat suitability that can be mapped and statistically analyzed to understand current and potential changes.
Model performance metrics were comparable among the hybrid lattice and 10-km grids; however, the hybrid lattice models generally had higher overall model reliability scores and were likely more representative of the inventory data.
Our efforts to update DISTRIB models with current information aims to produce a more representative depiction of recent conditions by accounting for the spatial density of forest inventory data and using the latest climate data. Additionally, we developed an approach that leverages a hybrid lattice to maximize the spatial information within the models and recommend that similar modeling efforts be used to evaluate the spatial density of response and predictor data and derive a modeling grid that best represents the environment.

Peterson, D. L., & Halofsky, J. E. (2018). Adapting to the effects of climate change on natural resources in the Blue Mountains, USA. *10*, 63-71. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020781503&doi=10.1016%2fj.cliser.2017.06.005&partnerID=40&md5=3618fc437e53d1433d75a481f59d7a54. doi:10.1016/j.cliser.2017.06.005
Research Tags: Forestry

Abstract: *National forests in the Blue Mountains (USA) region have developed adaptation options that address effects identified in a recent climate change vulnerability assessment. Adaptation strategies (general, overarching) and adaptation tactics (specific, on-the-ground) were elicited from resource specialists and stakeholders through a workshop process. For water supply and infrastructure, primary adaptation strategies restore hydrologic function of watersheds, connect floodplains, support groundwater-dependent ecosystems, maximize valley storage, and reduce fire hazard. For fisheries, strategies maintain or restore natural flow regimes and thermal conditions, improve water conservation, decrease fragmentation of stream networks, and develop geospatial data on stream temperature and geologic hazards. For upland vegetation, disturbance-focused strategies reduce severity and patch size of disturbances, protect refugia, increase resilience of native vegetation by reducing non-climate stressors, protect genotypic and phenotypic diversity, and focus on functional systems (not just species). For special habitats (riparian areas, wetlands, groundwater-dependent ecosystems), strategies restore or maintain natural flow regimes, maintain appropriate plant densities, improve soil health and streambank stability, and reduce non-climate stressors. Prominent interactions of resource effects makes coordination critical for implementation and effectiveness of adaptation tactics and restoration projects in the Blue Mountains.*

Peterson, S. C., & Joshee, N. (2018). Co-milled silica and coppiced wood biochars improve elongation and toughness in styrene-butadiene elastomeric composites while replacing carbon black. *Journal of Elastomers and Plastics, 50*(8), 667-676. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056598325&doi=10.1177%2f0095244317753653&partnerID=40&md5=a1d6b890505ca802dffc8757f76c4ffe. doi:10.1177/0095244317753653

Research Tags: Forestry

Abstract: *Carbon black (CB) is a petroleum by-product with a million ton market in the US tire industry. Finding renewable substitutes for CB reduces dependence on oil and alleviates global warming. Biochar is a renewable source of carbon that has been studied previously as a replacement for CB in styrene-butadiene rubber (SBR) composites. However, biochar typically has lower carbon content, higher ash content, and larger particle size, which are all significant detractors to making biochar a viable drop-replacement for CB. In this study, high carbon and low ash biochars made from fast-growing Paulownia elongata and Populus tremuloides were co-milled with small amounts of silica in order to reduce the particle size, and the biochar/silica blends were then used to partially replace CB in SBR composites. Using this method both Paulownia and poplar biochars were able to replace 30% of the CB filler and improve elongation and toughness with virtually no loss of tensile strength, compared to the 100% CB-filled control composite.*

Petrie, M. D., Bradford, J. B., Hubbard, R. M., Lauenroth, W. K., Andrews, C. M., & Schlaepfer, D. R. (2017). Climate change may restrict dryland forest regeneration in the 21st century. *Ecology, 98*(6), 1548-1559. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019761156&doi=10.1002%2fecy.1791&partnerID=40&md5=00b7bc3a4ddbec7046ef855b30590269. doi:10.1002/ecy.1791

Research Tags: Forestry

Abstract: *The persistence and geographic expansion of dryland forests in the 21st century will be influenced by how climate change supports the demographic processes associated with tree regeneration. Yet, the way that climate change may alter regeneration is unclear. We developed a quantitative framework that estimates forest regeneration potential (RP) as a function of key environmental conditions for ponderosa pine, a key dryland forest species. We integrated meteorological data and climate projections for 47 ponderosa pine forest sites across the western United States, and evaluated RP using an ecosystem water balance model. Our primary goal was to contrast conditions supporting regeneration among historical, mid-21st century and late-21st century time frames. Future climatic conditions supported 50% higher RP in 2020–2059 relative to 1910–2014. As temperatures increased more substantially in 2060–2099, seedling survival decreased, RP declined by 50%, and the frequency of years with very low RP increased from 25% to 58%. Thus, climate change may initially support higher RP and increase the likelihood of successful regeneration events, yet will ultimately reduce average RP and the frequency of years with moderate climate support of regeneration. Our results suggest that climate change alone may begin to restrict the persistence and expansion of dryland forests by limiting seedling survival in the late 21st century.*

Petrie, M. D., Peters, D. P. C., Burruss, N. D., Ji, W., & Savoy, H. M. (2019). Differing climate and landscape effects on regional dryland vegetation responses during wet periods allude to future patterns. *Global Change Biology*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069908152&doi=10.1111%2fgcb.14724&partnerID=40&md5=7b3041bd45504f8aced566cf0e2d7a1a. doi:10.1111/gcb.14724

Research Tags: Weather

Abstract: *Dryland vegetation is influenced by biotic and abiotic land surface template (LST) conditions and precipitation (PPT), such that enhanced vegetation responses to periods of high PPT may be shaped by multiple factors. High PPT stochasticity in the Chihuahuan Desert suggests that enhanced responses across broad geographic areas are improbable. Yet, multiyear wet periods may homogenize PPT patterns, interact with favorable LST conditions, and in this way produce enhanced responses. In contrast, periods containing multiple extreme high PPT pulse events could overwhelm LST influences, suggesting a divergence in how climate change could influence vegetation by altering PPT periods. Using a suite of stacked remote sensing and LST datasets from the 1980s to the present, we evaluated PPT-LST-Vegetation relationships across this region and tested the hypothesis that enhanced vegetation responses would be initiated by high PPT, but that LST favorability would underlie response magnitude, producing geographic differences between wet periods. We focused on two multiyear wet periods; one of above average, regionally distributed PPT (1990–1993) and a second with locally distributed PPT that contained two extreme wet pulses (2006–2008). 1990–1993 had regional vegetation responses that were correlated with soil properties. 2006–2008 had higher vegetation responses over a smaller area that were correlated primarily with PPT and secondarily to soil properties. Within the overlapping PPT area of both periods, enhanced vegetation responses occurred in similar locations. Thus, LST favorability underlied the geographic pattern of vegetation responses, whereas PPT initiated the response and controlled response area and maximum response magnitude. Multiyear periods provide foresight on the differing impacts that directional changes in mean climate and changes in extreme PPT pulses could have in drylands. Our study shows that future vegetation responses during wet periods will be tied to LST favorability, yet will be shaped by the pattern and magnitude of multiyear PPT events.*

Petrie, M. D., Peters, D. P. C., Yao, J., Blair, J. M., Burruss, N. D., Collins, S. L., . . . Steiner, J. L. (2018). Regional grassland productivity responses to precipitation during multiyear above- and below-average rainfall periods. *Global Change Biology, 24*(5), 1935-1951. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044753557&doi=10.1111%2fgcb.14024&partnerID=40&md5=307d1791f2c01ca775c3d2d1072f6ac0. doi:10.1111/gcb.14024

Research Tags: Grassland, Weather

Abstract: *There is considerable uncertainty in the magnitude and direction of changes in precipitation associated with climate change, and ecosystem responses are also uncertain. Multiyear periods of above- and below-average rainfall may foretell consequences of changes in rainfall regime. We compiled long-term aboveground net primary productivity (ANPP) and precipitation (PPT) data for eight North American grasslands, and quantified relationships between ANPP and PPT at each site, and in 1–3 year periods of above- and below-average rainfall for mesic, semiarid cool, and semiarid warm grassland types. Our objective was to improve understanding of ANPP dynamics associated with changing climatic conditions by contrasting PPT–ANPP relationships in above- and below-average PPT years to those that occurred during sequences of multiple above- and below-average years. We found differences in PPT–ANPP relationships in above- and below-average years compared to long-term site averages, and variation in ANPP not explained by PPT totals that likely are attributed to legacy effects. The correlation between ANPP and current- and prior-year conditions changed from year to year throughout multiyear periods, with some legacy effects declining, and new responses emerging. Thus, ANPP in a given year was influenced by sequences of conditions that varied across grassland types and climates. Most importantly, the influence of prior-year ANPP often increased with the length of multiyear periods, whereas the influence of the amount of current-year PPT declined. Although the mechanisms by which a directional change in the frequency of above- and below-average years imposes a persistent change in grassland ANPP require further investigation, our results emphasize the importance of legacy effects on productivity for sequences of above- vs. below-average years, and illustrate the utility of long-term data to examine these patterns.*

Pettit, J. L., Justin Derose, R., & Long, J. N. (2018). Climatic Drivers of Ponderosa Pine Growth in Central Idaho. *Tree-Ring Research, 74*(2), 172-184. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051200504&doi=10.3959%2f1536-1098-74.2.172&partnerID=40&md5=d08420c482ebbd7284c0d2650315bfec. doi:10.3959/1536-1098-74.2.172

Research Tags: Forestry

Abstract: *Despite the widespread use of ponderosa pine as an important hydroclimate proxy, we actually understand very little about its climate response in the Northern Rockies. Here, we analyze two new ponderosa pine chronologies to investigate how climate influences annual growth. Despite differences in precipitation amount and timing and large elevation differences (1820 m versus 1060 m), ring width at both sites was strongly driven by water availability. The mid-elevation, water-limited site responded well to previous fall precipitation whereas the wetter, high-elevation site responded to growing season precipitation and temperature. When precipitation and temperature were simultaneously accounted for using the standardized precipitation evapotranspiration index, ring-width response between sites converged and appeared nearly identical. Water stress drove the timing of ponderosa pine growth by a combination of factors such as strong water dependence, and determinate growth physiology, as indicated by lag-1 autocorrelation. When analyzing response to single-month climate variables, precipitation from growing-season months dominates. When we examined seasonal variables, climate from the previous year became more important. Temporal fidelity of the climatic response at both sites maintained significance across the historical record, although the relationship weakened at the low-elevation site. The collection of new tree-ring data sets such as these for central Idaho improves our understanding of ponderosa pine growth response to climate.*

Phillips, R. P., Brandt, L., Polly, P. D., Zollner, P., Saunders, M. R., Clay, K., . . . Fei, S. (2019). An integrated assessment of the potential impacts of climate change on Indiana forests. *Climatic Change*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059635741&doi=10.1007%2fs10584-018-2326-8&partnerID=40&md5=3c3178fa4ce2e6649d7c5a3aa656d8a3. doi:10.1007/s10584-018-2326-8

Research Tags: Forestry

Abstract: *Forests provide myriad ecosystem services, many of which are vital to local and regional economies. Consequently, there is a need to better understand how predicted changes in climate will impact forest dynamics and the implications of such changes for society as a whole. Here we focus on the impacts of climate change on Indiana forests, which are representative of many secondary growth broadleaved forests in the greater Midwest region in terms of their land use history and current composition. We found that predicted changes in climate for the state—warmer and wetter winters/springs and hotter and potentially drier summers—will dramatically shape forest communities, resulting in new assemblages of trees and wildlife that differ from forest communities of the past or present. Overall, suitable habitat is expected to decline for 17–29% of tree species and increase for 43–52% of tree species in the state, depending on the region and climate scenario. Such changes have important consequences for wildlife that depend on certain tree species or have ranges with strong sensitivities to climate. Additionally, these changes will have potential economic impacts on Indiana industries that depend on forest resources and products (both timber and non-timber). Finally, we offer some practical suggestions on how management may minimize the extent of climate-induced ecological impacts and highlight a case study from a tree planting initiative currently underway in the Patoka River National Wildlife Refuge and Management Area.*

Philpott, T. J., Barker, J. S., Prescott, C. E., & Grayston, S. J. (2018). Limited effects of variable-retention harvesting on fungal communities decomposing fine roots in coastal temperate rainforests. *Applied and Environmental Microbiology, 84*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040643644&doi=10.1128%2fAEM.02061-17&partnerID=40&md5=6f85a5497589dc7eb7988ac2d507e6c4. doi:10.1128/AEM.02061-17

Research Tags: Forestry

Abstract: *Fine root litter is the principal source of carbon stored in forest soils and a dominant source of carbon for fungal decomposers. Differences in decomposer capacity between fungal species may be important determinants of fine-root decomposition rates. Variable-retention harvesting (VRH) provides refuge for ectomycorrhizal fungi, but its influence on fine-root decomposers is unknown, as are the effects of functional*

shifts in these fungal communities on carbon cycling. We compared fungal communities decomposing fine roots (in litter bags) under VRH, clear-cut, and uncut stands at two sites (6 and 13 years postharvest) and two decay stages (43 days and 1 year after burial) in Douglas fir forests in coastal British Columbia, Canada. Fungal species and guilds were identified from decomposed fine roots using high-throughput sequencing. Variable retention had short-term effects on β-diversity; harvest treatment modified the fungal community composition at the 6-year-postharvest site, but not at the 13-year-postharvest site. Ericoid and ectomycorrhizal guilds were not more abundant under VRH, but stand age significantly structured species composition. Guild composition varied by decay stage, with ruderal species later replaced by saprotrophs and ectomycorrhizae. Ectomycorrhizal abundance on decomposing fine roots may partially explain why fine roots typically decompose more slowly than surface litter. Our results indicate that stand age structures fine-root decomposers but that decay stage is more important in structuring the fungal community than shifts caused by harvesting. The rapid postharvest recovery of fungal communities decomposing fine roots suggests resiliency within this community, at least in these young regenerating stands in coastal British Columbia. IMPORTANCE Globally, fine roots are a dominant source of carbon in forest soils, yet the fungi that decompose this material and that drive the sequestration or respiration of this carbon remain largely uncharacterized. Fungi vary in their capacity to decompose plant litter, suggesting that fungal community composition is an important determinant of decomposition rates. Variable-retention harvesting is a forestry practice that modifies fungal communities by providing refuge for ectomycorrhizal fungi. We evaluated the effects of variable retention and clear-cut harvesting on fungal communities decomposing fine roots at two sites (6 and 13 years postharvest), at two decay stages (43 days and 1 year), and in uncut stands in temperate rainforests. Harvesting impacts on fungal community composition were detected only after 6 years after harvest. We suggest that fungal community composition may be an important factor that reduces fine-root decomposition rates relative to those of above-ground plant litter, which has important consequences for forest carbon cycling.

Philpott, T. J., Barker, J. S., Prescott, C. E., & Grayston, S. J. (2018). Retention trees slow post-harvest fine-root decomposition in a coastal temperate rainforest. *Forest Ecology and Management, 430*, 431-444. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052296732&doi=10.1016%2fj.foreco.2018.08.036&partnerID=40&md5=8c10fd220d57b2c611402112a08fa960. doi:10.1016/j.foreco.2018.08.036

Research Tags: Forestry

Abstract: *Fine roots are a dominant, but often overlooked source of carbon (C) in forest soils, and decomposition of this material may have important consequences for C storage and turnover in forest ecosystems. Forest harvesting modifies soil physicochemical properties and microbial communities, which may lead to faster decomposition rates, but the effect of harvesting on fine-root decomposition is rarely investigated. Variable-retention harvesting, where some trees are left on site after harvest, often results in lower soil moisture and temperature, and increased ectomycorrhizal diversity relative to clearcut harvesting. As such, this harvesting practice may influence fine-root decomposition rates. In Douglas-fir forests in coastal British Columbia, we measured fine-root (<2 mm diameter) decomposition rates in variable-retention (aggregate and dispersed arrangements), clearcut, and uncut treatments, and determined if any effects persisted as stands aged. Within the variable-retention treatments, we also examined if fine-root decomposition rates varied with distance from retention trees or retention patches. Further, we determined which soil physicochemical variables best explained variation in fine-root carbon loss after two years of decomposition. Increased tree coverage slowed fine-root decomposition; fine roots decomposed as slowly under variable-retention treatments as in uncut stands, and 15–19% more carbon was retained in these treatments relative to the clearcut treatment. Fine roots also decomposed faster with increasing distance from retention patches or retention trees as decomposition was twofold slower in the aggregate centre relative to open areas, with similar patterns observed in the dispersed retention treatment. However, fine roots decomposed at similar rates in forests and stands with more advanced regeneration, suggesting the effects of harvesting on decomposition rates was not persistent. Across all sampling locations, 37% of the variation in fine-root carbon loss was explained by fine-root biomass, and nitrate, potassium and sulphate availability. Nitrate availability was also positively correlated with the proportional mass of carbon lost during the decomposition experiment, suggesting that fine-root decomposition is sensitive to harvesting-induced changes in soil physicochemistry, and that variable-retention harvesting moderates the effects of harvesting on decomposition rates. These findings*

indicate that shortly after harvest, retention of even single trees can prevent the increase in fine-root decomposition rates associated with clearcut harvesting in these coastal Douglas-fir forests. Accordingly, management practices such as variable-retention harvesting that retain some trees in a cutblock may reduce soil C losses following forest harvesting.

Phung, Q. A., Thompson, A. L., Baffaut, C., Costello, C., Sadler, E. J., Svoma, B. M., . . . Gautam, S. (2019). Climate and Land Use Effects on Hydrologic Processes in a Primarily Rain-Fed, Agricultural Watershed. *Journal of the American Water Resources Association*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068499790&doi=10.1111%2f1752-1688.12764&partnerID=40&md5=917378ef65285ec0b611b54b081346ae. doi:10.1111/1752-1688.12764

Research Tags: Water

Abstract: *Anticipating changes in hydrologic variables is essential for making socioeconomic water resource decisions. This study aims to assess the potential impact of land use and climate change on the hydrologic processes of a primarily rain-fed, agriculturally based watershed in Missouri. A detailed evaluation was performed using the Soil and Water Assessment Tool for the near future (2020–2039) and mid-century (2040–2059). Land use scenarios were mapped using the Conversion of Land Use and its Effects model. Ensemble results, based on 19 climate models, indicated a temperature increase of about 1.0°C in near future and 2.0°C in mid-century. Combined climate and land use change scenarios showed distinct annual and seasonal hydrologic variations. Annual precipitation was projected to increase from 6% to 7%, which resulted in 14% more spring days with soil water content equal to or exceeding field capacity in mid-century. However, summer precipitation was projected to decrease, a critical factor for crop growth. Higher temperatures led to increased potential evapotranspiration during the growing season. Combined with changes in precipitation patterns, this resulted in an increased need for irrigation by 38 mm representing a 10% increase in total irrigation water use. Analysis from multiple land use scenarios indicated converting agriculture to forest land can potentially mitigate the effects of climate change on streamflow, thus ensuring future water availability.*

Piaggio, A. J., Russell, A. L., Osorio, I. A., Jiménez Ramírez, A., Fischer, J. W., Neuwald, J. L., . . . McCracken, G. F. (2017). Genetic demography at the leading edge of the distribution of a rabies virus vector. *Ecology and Evolution, 7*(14), 5343-5351. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020429503&doi=10.1002%2fece3.3087&partnerID=40&md5=4f9a8999b4704bf83abcae9ca4341e45. doi:10.1002/ece3.3087

Research Tags: Wildlife

Abstract: *The common vampire bat, Desmodus rotundus, ranges from South America into northern Mexico in North America. This sanguivorous species of bat feeds primarily on medium to large-sized mammals and is known to rely on livestock as primary prey. Each year, there are hotspot areas of D. rotundus-specific rabies virus outbreaks that lead to the deaths of livestock and economic losses. Based on incidental captures in our study area, which is an area of high cattle mortality from D. rotundus transmitted rabies, it appears that D. rotundus are being caught regularly in areas and elevations where they previously were thought to be uncommon. Our goal was to investigate demographic processes and genetic diversity at the north eastern edge of the range of D. rotundus in Mexico. We generated control region sequences (441 bp) and 12-locus microsatellite genotypes for 602 individuals of D. rotundus. These data were analyzed using network analyses, Bayesian clustering approaches, and standard population genetic statistical analyses. Our results demonstrate panmixia across our sampling area with low genetic diversity, low population differentiation, loss of intermediate frequency alleles at microsatellite loci, and very low mtDNA haplotype diversity with all haplotypes being very closely related. Our study also revealed strong signals of population expansion. These results follow predictions from the leading-edge model of expanding populations and supports conclusions from another study that climate change may allow this species to find suitable habitat within the U.S. border.*

Picasso, V. D., Casler, M. D., & Undersander, D. (2019). Resilience, stability, and productivity of Alfalfa cultivars in rainfed regions of North America. *Crop Science, 59*(2), 800-810. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063662640&doi=10.2135%2fcropsci2018.06.0372&partnerID=40&md5=a25e89295474a34cce9e0c9c49a0bb13. doi:10.2135/cropsci2018.06.0372

Research Tags: Grassland, Crop

Abstract: *Resilient, stable, and productive forage systems are needed to endure increasingly frequent climatic extremes. Resilience is the ability of a forage system to withstand a climatic crisis with high yields, stability is the minimal variability of yields across normal years, and productivity is the average yield across normal years. The goal of this research was to quantify resilience, stability, and productivity of alfalfa (Medicago sativa L.) cultivars to identify superior ones. Forage yield means from alfalfa cultivar trials from 11 US states and one Canadian province over 19 yr (1995–2013) were analyzed using linear mixed models. Locations with an extreme crisis year were identified, and quantitative measures for resilience and stability for each cultivar were calculated. Productivity, stability, and resilience were different among cultivars across locations, showing that some cultivars were consistently superior for each variable. Cultivar stability was not associated with productivity, and it was negatively associated with disease resistance. Cultivar resilience was negatively associated with productivity, and not associated with other traits. Cultivar productivity has increased with year of release of cultivar, stability has not changed, and resilience has decreased. Therefore, stability and resilience are different dimensions, explained by different traits. A coordinated evaluation effort across locations is needed to test and improve cultivar resilience in the future, and develop alfalfa cultivars more profitable for the long term.*

Pierre, S., Hewson, I., Sparks, J. P., Litton, C. M., Giardina, C., Groffman, P. M., & Fahey, T. J. (2017). Ammonia oxidizer populations vary with nitrogen cycling across a tropical montane mean annual temperature gradient. *Ecology, 98*(7), 1896-1907. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021437631&doi=10.1002%2fecy.1863&partnerID=40&md5=1fa660c03dfdb140bcc80a0e7d306ea3. doi:10.1002/ecy.1863

Research Tags: Soil

Abstract: *Functional gene approaches have been used to better understand the roles of microbes in driving forest soil nitrogen (N) cycling rates and bioavailability. Ammonia oxidation is a rate limiting step in nitrification, and is a key area for understanding environmental constraints on N availability in forests. We studied how increasing temperature affects the role of ammonia oxidizing archaea (AOA) and bacteria (AOB) in soil N cycling and availability by using a highly constrained natural mean annual temperature (MAT) elevation gradient in a tropical montane wet forest. We found that net nitrate (NO3−) bioavailability is positively related to MAT (r2 = 0.79, P = 0.0033), and AOA DNA abundance is positively related to both NO3− availability (r2 = 0.34, P = 0.0071) and MAT (r2 = 0.34, P < 0.001). In contrast, AOB DNA was only detected in some soils across the gradient. We identified three distinct phylotypes within the AOA which differed from one another in abundance and relative gene expression. In addition, one AOA phylotype increased in abundance with MAT, while others did not. We conclude that MAT is the primary driver of ecosystem N availability across this gradient, and AOA population size and structure appear to mediate the relationship between the nitrification and N bioavailability. These findings hold important implications for nutrient limitation in forests and feedbacks to primary production under changing climate.*

Pighinelli, A. L. M. T., Schaffer, M. A., & Boateng, A. A. (2018). Utilization of eucalyptus for electricity production in Brazil via fast pyrolysis: A techno-economic analysis. *Renewable Energy, 119*, 590-597. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038879456&doi=10.1016%2fj.renene.2017.12.036&partnerID=40&md5=63bc5a951078a8a4a598b7f25990b89a. doi:10.1016/j.renene.2017.12.036

Research Tags: Economics, Energy, Forestry

Abstract: *A process model of a 2000 metric ton per day eucalyptus Tail Gas Reactive Pyrolysis (TGRP) and electricity generation plant was developed and simulated in Pro/II software for the purpose of evaluating its techno-economic viability in Brazil. Two scenarios were compared based on operational conditions in the country: a single biomass to bio-oil TGRP production facility and a distributed/satellite processing that consists of several small TGRP production facilities with aggregate capacity similar to the single one, both feeding into one centralized electricity generation plant. The selling price at the breakeven point of the electricity generated via TGRP was estimated to be US$0.34 and US$0.62 per kWh for the single and the distributed scenarios respectively, considering a 10-year payback period. The single capacity pyrolysis and electricity generation facility is found to have better economic benefits over the distributed plants of small sizes under the current conditions in Brazil. The results therefore indicate that pyrolysis of eucalyptus wood for electricity in a single facility cannot be competitive with the current electricity cost in Brazil (US$0.08–0.13/kWh) at present time.*

Considering auxiliary benefits such as climate change and carbon credits, plus the continuous increasing in the electricity market price in Brazil, both scenarios could be competitive in the future.

Pike, C. C., Warren, J. C., & Montgomery, R. A. (2017). Effects of artificial warming during quiescence on budbreak and growth of white spruce, Picea glauca. *Canadian Journal of Forest Research, 47*(11), 1538-1545. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032661540&doi=10.1139%2fcjfr-2017-0102&partnerID=40&md5=79a6377cc92847c9fbf5bab7f6d49cef. doi:10.1139/cjfr-2017-0102

Research Tags: Forestry, Weather

Abstract: *Climate change is expected to increase winter temperatures in boreal climates. White spruce (Picea glauca (Moench) Voss) is vulnerable to spring frost damage due to its habit of early budbreak, which may be exacerbated or lessened with increasingly warm winters at its southern range edge. We tested the effects of episodic warming during the quiescent stage on budbreak time and growth of seven seed sources grown in a common garden setting in Minnesota, USA. Treatment plots were warmed with infrared lamps for 4 days each in February, March, or February and March to simulate a midwinter thaw. Control plots for each treatment and an overall control were included for comparison. Trees warmed in February experienced a slight delay in spring budbreak, but differences in budbreak time were generally not significant. Terminal growth was significantly and negatively correlated with time of budbreak but not with time to growth cessation. Our results suggest that white spruce is relatively resilient to the effects of intermittent warming but that warming early in the season may delay budbreak time, which is expected to reduce terminal growth.*

Polley, H. W., Johnson, D. M., & Jackson, R. B. (2018). Projected drought effects on the demography of Ashe juniper populations inferred from remote measurements of tree canopies. *Plant Ecology, 219*(10), 1259-1267. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053053161&doi=10.1007%2fs11258-018-0876-5&partnerID=40&md5=a56342793dc2b498ae2f975a8cc2552d. doi:10.1007/s11258-018-0876-5

Research Tags: Weather, Forestry

Abstract: *Tree mortality from drought is anticipated to increase as climate change promotes more frequent or severe water limitation. Ecosystem impacts of woody mortality depend on both the number and sizes of trees that die, but a limited capacity to predict mortality risk for individual trees hinders the capacity to forecast drought effects on tree population demography and ecosystem processes. We remotely measured leaf area of living Ashe juniper trees at three savanna sites in central Texas, USA to characterize the frequency-size distribution (FSD) of juniper populations and evaluate mortality risk from drought as a function of tree size. Mortality risk of individuals was assessed from the deviation in leaf area per tree from that of a similarly sized individual with near maximal leaf area using correlations among leaf area, growth rate, and mortality measured during a prior drought. We found that the FSD of juniper trees is bell-shaped at each site. Mortality risk from drought exceeded 25% of emergent (> 4 m height) trees in savanna juniper populations, but was highest for largest trees. Mortality risk was greatest at a grazed savanna, exceeding 50% of trees with projected canopy area > 20 m2. Results imply that severe drought could kill a large fraction (18–85%) of intermediate- to large-sized Ashe juniper trees in central Texas savannas. Our analysis demonstrates a novel use of remote measurements of canopy foliation to link mortality risk from drought to the demography of Ashe juniper populations through properties of individual trees.*

Potter, B. E., & Hernandez, J. R. (2017). Downdraft outflows: Climatological potential to influence fire behaviour. *International Journal of Wildland Fire, 26*(8), 685-692. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027256033&doi=10.1071%2fWF17035&partnerID=40&md5=37d9a7d185dce8524a0912512d6423e2. doi:10.1071/WF17035

Research Tags: Weather

Abstract: *Sudden wind shifts caused by atmospheric gust fronts can lead to firefighter entrapments and fatalities. In this study, we describe the physical processes involved in the related phenomena of convective downdrafts, gust fronts and downbursts. We focus on the dominant process, evaporative cooling in a dry surface layer, as characterised by the measure known as downdraft maximum available potential energy (DMAPE). We present a climatological analysis of DMAPE for the coterminous United States, developed from the Climate Forecast System Reanalysis data for the period 1979–2008. Diurnal and seasonal patterns are* *described. We conclude with a discussion of the implications and limitations of the analysis and DMAPE as an indicator of gust front strength or downburst occurrence.*

Potter, K. M., Crane, B. S., & Hargrove, W. W. (2017). A United States national prioritization framework for tree species vulnerability to climate change. *New Forests, 48*(2), 275-300. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009865510&doi=10.1007%2fs11056-017-9569-5&partnerID=40&md5=70aced1aad42b1284edb8c69be7c54c9. doi:10.1007/s11056-017-9569-5
Research Tags: Research, Forestry
Abstract: *Climate change is one of several threats that will increase the likelihood that forest tree species could experience population-level extirpation or species-level extinction. Scientists and managers from throughout the United States Forest Service have cooperated to develop a framework for conservation priority-setting assessments of forest tree species. This framework uses trait data and predictions of expected climate change pressure to categorize and prioritize 339 native tree species for conservation, monitoring, management and restoration across all forested lands in the contiguous United States and Alaska. The framework allows for the quantitative grouping of species into vulnerability classes that may require different management and conservation strategies for maintaining the adaptive genetic variation of the species within each group. This categorization is based on risk factors relating to the species' (1) exposure to climate change, (2) sensitivity to climate change, and (3) capacity to adapt to climate change. We used K-means clustering to group species into seven classes based on these three vulnerability dimensions. The most vulnerable class encompassed 35 species with high scores for all three vulnerability dimensions. These will require the most immediate conservation intervention. A group of 43 species had high exposure and sensitivity, probably requiring conservation assistance, while a group of 69 species had high exposure and low adaptive capacity, probably needing close monitoring. This assessment tool should be valuable for scientists and managers determining which species and populations to target for monitoring efforts and for pro-active gene conservation and management activities.*

Potter, K. M., Jetton, R. M., Bower, A., Jacobs, D. F., Man, G., Hipkins, V. D., & Westwood, M. (2017). Banking on the future: progress, challenges and opportunities for the genetic conservation of forest trees. *New Forests, 48*(2), 153-180. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017116476&doi=10.1007%2fs11056-017-9582-8&partnerID=40&md5=3c42c75886c6d6c02a2412609646e9fc. doi:10.1007/s11056-017-9582-8
Research Tags: Forestry
Abstract: *Genetic diversity provides the essential basis for the adaptation and resilience of tree species to environmental stress and change. The genetic conservation of tree species is an urgent global necessity as forest conversion and fragmentation continue apace, damaging insects and pathogens are transported between continents, and climate change alters local habitat suitability. Effective and efficient genetic conservation of tree species presents a substantial challenge because of the lack of basic information about many species, inadequate resources, and a historical lack of coordination within and between conservation sectors. Several cooperative efforts are already under way and are achieving conservation success, but much work remains. The Gene Conservation of Tree Species—Banking on the Future workshop in 2016 enabled the exchange of information and the creation of collaborations among tree conservation stakeholders. Several key themes emerged during the meeting's presentations and dialogue, which are further explored in this paper. In situ conservation of species is the long-term goal and is often the most efficient approach for preserving the genetic diversity of many forest tree species. Whether existing reserves adequately protect species and are sufficient for future conservation needs is uncertain. Ex situ conservation is an important complement to in situ efforts, acting as an insurance measure against extinction, providing material for restoration, enabling additional research opportunities, and educating the public. Networks of botanic gardens, government agencies, and non-governmental organizations must continue to coordinate ex situ and in situ efforts to improve the efficiency and effectiveness of tree conservation efforts. Assessing and prioritizing which species and populations require genetic conservation and prioritizing among them is a critical need. Two key tree restoration needs are for wider dissemination of planting stock, particularly stock with resistance to insects and pathogens, and for specific silvicultural prescriptions that facilitate restoration efforts. Effective genetic conservation of forest trees will require ongoing cooperation among widely diverse groups of scientists, managers, and policymakers from the public and private sectors.*

Potvin, L. R., & Lilleskov, E. A. (2017). Introduced earthworm species exhibited unique patterns of seasonal activity and vertical distribution, and Lumbricus terrestris burrows remained usable for at least 7 years in hardwood and pine stands. *Biology and Fertility of Soils, 53*(2), 187-198. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006971681&doi=10.1007%2fs00374-016-1173-x&partnerID=40&md5=63cf59ec5c26be694f638c1ca2589475. doi:10.1007/s00374-016-1173-x

Research Tags: Forestry, Soil, Wildlife

Abstract: *It is difficult to obtain non-destructive information on the seasonal dynamics of earthworms in northern forest soils. To overcome this, we used a Rhizotron facility to compile 7 years of data on the activity of anecic (Lumbricus terrestris) and endogeic (Aporrectodea caliginosa complex) earthworms in two contrasting soil/plant community types. We hypothesized that L. terrestris burrows would be used for longer than a typical L. terrestris lifetime, and that the distribution and activity pattern of the two earthworm species would respond differently to changes in soil moisture and temperature. For 7 years we recorded earthworm distribution and activity state bi-weekly to a depth of 1.5 m, tracked L. terrestris burrows using images captured annually, and measured soil temperature and moisture. Activity and vertical distribution of earthworms was closely linked to earthworm species and soil temperature in the fall, winter and spring. Lumbricus terrestris typically remained active through the winter, whereas the A. caliginosa complex was more likely to enter an aestivation period. Activity of all earthworms decreased substantially in July and August when soil temperature was at its highest and soil moisture at its lowest for the year. Most L. terrestris burrows were used continuously and moved very little during the 7-year study, likely creating spatiotemporally stable hotspots of soil resources. The different patterns of response of these species to soil temperature and moisture suggests that endogeic earthworms are more likely than anecic earthworms to adjust activity states in response to climate change mediated shifts in soil moisture and temperature.*

Poudel, H. P., Sanciangco, M. D., Kaeppler, S. M., Robin Buell, C., & Casler, M. D. (2019). Genomic prediction for winter survival of lowland switchgrass in the northern USA. *G3: Genes, Genomes, Genetics, 9*(6), 1921-1931. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067113152&doi=10.1534%2fg3.119.400094&partnerID=40&md5=fea4a4063e6d865c3e98c02a499b99cc. doi:10.1534/g3.119.400094

Research Tags: Grassland

Abstract: *The lowland ecotype of switchgrass has generated considerable interest because of its higher biomass yield and late flowering characteristics compared to the upland ecotype. However, lowland ecotypes planted in northern latitudes exhibit very low winter survival. Implementation of genomic selection could potentially enhance switchgrass breeding for winter survival by reducing generation time while eliminating the dependence on weather. The objectives of this study were to assess the potential of genomic selection for winter survival in lowland switchgrass by combining multiple populations in the training set and applying the selected model in two independent testing datasets for validation. Marker data were generated using exome capture sequencing. Validation was conducted using (1) indirect indicators of winter adaptation based on geographic and climatic variables of accessions from different source locations and (2) winter survival estimates of the phenotype. The prediction accuracies were significantly higher when the training dataset comprising all populations was used in fivefold cross validation but its application was not useful in the independent validation dataset. Nevertheless, modeling for population heterogeneity improved the prediction accuracy to some extent but the genetic relationship between the training and validation populations was found to be more influential. The predicted winter survival of lowland switchgrass indicated latitudinal and longitudinal variability, with the northeast USA the region for most cold tolerant lowland populations. Our results suggested that GS could provide valuable opportunities for improving winter survival and accelerate the lowland switchgrass breeding programs toward the development of cold tolerant cultivars suitable for northern latitudes.*

Pourmokhtarian, A., Driscoll, C. T., Campbell, J. L., Hayhoe, K., Stoner, A. M. K., Adams, M. B., . . . Shanley, J. B. (2017). Modeled ecohydrological responses to climate change at seven small watersheds in the northeastern United States. *Global Change Biology, 23*(2), 840-856. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84983426678&doi=10.1111%2fgcb.13444&partnerID

=40&md5=225366e9e54d40f0a3a9476b1c17e841. doi:10.1111/gcb.13444
Research Tags: Water
Abstract: *A cross-site analysis was conducted on seven diverse, forested watersheds in the northeastern United States to evaluate hydrological responses (evapotranspiration, soil moisture, seasonal and annual streamflow, and water stress) to projections of future climate. We used output from four atmosphere–ocean general circulation models (AOGCMs; CCSM4, HadGEM2-CC, MIROC5, and MRI-CGCM3) included in Phase 5 of the Coupled Model Intercomparison Project, coupled with two Representative Concentration Pathways (RCP 8.5 and 4.5). The coarse resolution AOGCMs outputs were statistically downscaled using an asynchronous regional regression model to provide finer resolution future climate projections as inputs to the deterministic dynamic ecosystem model PnET-BGC. Simulation results indicated that projected warmer temperatures and longer growing seasons in the northeastern United States are anticipated to increase evapotranspiration across all sites, although invoking CO2 effects on vegetation (growth enhancement and increases in water use efficiency (WUE)) diminish this response. The model showed enhanced evapotranspiration resulted in drier growing season conditions across all sites and all scenarios in the future. Spruce-fir conifer forests have a lower optimum temperature for photosynthesis, making them more susceptible to temperature stress than more tolerant hardwood species, potentially giving hardwoods a competitive advantage in the future. However, some hardwood forests are projected to experience seasonal water stress, despite anticipated increases in precipitation, due to the higher temperatures, earlier loss of snow packs, longer growing seasons, and associated water deficits. Considering future CO2 effects on WUE in the model alleviated water stress across all sites. Modeled streamflow responses were highly variable, with some sites showing significant increases in annual water yield, while others showed decreases. This variability in streamflow responses poses a challenge to water resource management in the northeastern United States. Our analyses suggest that dominant vegetation type and soil type are important attributes in determining future hydrological responses to climate change.*

Povak, N. A., Hessburg, P. F., Giardina, C. P., Reynolds, K. M., Heider, C., Salminen, E., . . . MacKenzie, R. A. (2017). A watershed decision support tool for managing invasive species on Hawai'i Island, USA. *Forest Ecology and Management*, *400*, 300-320. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020873895&doi=10.1016%2fj.foreco.2017.05.046&partnerID=40&md5=23714dacaf228f5f53aab604487c8378. doi:10.1016/j.foreco.2017.05.046
Research Tags: Water, Wildlife
Abstract: *Non-native species invasions, growing human populations, and climate change are central ecological concerns in tropical island communities. The combination of these threats have led to losses of native biota, altered hydrological and ecosystem processes, and reduced ecosystem services. These threats pose complex problems to often underfunded management entities. We developed a watershed decision support tool (WDST) for the windward coast of Hawai'i Island aimed at prioritizing catchments for invasive species removal and native forest protection from non-native species invasions. Using the Ecosystem Management Decision Support (EMDS) system, we integrated spatial data from four sources: (i) native and invasive species coverage; (ii) modeled water yield; (iii) treatment cost and efficacy; and (iv) native species conservation value. We used a distributed hydrology model (DHSVM) to estimate catchment-level (~90 ha) water yield under six climate and non-native species invasion scenarios to identify where (1) invasive species removal and (2) protection from invasion would have the greatest benefit to increasing or maintaining native biodiversity and hydrologic functioning. The hydrology model predicted a 30% decline (386 Gl yr−1) in total water yield under a drier future climate (20% reduction in rainfall), with an additional 2% reduction when catchments were fully invaded by non-native species. Increased temperatures had a small compensatory effect on water yield. The WDST identified 6.3% of the study area as high priority for invasive species removal, based on characteristics of large hydrological response to the removal treatment (concentrated in high rainfall areas), high quality road or trail access, and high conservation value. High protection priority from invasive species (5.9% by area) occurred in higher elevation catchments, near the upper range of strawberry guava (the main invasive species), where water yield was most sensitive to invasion. Climate change scenarios had little influence on the spatial distribution of priority scores despite large changes in overall water yield. In contrast, priority scores were sensitive to very high variation in treatment costs, which were influenced largely by travel times to catchments via road and trail networks. This last finding suggests that future management feasibility will hinge on improvements to road and trail networks, or development of alternative management strategies that reduce*

travel costs and time.

Powell, R. A., Facka, A. N., Gilbert, J. H., Higley, J. M., LaPoint, S. D., McCann, N. P., . . . Thompson, C. M. (2018). The fisher as a model organism. In *Biology and Conservation of Musteloids* (pp. 278-291).
Research Tags: Wildlife, Research
Abstract: *The literature on fishers - medium-sized, North American carnivores - is broad, despite being limited, and traditional ecological knowledge of Native Americans contributes to our understanding of fishers. Fishers are generalist predators but also specialized predators of North American porcupines. Over trapping, habitat loss and climate change reduced fisher populations after European colonization of North America. Protection and reintroductions led to general but not to universal population recovery, contributing to the understanding of reintroduction science, including population genetics of both rare and expanding populations. Although adapted to live in old forests with complex structure, some fishers have colonized fragmented habitats, including suburbs. Models of fisher habitat, energetics, sexual dimorphism, genetics, and use of space illustrate the diversity of approaches possible for carnivore studies. Thus, the fisher has become a model organism for ecological and conservation research on mammalian carnivores.*

Powers, M., Kolka, R., Bradford, J., Palik, B., & Jurgensen, M. (2017). Forest floor and mineral soil respiration rates in a northern Minnesota red pine chronosequence. *Forests, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039777973&doi=10.3390%2ff9010016&partnerID=40&md5=bc509c941177e471bc3e05722a40f798. doi:10.3390/f9010016
Research Tags: Soil, Forestry, Emissions
Abstract: *We measured total soil CO2 efflux (RS) and efflux from the forest floor layers (RFF) in red pine (Pinus resinosa Ait.) stands of different ages to examine relationships between stand age and belowground C cycling. Soil temperature and RS were often lower in a 31-year-old stand (Y31) than in 9-year-old (Y9), 61-year-old (Y61), or 123-year-old (Y123) stands. This pattern was most apparent during warm summer months, but there were no consistent differences in RFF among different-aged stands. RFF represented an average of 4–13% of total soil respiration, and forest floor removal increased moisture content in the mineral soil. We found no evidence of an age effect on the temperature sensitivity of RS, but respiration rates in Y61 and Y123 were less sensitive to low soil moisture than RS in Y9 and Y31. Our results suggest that soil respiration's sensitivity to soil moisture may change more over the course of stand development than its sensitivity to soil temperature in red pine, and that management activities that alter landscape-scale age distributions in red pine forests could have significant impacts on rates of soil CO2 efflux from this forest type.*

Prasad, A. M., & Potter, K. M. (2017). Macro-scale assessment of demographic and environmental variation within genetically derived evolutionary lineages of eastern hemlock (Tsuga canadensis), an imperiled conifer of the eastern United States. *Biodiversity and Conservation, 26*(9), 2223-2249. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018673165&doi=10.1007%2fs10531-017-1354-4&partnerID=40&md5=def8cacb0114ca8d4115b935046be098. doi:10.1007/s10531-017-1354-4
Research Tags: Forestry
Abstract: *Eastern hemlock (Tsuga canadensis) occupies a large swath of eastern North America and has historically undergone range expansion and contraction resulting in several genetically separate lineages. This conifer is currently experiencing mortality across most of its range following infestation of a non-native insect. With the goal of better understanding the current and future conservation potential of the species, we evaluate ecological differences among populations within these genetically defined clusters, which were previously inferred using nuclear microsatellite molecular markers from 58 eastern hemlock populations. We sub-divide these clusters into four genetic zones to differentiate putative north-central, north-east and southeast (SE) and southwest evolutionary lineages in eastern hemlock. We use demographic data (relative abundance, mortality, and seedling regeneration) from the Forest Inventory Analysis program in conjunction with environmental data to model how these lineages respond to current and future climatic gradients. Ecologically meaningful relationships are explored in the intraspecific context of hemlock abundance distribution and then related to genetic variation. We also assess hemlock's colonization likelihood via a long distance dispersal model and explore its future genetic and ecological conservation potential by combining the future suitable habitats with colonization likelihoods. Results show that future habitats under climate change will markedly decline for*

eastern hemlock. The remaining areas with higher habitat quality and colonization potential are confined to the SE, the genetic zone nearest the species' putative glacial refugia, pointing to the need to focus our conservation efforts on this ecologically and genetically important region.

Prasad, R., Gunn, S. K., Rotz, C. A., Karsten, H., Roth, G., Buda, A., & Stoner, A. M. K. (2018). Projected climate and agronomic implications for corn production in the Northeastern United States. *PLoS ONE, 13*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048895786&doi=10.1371%2fjournal.pone.0198623&partnerID=40&md5=fb7757aadf8133ca27dece0807883fc9. doi:10.1371/journal.pone.0198623

Research Tags: Crops

Abstract: *Corn has been a pillar of American agriculture for decades and continues to receive much attention from the scientific community for its potential to meet the food, feed and fuel needs of a growing human population in a changing climate. By midcentury, global temperature increase is expected to exceed 2°C where local effects on heat, cold and precipitation extremes will vary. The Northeast United States is a major dairy producer, corn consumer, and is cited as the fastest warming region in the contiguous U.S. It is important to understand how key agronomic climate variables affect corn growth and development so that adaptation strategies can be tailored to local climate changes. We analyzed potential local effects of climate change on corn growth and development at three major dairy locations in the Northeast (Syracuse, New York; State College, Pennsylvania and Landisville, Pennsylvania) using downscaled projected climate data (2000–2100) from nine Global Climate Models under two emission pathways (Representative Concentration Pathways (RCP) 4.5 and 8.5). Our analysis indicates that corn near the end of the 21st century will experience fewer spring and fall freezes, faster rate of growing degree day accumulation with a reduction in time required to reach maturity, greater frequencies of daily high temperature ≥35°C during key growth stages such as silking-anthesis and greater water deficit during reproductive (R1-R6) stages. These agronomic anomalies differ between the three locations, illustrating varying impacts of climate change in the more northern regions vs. the southern regions of the Northeast. Management strategies such as shifting the planting dates based on last spring freeze and irrigation during the greatest water deficit stages (R1-R6) will partially offset the projected increase in heat and drought stress. Future research should focus on understanding the effects of global warming at local levels and determining adaptation strategies that meet local needs.*

Prather, C., Strickland, M. S., Laws, A., & Branson, D. (2017). Herbivore species identity and composition affect soil enzymatic activity through altered plant composition in a coastal tallgrass prairie. *Soil Biology and Biochemistry, 112*, 277-280. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020054631&doi=10.1016%2fj.soilbio.2017.05.013&partnerID=40&md5=b7bab7fbd45c9e3aa6c4f9631b9e1cae. doi:10.1016/j.soilbio.2017.05.013

Research Tags: Grassland, Wildlife, Soil

Abstract: *Although single herbivore species are known to affect soil microbial communities, the effects of herbivore species identity and community composition on soil microbes and their functioning are unknown. We tested the effects of single orthopteran species and species combinations on soil enzymatic activity with an enclosure experiment in a coastal tallgrass prairie. Species effects on soil enzymatic activity were non-additive: one particular mixed feeding species (M. femurrubrum) resulted in 65% higher BG enzyme activity and 35% higher total hydrolytic enzyme activity, whereas certain combinations containing this species had little to no effects. These results suggest that critical species or combinations of species that strongly affect plant functional composition may also have strong effects on soil enzymatic functioning and nutrient limitation.*

Pravia, M. V., Kemanian, A. R., Terra, J. A., Shi, Y., Macedo, I., & Goslee, S. (2019). Soil carbon saturation, productivity, and carbon and nitrogen cycling in crop-pasture rotations. *Agricultural Systems, 171*, 13-22. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059823687&doi=10.1016%2fj.agsy.2018.11.001&partnerID=40&md5=7ae059e9194027c332c2b561850d0506. doi:10.1016/j.agsy.2018.11.001

Research Tags: Soil, Crops, Livestock, Emissions

Abstract: *Agricultural systems integrating perennial grass-legume pastures in rotation with grain crops sustain high crop yields while preserving soil organic carbon (Cs) with low nitrogen (N) fertilizer inputs. We hypothesize that Cs saturation in the topsoil may explain the favorable C and N cycling in these systems. We tested this* *hypothesis by evaluating and simulating three contrasting crop and pasture rotational systems from a 20-year no-till experiment in Treinta y Tres, Uruguay. The systems were: 1) Continuous annual cropping (CC); 2) crop-pasture rotation with two years of crops and four years of pastures (CP); and 3) perennial pasture (PP). Using the Cycles agroecosystems model, we evaluated the inclusion or exclusion of a Cs saturation algorithm. The model simulated forage, soybean, and sorghum grain yields correctly, with low root mean square error (RMSE) of 1.5, 0.7 and 1.0 Mg ha−1, respectively. Measurements show Cs accretion and Cs decline for the first and second half of the experiment, respectively. The Cs accretion rate was highest for PP, while the Cs decline was highest for CC (1.3 vs −0.6 Mg ha−1 y−1 of C). The model captured this Cs dynamics and performed better when using the Cs saturation algorithm than when excluding it (RMSE 4.7 vs 6.8 Mg C ha−1 and relative RMSE of 14% and 21% for the top 15-cm). The model with saturation simulated subsoil Cs distribution with depth well, and simulated faster N turnover and greater N availability for the subsequent grain crop in CP vs CC. The results suggest that Cs saturation, and by extension soil organic N saturation, underpin the sustainability of crop-pasture rotations, and that modeling Cs saturation dynamics can be critical to reliably simulate complex crop-pasture rotational systems.*

Pregler, K. C., Kanno, Y., Rankin, D., Coombs, J. A., & Whiteley, A. R. (2018). Characterizing genetic integrity of rear-edge trout populations in the southern Appalachians. *Conservation Genetics, 19*(6), 1487-1503. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055968301&doi=10.1007%2fs10592-018-1116-1&partnerID=40&md5=163246595f46525382a4e57d69df2307. doi:10.1007/s10592-018-1116-1

Research Tags: Wildlife

Abstract: *Vertebrate populations at the periphery of their range can show pronounced genetic drift and isolation, and therefore offer unique challenges for conservation and management. These populations are often candidates for management actions such as translocations that are designed to improve demographic and genetic integrity. This is particularly true of coldwater species like brook trout (Salvelinus fontinalis), whose numbers have declined greatly across its historic range. At the southern margin, remnant wild populations persist in isolated headwater streams, and many have a history of receiving translocated individuals through either stocking of hatchery reared fish, relocation of wild fish, or both during restoration attempts. To determine current genetic integrity and resolve the genetic effects of past management actions for brook trout populations in SC, USA, we genetically assessed all 18 documented remaining brook trout populations along with individuals acquired from six hatcheries with recorded stocking events in SC. Our results indicated that six of the 18 streams showed signs of hatchery admixture (range 57–97%) and restored patches retained genetic signatures from multiple source populations. Populations had among the lowest genetic diversity (min average HE = 0.147) and effective number of breeders (mean Nb = 31.2) estimates observed throughout the native brook trout range. Populations were highly differentiated (mean pair-wise FST = 0.396), and substantial genetic divergence was evident across major river drainages (max pair-wise FST = 0.773). The lowest local genetic diversity and highest genetic differentiation ever reported for this species make its conservation a challenging task, particularly when combined with other threats such as climate change and non-native species. We offer recommendations on managing peripheral populations with depleted genetic characteristics and provide a reference for determining which existing populations will best serve as sources for future translocation efforts aimed at enhancing or restoring wild brook trout genetic integrity.*

Prevéy, J., Vellend, M., Rüger, N., Hollister, R. D., Bjorkman, A. D., Myers-Smith, I. H., . . . Rixen, C. (2017). Greater temperature sensitivity of plant phenology at colder sites: implications for convergence across northern latitudes. *Global Change Biology, 23*(7), 2660-2671. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012068022&doi=10.1111%2fgcb.13619&partnerID=40&md5=e7d31167ff3248d15f69456c1e1207c2. doi:10.1111/gcb.13619

Research Tags: Weather

Abstract: *Warmer temperatures are accelerating the phenology of organisms around the world. Temperature sensitivity of phenology might be greater in colder, higher latitude sites than in warmer regions, in part because small changes in temperature constitute greater relative changes in thermal balance at colder sites. To test this hypothesis, we examined up to 20 years of phenology data for 47 tundra plant species at 18 high-latitude sites along a climatic gradient. Across all species, the timing of leaf emergence and flowering was more sensitive to*

a given increase in summer temperature at colder than warmer high-latitude locations. A similar pattern was seen over time for the flowering phenology of a widespread species, Cassiope tetragona. These are among the first results highlighting differential phenological responses of plants across a climatic gradient and suggest the possibility of convergence in flowering times and therefore an increase in gene flow across latitudes as the climate warms.

Prevéy, J. S., & Harrington, C. A. (2018). Effectiveness of winter temperatures for satisfying chilling requirements for reproductive budburst of red alder (Alnus rubra). *PeerJ, 2018*(9). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054678838&doi=10.7717%2fpeerj.5221&partnerID=40&md5=bbe2b69b2350695cf82d14fa913af47a. doi:10.7717/peerj.5221

Research Tags:

Abstract: *Background*

Experiencing an adequate amount of cold temperatures over winter is necessary for many temperate tree species to break dormancy and flower in spring. Thus, changes in winter and spring temperatures associated with climate change may influence when trees break dormancy and flower in the future. There have been several experimental studies that have quantified the effectiveness of cold temperatures for chilling requirements for vegetative budburst of temperate trees; however, there are few experimental studies addressing the chilling requirements for reproductive budburst of trees, as it is difficult to place reproductively mature trees in temperature-controlled environments.

Methods

To identify how changing temperatures associated with climate change may impact reproductive phenology, we completed a temperature-controlled growth chamber experiment using cuttings of reproductive branches of red alder (Alnus rubra), one of the most widespread hardwood tree species of the Pacific Northwest, USA. The purpose of this study was to examine how colder (4 °C) and warmer (9 °C) winter temperature regimes influenced the timing of reproductive budburst of red alder cuttings in spring. We also compared the date of budburst of cuttings to that of branches from intact trees.

Results

We found that cuttings flowered earlier after pretreatment with a 4 °C winter temperature regime than after a 9 °C winter temperature regime. We found no significant differences between the timing of male budburst of cuttings exposed to ambient conditions compared to male budburst of branches from intact trees. We used our experimental data to estimate a "possibility-line" that shows the accumulated chilling and forcing temperatures necessary prior to reproductive budburst of red alder.

Discussion

This study provides a preliminary indication that warmer winters with climate change may not be as effective as colder winters for satisfying chilling temperature requirements of a Northwest hardwood tree species.

Prevéy, J. S., Harrington, C. A., & St. Clair, J. B. (2018). The timing of flowering in Douglas-fir is determined by cool-season temperatures and genetic variation. *Forest Ecology and Management, 409*, 729-739. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037982344&doi=10.1016%2fj.foreco.2017.11.062&partnerID=40&md5=5de6ffb0e4c17cc7b2835bec4f93e9cb. doi:10.1016/j.foreco.2017.11.062

Research Tags: Forestry, Weather

Abstract: *Trees have evolved to time flowering to maximize outcrossing, minimize exposure to damaging frosts, and synchronize development with soil moisture and nutrient availability. Understanding the environmental cues that influence the timing of reproductive budburst will be important for predicting how flowering phenology of trees will change with a changing climate, and aid in the time-sensitive management of seed orchards. We examined how temperature influenced the timing of female flowering of coastal Douglas-fir with over 4500 flowering observations of trees from 12 sites across western Oregon and Washington. We predicted flowering dates by modifying chilling and forcing effectiveness functions from a model of vegetative budburst of Douglas-fir. We also examined whether genetic variation in Douglas-fir influenced the relationships between chilling and forcing accumulations using flowering observations from two common-garden experiments with trees from 60 populations from a diverse range of climates. Our reproductive budburst model predicted the day of flowering within an average of five days of the observed*

flowering dates across all sites and years. Fewer hours of forcing temperatures were required for flowering on sites that had experienced high chilling. Warmer temperatures in the future will likely result in earlier flowering on sites which currently have high chilling; however, sites which currently experience low chilling may display no change or possibly even a delay in flowering. Douglas-fir genotypes from different geographic regions flowered in the same order from year to year in common gardens, indicating that both temperature and genetic variation influence flowering. Genetic variation in flowering dates was more strongly related to summer drought of seed source locations than to cold winters. Knowledge of the environmental cues and genetic variation in timing of flowering can help predict how future changes in temperature under various climate models could change flowering time across the range of coastal Douglas-fir.

Prevéy, J. S., Rixen, C., Rüger, N., Høye, T. T., Bjorkman, A. D., Myers-Smith, I. H., . . . Wipf, S. (2019). Warming shortens flowering seasons of tundra plant communities. *Nature Ecology and Evolution, 3*(1), 45-52. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058178081&doi=10.1038%2fs41559-018-0745-6&partnerID=40&md5=43ee51714bcb4e6d5c7a420ba5e2bbf8. doi:10.1038/s41559-018-0745-6

Research Tags: Grassland

Abstract: *Advancing phenology is one of the most visible effects of climate change on plant communities, and has been especially pronounced in temperature-limited tundra ecosystems. However, phenological responses have been shown to differ greatly between species, with some species shifting phenology more than others. We analysed a database of 42,689 tundra plant phenological observations to show that warmer temperatures are leading to a contraction of community-level flowering seasons in tundra ecosystems due to a greater advancement in the flowering times of late-flowering species than early-flowering species. Shorter flowering seasons with a changing climate have the potential to alter trophic interactions in tundra ecosystems. Interestingly, these findings differ from those of warmer ecosystems, where early-flowering species have been found to be more sensitive to temperature change, suggesting that community-level phenological responses to warming can vary greatly between biomes.*

Prichard, S. J., Stevens-Rumann, C. S., & Hessburg, P. F. (2017). Tamm Review: Shifting global fire regimes: Lessons from reburns and research needs. *Forest Ecology and Management, 396*, 217-233. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018958216&doi=10.1016%2fj.foreco.2017.03.035&partnerID=40&md5=890e762fd2a5b40263c6a491434865d6. doi:10.1016/j.foreco.2017.03.035

Research Tags: Forestry

Abstract: *Across the globe, rising temperatures and altered precipitation patterns have caused persistent regional droughts, lengthened fire seasons, and increased the number of weather-driven extreme fire events. Because wildfires currently impact an increasing proportion of the total area burned, land managers need to better understand reburns – in which previously burned areas can modify the patterns and severity of subsequent fires. For example, knowing how long past fire boundaries can function as barriers to fire spread may empower decision-makers to manage some wildfires as large-scale fuel treatments, or alternatively, determine where prescribed burning or strategic wildfire management are required. Additionally, a clear understanding of how prior burn mosaics influence future fire spread and burn severity is critical knowledge for landscape and fire-dependent wildlife habitat planning under a rapidly changing climate. Here, we review published studies on reburns in fire-adapted ecosystems of the world, including temperate forests of North America, semi-arid forests and rangelands, tropical and subtropical forests, grasslands and savannas, and Mediterranean ecosystems. To date, research on reburns is unevenly distributed across the world with a relative abundance of literature in Australia, Europe and North America and a scarcity of studies in Africa, Asia and South America. This review highlights the complex role of repeated fires in modifying vegetation and fuels, and patterns of subsequent wildfires. In fire-prone ecosystems, the return of fire is inevitable, and legacies of past fires, or their absence, often dictate the characteristics of subsequent fires.*

Provenza, F. D., Kronberg, S. L., & Gregorini, P. (2019). Is grassfed meat and dairy better for human and environmental health? *Frontiers in Nutrition, 6*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067812090&doi=10.3389%2ffnut.2019.00026&partnerID=40&md5=f0ec85c0150b63419ed5a6b3ae1ec8a8. doi:10.3389/fnut.2019.00026

Research Tags: Emissions, Livestock

Abstract: *The health of livestock, humans, and environments is tied to plant diversity—and associated phytochemical richness—across landscapes. Health is enhanced when livestock forage on phytochemically rich landscapes, is reduced when livestock forage on simple mixture or monoculture pastures or consume high-grain rations in feedlots, and is greatly reduced for people who eat highly processed diets. Circumstantial evidence supports the hypothesis that phytochemical richness of herbivore diets enhances biochemical richness of meat and dairy, which is linked with human and environmental health. Among many roles they play in health, phytochemicals in herbivore diets protect meat and dairy from protein oxidation and lipid peroxidation that cause low-grade systemic inflammation implicated in heart disease and cancer in humans. Yet, epidemiological and ecological studies critical of red meat consumption do not discriminate among meats from livestock fed high-grain rations as opposed to livestock foraging on landscapes of increasing phytochemical richness. The global shift away from phytochemically and biochemically rich wholesome foods to highly processed diets enabled 2.1 billion people to become overweight or obese and increased the incidence of type II diabetes, heart disease, and cancer. Unimpeded, these trends will add to a projected substantial increase in greenhouse gas emissions (GHGE) from producing food and clearing land by 2050. While agriculture contributes one quarter of GHGE, livestock can play a sizable role in climate mitigation. Of 80 ways to alleviate climate change, regenerative agriculture—managed grazing, silvopasture, tree intercropping, conservation agriculture, and farmland restoration—jointly rank number one as ways to sequester GHG. Mitigating the impacts of people in the Anthropocene can be enabled through diet to improve human and environmental health, but that will require profound changes in society. People will have to learn we are members of nature's communities. What we do to them, we do to ourselves. Only by nurturing them can we nurture ourselves.*

Puhlick, J., Woodall, C., & Weiskittel, A. (2017). Implications of land-use change on forest carbon stocks in the eastern United States. *Environmental Research Letters, 12*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015770025&doi=10.1088%2f1748-9326%2faa597f&partnerID=40&md5=fff4439e5c4111fd96c7a171c349c31c. doi:10.1088/1748-9326/aa597f

Research Tags: Forestry

Abstract: *Given the substantial role that forests play in removing CO2 from the atmosphere, there has been a growing need to evaluate the carbon (C) implications of various forest management and land-use decisions. Although assessment of land-use change is central to national-level greenhouse gas monitoring guidelines, it is rarely incorporated into forest stand-level evaluations of C dynamics and trajectories. To better inform the assessment of forest stand C dynamics in the context of potential land-use change, we used a region-wide repeated forest inventory (n = 71 444 plots) across the eastern United States to assess forest land-use conversion and associated changes in forest C stocks. Specifically, the probability of forest area reduction between 2002–2006 and 2007–2012 on these plots was related to key driving factors such as proportion of the landscape in forest land use, distance to roads, and initial forest C. Additional factors influencing the actual reduction in forest area were then used to assess the risk of forest land-use conversion to agriculture, settlement, and water. Plots in forests along the Great Plains had the highest periodic (approximately 5 years) probability of land-use change (0.160 ± 0.075; mean ± SD) with forest conversion to agricultural uses accounting for 70.5% of the observed land-use change. Aboveground forest C stock change for plots with a reduction in forest area was −4.2 ± 17.7 Mg ha−1 (mean ± SD). The finding that poorly stocked stands and/or those with small diameter trees had the highest probability of conversion to non-forest land uses suggests that forest management strategies can maintain the US terrestrial C sink not only in terms of increased net forest growth but also retention of forest area to avoid conversion. This study highlights the importance of considering land-use change in planning and policy decisions that seek to maintain or enhance regional C sinks.*

Purcell, K. L., McGregor, E. L., & Calderala, K. (2017). Effects of drought on western pond turtle survival and movement patterns. *Journal of Fish and Wildlife Management, 8*(1), 15-27. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020418324&doi=10.3996%2f012016-JFWM-005&partnerID=40&md5=828c1c04837b0690ac9387081859ada0. doi:10.3996/012016-JFWM-005

Research Tags: Wildlife, Weather, Water

Abstract: *Drought has the ability to affect the persistence of small animal populations, especially those tied to aquatic habitats. We studied the response of western pond turtles Actinemys marmorata to California's worst drought on record. From 2009 through 2015 we used telemetry to track movements and assess survival of 19*

western pond turtles in a stock pond at the San Joaquin Experimental Range in the western foothills of the Sierra Nevada, in Madera County, California. In 2013 the pond dried in late summer and winter rains were insufficient for pond formation. The pond remained dry through the end of the study in March 2015. In years with below average precipitation the pond often dried completely in late summer; however, the lack of a pond forming in winter and spring had not been previously documented. We observed no mortalities of radiotagged western pond turtles in years with normal precipitation. All observed mortalities occurred in drought years and in years when the pond completely dried up in the summer or never formed. Results from known-fate survival models revealed that survival decreased with increasing drought. Model results also indicated that male survival was slightly higher than female survival (19.1% vs. 11.5%), although the 95% confidence intervals overlapped. We observed high variability in western pond turtle movement distances from the pond in the final 2 y of the study. Two individuals that survived to the end of the study showed unique movement patterns. One young male moved frequently, accumulating a large total distance, moved into new areas, and eventually found his way into a livestock water trough. The other, a young female, moved 2.6 km from the pond (a minimum total distance traveled of 3.3 km based on telemetry locations) and emigrated to a pond on a neighboring ranch. Turtles that died exhibited no distinctive behaviors. After the pond dried western pond turtles remained terrestrial for long periods, with one surviving individual remaining out of water for 617 consecutive days, which is an unprecedented finding for this species to our knowledge. Our findings suggest that increased frequency and severity of droughts can affect the resiliency of small, isolated western pond turtle populations, especially those in ephemeral aquatic environments. These small populations are essential to the long-term survival of the species because of the current fragmented distribution of the species.

Qin, M., Hao, L., Sun, L., Liu, Y., & Sun, G. (2019). Climatic Controls on Watershed Reference Evapotranspiration Varied during 1961–2012 in Southern China. *Journal of the American Water Resources Association, 55*(1), 189-208. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058951496&doi=10.1111%2f1752-1688.12714&partnerID=40&md5=f0390ff91570f78b0562e34702478383. doi:10.1111/1752-1688.12714

Research Tags: Water

Abstract: *Reference evapotranspiration (ETo) is an important hydrometeorological term widely used in understanding and projecting the hydrological effects of future climate and land use change. We conducted a case study in the Qinhuai River Basin that is dominated by a humid subtropical climate and mixed land uses in southern China. Long-term (1961–2012) meteorological data were used to estimate ETo by the FAO-56 Penman–Monteith model. The individual contribution from each meteorological variable to the trend of ETo was quantified. We found basin-wide annual ETo decreased significantly (p < 0.05) by 3.82 mm/yr during 1961–1987, due to decreased wind speed, solar radiation, vapor pressure deficit (VPD), and increased relative humidity (RH). However, due to the increased VPD and decreased RH, the ETo increased significantly (p < 0.05) in spring, autumn, and annually at a rate of 2.55, 0.56, and 3.16 mm/yr during 1988–2012, respectively. The aerodynamic term was a dominant factor controlling ETo variation in both two periods. We concluded the key climatic controls on ETo have shifted as a result of global climate change during 1961–2012. The atmospheric demand, instead of air temperature alone, was a major control on ETo. Models for accurately predicting ETo and hydrological change under a changing climate must include VPD in the study region. The shifts of climatic control on the hydrological cycles should be considered in future water resource management in humid regions.*

Qiu, Y., Jiang, Y., Guo, L., Burkey, K. O., Zobel, R. W., Shew, H. D., & Hu, S. (2018). Contrasting Warming and Ozone Effects on Denitrifiers Dominate Soil N <inf>2</inf> O Emissions. *Environmental Science and Technology, 52*(19), 10956-10966. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053514273&doi=10.1021%2facs.est.8b01093&partnerID=40&md5=95f9ce8cf46d182d5ee538205a2d978c. doi:10.1021/acs.est.8b01093

Research Tags: Soil, Emissions

Abstract: *Nitrous oxide (N2O) in the atmosphere is a major greenhouse gas and reacts with volatile organic compounds to create ozone (an air pollutant) in the troposphere. Climate change factors such as warming and elevated ozone (eO3) affect N2O fluxes, but the direction and magnitude of these effects are uncertain and the underlying mechanisms remain unclear. We examined the impact of simulated warming (control + 3.6 °C) and*

eO3 (control + 45 ppb) on soil N2O fluxes in a soybean agroecosystem. Results obtained showed that warming significantly increased soil labile C, microbial biomass, and soil N mineralization, but eO3 reduced these parameters. Warming enhanced N2O-producing denitrifers (nirS- and nirK-type), corresponding to increases in both the rate and sum of N2O emissions. In contrast, eO3 significantly reduced both N2O-producing and N2O-consuming (nosZ-type) denitrifiers but had no impact on N2O emissions. Further, eO3 offsets the effects of warming on soil labile C, microbial biomass, and the population size of denitrifiers but still increased N2O emissions, indicating a direct effect of temperature on N2O emissions. Together, these findings suggest that warming may promote N2O production through increasing both the abundance and activities of N2O-producing microbes, positively feeding back to the ongoing climate change.

Quesada, T., Lucas, S., Smith, K., & Smith, J. (2019). Response to temperature and virulence assessment of Fusarium circinatum isolates in the context of climate change. *Forests, 10*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059738737&doi=10.3390%2ff10010040&partnerID=40&md5=093b550369ae2c9d40eb4c8b3afeae31. doi:10.3390/f10010040

Research Tags: Forestry

Abstract: *With future global temperatures predicted to increase, the relationship between a host, pathogen, and environment, becomes less predictable and epidemics may pose a greater risk to forests worldwide. Resistance breeding is an important disease management tool, but because tree species require long breeding times, it is necessary to develop techniques for testing current pathogen isolates against their hosts. Pitch canker disease of pines, caused by the pathogen Fusarium circinatum, is no exception and represents a threat to pine forests and commercial plantations worldwide, as it thrives at warm temperatures and high humidity. We tested growth of 15 F. circinatum isolates in culture at three temperatures: 25, 27, and 31 °C. We also evaluated the sporulation and pathogenicity of eight of the isolates on two susceptible Pinus elliotti (slash pine) open-pollinated families and one tolerant open-pollinated Pinus taeda (loblolly pine) family. Our results showed significant differences among isolates in the temperature and pathogenicity tests. All isolates showed a significant decrease in growth at 31 °C, although some showed similar growth at 25 and 27 °C. Several of the new isolates tested were more pathogenic than the isolates that the USDA Forest Service Resistance Screening Center (RSC) had been using. The new isolates have now been incorporated into their operational screening program.*

Quiroz, R., Ramírez, D. A., Kroschel, J., Andrade-Piedra, J., Barreda, C., Condori, B., . . . Perez, W. (2018). Impact of climate change on the potato crop and biodiversity in its center of origin. *Open Agriculture, 3*(1), 273-283. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053178072&doi=10.1515%2fopag-2018-0029&partnerID=40&md5=81296edd481409b8c38a7e2cd582da8f. doi:10.1515/opag-2018-0029

Research Tags: Crops

Abstract: *The Andean region is the most important center of potato diversity in the world. The global warming trend which has taken place since the 1950s, that is 2-3 times the reported global warming and the continuous presence of extreme events makes this region a live laboratory to study the impact of climate change. In this review, we first present the current knowledge on climate change in the Andes, as compared to changes in other mountain areas, and the globe in general. Then, the review describes the ecophysiological strategies to cope and adapt to changes in atmospheric CO2 levels, temperature and soil water availability. As climate change also has a significant effect on the magnitude and frequency of the incidence of pests and diseases, the current knowledge of the dynamics of vectors in the Andean region is discussed. The use of modeling techniques to describe changes in the range expansion and number of insect pest generations per year as affected by increases in temperature is also presented. Finally, the review deals with the use of crop modeling to analyze the likely impact of projected climate scenarios on potato yield and tuber initiation.*

Radtke, P., Walker, D., Frank, J., Weiskittel, A., DeYoung, C., MacFarlane, D., . . . Westfall, J. (2017). Improved accuracy of aboveground biomass and carbon estimates for live trees in forests of the eastern United States. *Forestry, 90*(1), 32-46. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016087553&doi=10.1093%2fforestry%2fcpw047&partnerID=40&md5=c39436ac5efe29513d5680b1661bb3ce. doi:10.1093/forestry/cpw047

Research Tags: Forestry

Abstract: *Accurate estimation of forest biomass and carbon stocks at regional to national scales is a key requirement in determining terrestrial carbon sources and sinks on United States (US) forest lands. To that end, comprehensive assessment and testing of alternative volume and biomass models were conducted for individual tree models employed in the component ratio method (CRM) currently used in the US' National Greenhouse Gas Inventory. The CRM applies species-specific stem volume equations along with specific gravity conversions and component expansion factors to ensure consistency between predicted stem volumes and weights, and additivity of predicted live tree component weights to match aboveground biomass (AGB). Data from over 76 600 stem volumes and 6600 AGB observations were compiled from individual studies conducted in the past 115 years – what we refer to as legacy data – to perform the assessment. Scenarios formulated to incrementally replace constituent equations in the CRM with models fitted to legacy data were tested using cross-validation methods, and estimates of AGB were scaled using forest inventory data to compare across 33 states in the eastern US. Modifications all indicated that the CRM in its present formulation underestimates AGB in eastern forests, with the range of underestimation ranging from 6.2 to 17 per cent. Cross-validation results indicated the greatest reductions in estimation bias and root-mean squared error could be achieved by scenarios that replaced stem volume, sapling AGB, and component ratio equations in the CRM. A change in the definitions used in apportioning biomass to aboveground components was also shown to increase prediction accuracy. Adopting modifications tested here would increase AGB estimates for the eastern US by 15 per cent, accounting for 1.5 Pg of C currently unaccounted for in live tree aboveground forest C stock assessments. Expansion of the legacy data set currently underway should be useful for further testing, such as whether similar gains in accuracy can be achieved in estimates of regional or national-scale C sequestration rates.*

Rains, M. T. (2017). A forest service vision during the anthropocene. *Forests, 8*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016072534&doi=10.3390%2ff8030094&partnerID=40&md5=02ff5a55d717df76e876fb48ed713f49. doi:10.3390/f8030094

Research Tags: Forestry

Abstract: *During the history of the Forest Service, human activity has been the dominant influence on climate and the environment; the time being called the Anthropocene. As we look ahead and strive to continue our mission of sustaining the health, diversity, and productivity of the Nation's forests and grasslands to meet our current and future needs, we must be more flexible to focus our actions to better meet the contemporary conservation challenges now and ahead. During this era of intense human activity, a changing climate; development and loss of open space; resource consumption; destructive invasive species; and diversity in core beliefs and values will test our task relevant maturity—ability and willingness to meet the growing demands for services. The Forest Service is now on a transformative campaign to improve our abilities and meet these challenges, including forest resiliency through restorative actions. There are several things we must do to ensure we are brilliantly competitive to address the contemporary conservation needs along a complex rural to urban land gradient, now and ahead. The intent of this paper is to present one person's view of what this "campaign of our campaign" should include.*

Ralston, J., DeLuca, W. V., Feldman, R. E., & King, D. I. (2017). Population trends influence species ability to track climate change. *Global Change Biology, 23*(4), 1390-1399. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014740173&doi=10.1111%2fgcb.13478&partnerID=40&md5=91f1cb7b375aec23d611456b03146a42. doi:10.1111/gcb.13478

Research Tags: Wildlife

Abstract: *Shifts of distributions have been attributed to species tracking their fundamental climate niches through space. However, several studies have now demonstrated that niche tracking is imperfect, that species' climate niches may vary with population trends, and that geographic distributions may lag behind rapid climate change. These reports of imperfect niche tracking imply shifts in species' realized climate niches. We argue that quantifying climate niche shifts and analyzing them for a suite of species reveal general patterns of niche shifts and the factors affecting species' ability to track climate change. We analyzed changes in realized climate niche between 1984 and 2012 for 46 species of North American birds in relation to population trends in an effort to determine whether species differ in the ability to track climate change and whether differences in niche tracking are related to population trends. We found that increasingly abundant species tended to show* *greater levels of niche expansion (climate space occupied in 2012 but not in 1980) compared to declining species. Declining species had significantly greater niche unfilling (climate space occupied in 1980 but not in 2012) compared to increasing species due to an inability to colonize new sites beyond their range peripheries after climate had changed at sites of occurrence. Increasing species, conversely, were better able to colonize new sites and therefore showed very little niche unfilling. Our results indicate that species with increasing trends are better able to geographically track climate change compared to declining species, which exhibited lags relative to changes in climate. These findings have important implications for understanding past changes in distribution, as well as modeling dynamic species distributions in the face of climate change.*

Ramírez, P. B., Calderón, F. J., Fonte, S. J., & Bonilla, C. A. (2019). Environmental controls and long-term changes on carbon stocks under agricultural lands. *Soil and Tillage Research, 186*, 310-321. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056650448&doi=10.1016%2fj.still.2018.10.018&partnerID=40&md5=de4274d933dd626c24d4ad1661984d34. doi:10.1016/j.still.2018.10.018

Research Tags: Crops, Soil

Abstract: *Improved understanding of changes in soil organic carbon (SOC) stocks is critical for developing strategies that ensure effective climate change mitigation and the long-term productivity. Changes in SOC are likely to vary across soil and climate conditions, yet long-term data to elucidate these trends across different ecosystems remains limited. In this study we evaluated long-term changes in SOC across a gradient of climate conditions (from arid to hyper humid), soil orders, and land uses (non- cultivated, woody perennial, and cultivated) in central Chile. Thus, we sought to find evidence for SOC changes in the agricultural lands over past three or four decades. Surface soils (8–29 cm depth) were sampled between 2014 and 2016 and analyzed for total C and N content, aggregate stability, texture, bulk density, pH as well as spectral properties using Mid-infrared (MidIR) and Near-infrared spectroscopy. SOC stocks were compared to those previously measured at the same sites between 1968 and 1994, covering a wide range of SOC values (from 12 Mg C ha−1 to 128 Mg C ha−1). Our findings show that the largest SOC losses occurred in semiarid and subhumid areas for the time frame considered, decreasing from their initial C stocks by 24.7% and 26.1%, respectively. Moreover, cultivated soils in semiarid regions were more vulnerable than those in arid regions to SOC losses. The results also indicated that in cooler and humid regions, SOC stocks were stable or increased over time. Among soil orders, Mollisols showed the largest losses (29.9% reduction between sampling dates). The MidIR results indicate that the mineral bands for clays and silicates were associated with these sites demonstrating SOC conservation, suggesting that mineral protection played an important role in the long-term SOC storage in semiarid areas. This study provides a better understanding of temporal changes of SOC to address the restoration of degraded land and adaptation for future trends in global change.*

Ramlow, M., Foster, E. J., Del Grosso, S. J., & Cotrufo, M. F. (2019). Broadcast woody biochar provides limited benefits to deficit irrigation maize in Colorado. *Agriculture, Ecosystems and Environment, 269*, 71-81. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054030809&doi=10.1016%2fj.agee.2018.09.017&partnerID=40&md5=4ea1afdaeab1515918d20e85af7a0d0d. doi:10.1016/j.agee.2018.09.017

Research Tags: Soil, Crops, Water

Abstract: *Biochar soil amendments have been widely promoted for their ability to improve soil fertility in degraded tropical soils, and irrigation and fertilizer use efficiency in fertile temperate agricultural systems. Here, we evaluate if a woody biochar can produce both agronomic and environmental benefits in deficit irrigation systems by ameliorating water stress, improving crop N uptake and mitigating greenhouse gas emissions. To evaluate these responses, we established a maize field trial in northern Colorado under deficit irrigation treatments with a woody biochar amendment. Irrigation treatments included recommended irrigation (Full), recommended irrigation except during non-essential growth phases (Limited) and 50% of recommended irrigation (Drought). We measured crop biomass, grain yield, grain N uptake, mineral N availability, soil water content, soil field capacity, soil C sequestration and N2O emissions. Drought treatments reduced both grain and biomass yield while Limited irrigation showed no significant yield reduction relative to Full irrigation. Biochar amendments did not provide any yield improvements. Biochar also did not alter mineral N availability within the soil profile or grain N uptake. Biochar amendments increased gravimetric soil water content by 9.7% over the field season and increased water retention by 7.4%. However, these increases failed to alleviate the water stress coefficient, an index of how much the water content has dropped below the maximum soil water*

depletion acceptable between irrigation applications, which was correlated with yield. Biochar sequestered C primarily as coarse biochar particles with significant losses, likely a result of erosion. Across irrigation treatments biochar treatments trended towards a lower mean cumulative N2O emissions over the growing season, but such effect was not significant due to high spatial variability in N2O fluxes. Both biochar amendments and Limited irrigation treatments did not significantly impact yield-scaled cumulative N2O emissions or irrigation water-use efficiency. This research highlights the importance of targeting the deficit irrigation treatment timing and amount to maximize biochar's improved water retention in order to reduce crop water stress. It also confirms the diminished biochar N2O emission reductions in the field relative to most lab incubations due to drier field conditions and crop N uptake.

Ramlow, M., Rhoades, C. C., & Cotrufo, M. F. (2018). Promoting revegetation and soil carbon sequestration on decommissioned forest roads in Colorado, USA: A comparative assessment of organic soil amendments. *Forest Ecology and Management, 427*, 230-241. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048527843&doi=10.1016%2fj.foreco.2018.05.059&partnerID=40&md5=24fe475463bccef7c21fb9ff70a78aa0. doi:10.1016/j.foreco.2018.05.059

Research Tags: Soil

Abstract: *Forest roads are commonly decommissioned and revegetated to decrease erosion, prevent weed encroachment, manage recreation and improve overall watershed condition on federal lands, but may also provide a complementary opportunity to sequester carbon (C) in soils. Soils on decommissioned roads are typically compacted with limited capacity for water retention, decreased mineral nitrogen (N) availability and low organic matter content, impairing revegetation and soil C sequestration efforts. We evaluated the effects of an organic fertilizer, wood strand mulch and a woody biochar on soil physical, chemical and biological processes to improve revegetation and C sequestration on decompacted forest roads. We monitored plant and soil responses to the treatments and their combinations over three growing seasons on four decommissioned road segments in northern Colorado. The organic fertilizer increased plant available mineral N for the first year of the study and resulted in a 21% increase in total plant cover and 67% increase in root biomass. The wood strand mulch increased total plant cover and root biomass to a similar extent, but had no effect on soil water content or mineral N availability. Instead, mulch stimulated soil microbial respiration and increased soil C content, two of the best predictors of plant cover and biomass. The woody biochar increased soil water content by 26% and elevated mineral N availability throughout the study, but did not improve plant cover, above- or belowground biomass. Mulch, biochar and their combined treatments sequestered C, but through distinct pathways. Microbial processing of wood strand mulch added C to the mineral soil fraction, whereas biochar added C directly to the coarse particulate fraction with no effect on mineral soil C or soil respiration. Restoration practitioners can utilize these results to inform management decisions and guide further research on different rates and combinations of organic amendments to revegetate and sequester C on decommissioned forest roads.*

Ramsey, M. M., Muñoz-Erickson, T. A., Mélendez-Ackerman, E., Nytch, C. J., Branoff, B. L., & Carrasquillo-Medrano, D. (2019). Overcoming barriers to knowledge integration for urban resilience: A knowledge systems analysis of two-flood prone communities in San Juan, Puerto Rico. *Environmental Science and Policy, 99*, 48-57. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066267807&doi=10.1016%2fj.envsci.2019.04.013&partnerID=40&md5=5d49496e11bc6af659c26bd8fb4b80d4. doi:10.1016/j.envsci.2019.04.013

Research Tags: Research

Abstract: *Despite increasing attention to the role that multiple sets of knowledge, including citizen-based knowledge, have in developing more resilient and sustainable pathways for flood management, informal knowledge systems have yet to gain legitimacy and be integrated into formal planning and decision-making process. Here we show that a knowledge systems lens can bring to the fore the prospects and barriers to align different knowledge systems for urban resilience. Focusing on two communities in San Juan, Puerto Rico, we use knowledge systems analysis to identify, analyze, and compare the elements and functions of formal and citizen knowledge systems coming to bear on urban flood management. We found key aspects of these knowledge systems that deserve attention to overcome integration barriers, including different frames about how stormwater and riverine flood systems work, a fragmented and unclear formal knowledge system for* *stormwater management, and a focus on short-term approaches that limit anticipatory capacities in both community and governance. We discuss how citizen knowledge systems have a more nuanced and granular understanding of riverine and stormwater flood dynamics and the opportunities that exist to integrate knowledge systems through co-production, citizen science, and other governance interventions. As officials and citizens continue to learn from experiences with extreme events like Hurricane María, a goal of knowledge integration interventions should be the transformation of our knowledge infrastructures to build climate resilience in more just and sustainable ways.*

Randolph, P., Bansode, R. R., Hassan, O. A., Rehrah, D., Ravella, R., Reddy, M. R., . . . Ahmedna, M. (2017). Effect of biochars produced from solid organic municipal waste on soil quality parameters. *Journal of Environmental Management, 192*, 271-280. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011660582&doi=10.1016%2fj.jenvman.2017.01.061&partnerID=40&md5=c31eda6ad88e9f12c9b323f851dd7c32. doi:10.1016/j.jenvman.2017.01.061

Research Tags: Soil

Abstract: *New value-added uses for solid municipal waste are needed for environmental and economic sustainability. Fortunately, value-added biochars can be produced from mixed solid waste, thereby addressing solid waste management issues, and enabling long-term carbon sequestration. We hypothesize that soil deficiencies can be remedied by the application of municipal waste-based biochars. Select municipal organic wastes (newspaper, cardboard, woodchips and landscaping residues) individually or in a 25% blend of all four waste streams were used as feedstocks of biochars. Three sets of pyrolysis temperatures (350, 500, and 750 °C) and 3 sets of pyrolysis residence time (2, 4 and 6 h) were used for biochar preparation.*

The biochar yield was in the range of 21–62% across all feedstocks and pyrolysis conditions. We observed variations in key biochar properties such as pH, electrical conductivity, bulk density and surface area depending on the feedstocks and production conditions. Biochar increased soil pH and improved its electrical conductivity, aggregate stability, water retention and micronutrient contents. Similarly, leachate from the soil amended with biochar showed increased pH and electrical conductivity. Some elements such as Ca and Mg decreased while NO3-N increased in the leachates of soils incubated with biochars. Overall, solid waste-based biochar produced significant improvements to soil fertility parameters indicating that solid municipal wastes hold promising potential as feedstocks for manufacturing value-added biochars with varied physicochemical characteristics, allowing them to not only serve the needs for solid waste management and greenhouse gas mitigation, but also as a resource for improving the quality of depleted soils.

Rappaport, D. I., Morton, D. C., Longo, M., Keller, M., Dubayah, R., & Dos-Santos, M. N. (2018). Quantifying long-term changes in carbon stocks and forest structure from Amazon forest degradation. *Environmental Research Letters, 13*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047826863&doi=10.1088%2f1748-9326%2faac331&partnerID=40&md5=d29824be79ba522ec909a7a5bf2a239c. doi:10.1088/1748-9326/aac331

Research Tags: Forestry

Abstract: *Despite sustained declines in Amazon deforestation, forest degradation from logging and fire continues to threaten carbon stocks, habitat, and biodiversity in frontier forests along the Amazon arc of deforestation. Limited data on the magnitude of carbon losses and rates of carbon recovery following forest degradation have hindered carbon accounting efforts and contributed to incomplete national reporting to reduce emissions from deforestation and forest degradation (REDD+). We combined annual time series of Landsat imagery and high-density airborne lidar data to characterize the variability, magnitude, and persistence of Amazon forest degradation impacts on aboveground carbon density (ACD) and canopy structure. On average, degraded forests contained 45.1% of the carbon stocks in intact forests, and differences persisted even after 15 years of regrowth. In comparison to logging, understory fires resulted in the largest and longest-lasting differences in ACD. Heterogeneity in burned forest structure varied by fire severity and frequency. Forests with a history of one, two, and three or more fires retained only 54.4%, 25.2%, and 7.6% of intact ACD, respectively, when measured after a year of regrowth. Unlike the additive impact of successive fires, selective logging before burning did not explain additional variability in modeled ACD loss and recovery of burned forests. Airborne lidar also provides quantitative measures of habitat structure that can aid the estimation of co-benefits of avoided degradation. Notably, forest carbon stocks recovered faster than attributes* *of canopy structure that are critical for biodiversity in tropical forests, including the abundance of tall trees. We provide the first comprehensive look-up table of emissions factors for specific degradation pathways at standard reporting intervals in the Amazon. Estimated carbon loss and recovery trajectories provide an important foundation for assessing the long-term contributions from forest degradation to regional carbon cycling and advance our understanding of the current state of frontier forests.*

Rastogi, B., Berkelhammer, M., Wharton, S., Whelan, M. E., Meinzer, F. C., Noone, D., & Still, C. J. (2018). Ecosystem fluxes of carbonyl sulfide in an old-growth forest: Temporal dynamics and responses to diffuse radiation and heat waves. *Biogeosciences, 15*(23), 7127-7139. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057586913&doi=10.5194%2fbg-15-7127-2018&partnerID=40&md5=5e43bd36be1316f61a01808d4c2b3cba. doi:10.5194/bg-15-7127-2018

Research Tags: Forestry

Abstract: *Carbonyl sulfide (OCS) has recently emerged as a tracer for terrestrial carbon uptake. While physiological studies relating OCS fluxes to leaf stomatal dynamics have been established at leaf and branch scales and incorporated into global carbon cycle models, the quantity of data from ecosystem-scale field studies remains limited. In this study, we employ established theoretical relationships to infer ecosystem-scale plant OCS uptake from mixing ratio measurements. OCS fluxes showed a pronounced diurnal cycle, with maximum uptake at midday. OCS uptake was found to scale with independent measurements of CO_2 fluxes over a 60 m tall old-growth forest in the Pacific Northwest of the US (45∘49'13.76'' N, 121∘57'06.88'' W) at daily and monthly timescales under mid–high light conditions across the growing season in 2015. OCS fluxes were strongly influenced by the fraction of downwelling diffuse light. Finally, we examine the effect of sequential heat waves on fluxes of OCS, CO_2, and H_2O. Our results bolster previous evidence that ecosystem OCS uptake is strongly related to stomatal dynamics, and measuring this gas improves constraints on estimating photosynthetic rates at the ecosystem scale.*

Rathburn, S. L., Bennett, G. L., Wohl, E. E., Briles, C., McElroy, B., & Sutfin, N. (2017). The fate of sediment, wood, and organic carbon eroded during an extreme flood, Colorado Front Range, USA. *Geology, 45*(6), 499-502. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019230076&doi=10.1130%2fG38935.1&partnerID=40&md5=ffa9dcb1fb9c16754f0d819ffb707d0e. doi:10.1130/G38935.1

Research Tags: Soil, Weather

Abstract: *Identifying and quantifying the dominant processes of erosion and tracking the fate of sediment, wood, and carbon eroded during floods is important for understanding channel response to floods, downstream sediment and carbon loading, and the influence of extreme events on landscapes and the terrestrial carbon cycle. We quantify sediment, wood, and organic carbon (OC) from source to local sink following an extreme flood in the tectonically quiescent, semiarid Colorado (USA) Front Range. Erosion of >500,000 m3 or as much as ~115 yr of weathering products occurred through landsliding and channel erosion during September 2013 flooding. More than half of the eroded sediment was deposited at the inlet and delta of a water supply reservoir, resulting in the equivalent of 100 yr of reservoir sedimentation and 2% loss in water storage capacity. The flood discharged 28 Mg C/km2, producing an event OC flux equivalent to humid, tectonically active areas. Post-flood remobilization resulted in a further ~100 yr of reservoir sedimentation plus export of an additional 1.3 Mg C/km2 of wood, demonstrating the ongoing impact of the flood on reservoir capacity and carbon cycling. Pronounced channel widening during the flood created accommodation space for 40% of flood sediment and storage of wood and eroded carbon. We conclude that confined channels, normally dismissed as transport reaches, can store and export substantial amounts of flood constituents.*

Ravelombola, W., Shi, A., Weng, Y., Mou, B., Motes, D., Clark, J., . . . Sugihara, Y. (2018). Association analysis of salt tolerance in cowpea (Vigna unguiculata (L.) Walp) at germination and seedling stages. *Theoretical and Applied Genetics, 131*(1), 79-91. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029819630&doi=10.1007%2fs00122-017-2987-0&partnerID=40&md5=90907364b89954ba76a5af2a00e63915. doi:10.1007/s00122-017-2987-0

Research Tags: Crops

Abstract: *Abstract*

Cowpea (Vigna unguiculata (L.) Walp) is one of the most important cultivated legumes in Africa. The worldwide annual production in cowpea dry seed is 5.4 million metric tons. However, cowpea is unfavorably affected by salinity stress at germination and seedling stages, which is exacerbated by the effects of climate change. The lack of knowledge on the genetic underlying salt tolerance in cowpea limits the establishment of a breeding strategy for developing salt-tolerant cowpea cultivars. The objectives of this study were to conduct association mapping for salt tolerance at germination and seedling stages and to identify SNP markers associated with salt tolerance in cowpea. We analyzed the salt tolerance index of 116 and 155 cowpea accessions at germination and seedling stages, respectively. A total of 1049 SNPs postulated from genotyping-by-sequencing were used for association analysis. Population structure was inferred using Structure 2.3.4; K optimal was determined using Structure Harvester. TASSEL 5, GAPIT, and FarmCPU involving three models such as single marker regression, general linear model, and mixed linear model were used for the association study. Substantial variation in salt tolerance index for germination rate, plant height reduction, fresh and dry shoot biomass reduction, foliar leaf injury, and inhibition of the first trifoliate leaf was observed. The cowpea accessions were structured into two subpopulations. Three SNPs, Scaffold87490_622, Scaffold87490_630, and C35017374_128 were highly associated with salt tolerance at germination stage. Seven SNPs, Scaffold93827_270, Scaffold68489_600, Scaffold87490_633, Scaffold87490_640, Scaffold82042_3387, C35069468_1916, and Scaffold93942_1089 were found to be associated with salt tolerance at seedling stage. The SNP markers were consistent across the three models and could be used as a tool to select salt-tolerant lines for breeding improved cowpea tolerance to salinity.

Ray, C., Cluck, D. R., Wilkerson, R. L., Siegel, R. B., White, A. M., Tarbill, G. L., . . . Howell, C. A. (2019). Patterns of woodboring beetle activity following fires and bark beetle outbreaks in montane forests of California, USA. *Fire Ecology, 15*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068805632&doi=10.1186%2fs42408-019-0040-1&partnerID=40&md5=b43a42135f3f7d63e82b29af51211cd5. doi:10.1186/s42408-019-0040-1

Research Tags: Forestry, Wildlife, Weather

Abstract: *Background*

Increasingly frequent and severe drought in the western United States has contributed to more frequent and severe wildfires, longer fire seasons, and more frequent bark beetle outbreaks that kill large numbers of trees. Climate change is expected to perpetuate these trends, especially in montane ecosystems, calling for improved strategies for managing Western forests and conserving the wildlife that they support. Woodboring beetles (e.g., Buprestidae and Cerambycidae) colonize dead and weakened trees and speed succession of habitats altered by fire or bark beetles, while serving as prey for some early-seral habitat specialists, including several woodpecker species. To understand how these ecologically important beetles respond to different sources of tree mortality, we sampled woodborers in 16 sites affected by wildfire or bark beetle outbreak in the previous one to eight years. Study sites were located in the Sierra Nevada, Modoc Plateau, Warner Mountains, and southern Cascades of California, USA. We used generalized linear mixed models to evaluate hypotheses concerning the response of woodboring beetles to disturbance type, severity, and timing; forest stand composition and structure; and tree characteristics.

Results

Woodborer activity was often similar in burned and bark beetle outbreak sites, tempered by localized responses to bark beetle activity, burn severity, tree characteristics, and apparent response to ignition date. Larval woodborer activity was inversely related to bark beetle sign within a sampling quadrat, was higher on pines, and—in burned sites—was higher on the south-facing sides of smaller trees. Adults—especially buprestids—were more abundant where burn severity was higher. Fires with intermediate ignition dates during the study period supported higher rates of larval woodborer activity and higher numbers of adult buprestids as well as cerambycids in the genus Monochamus Dejean 1821.

Conclusions

Woodboring beetle abundance was related to bark beetle activity, burn severity, tree characteristics, and ignition date. Considering these patterns when managing disturbed forest stands could yield improved outcomes for wildlife, including species that prey on woodboring beetles. We also reported preliminary evidence that the current trend toward more frequent wildfires might not stimulate larger woodboring beetle populations if those fires increasingly occur outside the historical fire season.

Raymundo, R., Asseng, S., Prassad, R., Kleinwechter, U., Concha, J., Condori, B., . . . Porter, C. (2017). Performance of the SUBSTOR-potato model across contrasting growing conditions. *Field Crops Research, 202*, 57-76. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84964643216&doi=10.1016%2fj.fcr.2016.04.012&partnerID=40&md5=8dd31c4bb6e5cf9f12cb4e1497eb4488. doi:10.1016/j.fcr.2016.04.012

Research Tags: Crops, Research

Abstract: *Crop models are essential tools in climate change impact assessments, but they often lack comprehensive field testing. In this study, we tested the SUBSTOR-potato model with 87 field experiments, including 204 treatments from 19 countries. The field experiments varied in potato species and cultivars, N fertilizer application, water supply, sowing dates, soil types, temperature environments, and atmospheric CO2 concentrations, and included open top chamber and Free-Air-CO2-Enrichment (FACE) experiments. Tuber yields were generally well simulated with the SUBSTOR-potato model across a wide range of current growing conditions and for diverse potato species and cultivars, including Solanum tuberosum, Solanum andigenum, Solanum juzepczukii species, as well as modern, traditional, early, medium, and late maturity-type cultivars, with a relative RMSE of 37.2% for tuber dry weight and 21.4% for tuber fresh weight. Cultivars 'Desiree' and 'Atlantic' were grown in experiments across the globe and well simulated using consistent cultivar parameters. However, the model underestimated the impact of elevated atmospheric CO2 concentrations and poorly simulated high temperature effects on crop growth. Other simulated crop variables, including leaf area, stem weight, crop N, and soil water, differed frequently from measurements; some of these variables had significant large measurement errors. The SUBSTOR-potato model was shown to be suitable to simulate tuber growth and yields over a wide range of current growing conditions and crop management practices across many geographic regions. However, before the model can be used effectively in climate change impact assessments, it requires improved model routines to capture the impacts of elevated atmospheric CO2 and high temperatures on crop growth.*

Reeves, M. C., Bagne, K. E., & Tanaka, J. (2017). Potential Climate Change Impacts on Four Biophysical Indicators of Cattle Production from Western US Rangelands. *Rangeland Ecology and Management, 70*(5), 529-539. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028412500&doi=10.1016%2fj.rama.2017.02.005&partnerID=40&md5=6f7b8930fadb4ca58c1a1ac2861235b5. doi:10.1016/j.rama.2017.02.005

Research Tags: Livestock

Abstract: *We examined multiple environmental factors related to climate change that affect cattle production on rangelands to identify sources of vulnerability among seven regions of the western United States. Climate change effects were projected to 2100 using published spatially explicit model output for four indicators of vulnerability: forage quantity, vegetation type trajectory, heat stress, and interannual forage variability. Departure of projections from the baseline (2001–2010) was used to estimate vulnerability of present-day cattle operations. The analysis indicated 1) an increase in forage quantity in northern regions; 2) a move from woody dominance toward grassier vegetation types overall but with considerable spatial heterogeneity; 3) a substantial increase in the number of heat-stress days across all regions beginning as early as 2020–2030; and 4) higher interannual variability of forage quantity for most regions. All four factors evaluated in tandem suggest declining production in southern and western regions. In northern and interior regions, the benefits of increased net primary productivity or increasing abundance of herbaceous vegetation are mostly tempered by increases in heat stress and forage variability. Multiple indicators point toward increasing vulnerability of cattle production in southwestern regions providing strong support for the need for adaptation measures and suggest significant change to the industry. Opposing indicators in northern regions point toward the need for cattle operations to increase flexibility to take advantage of periods of favorable production while preparing for uncertainty, variability, and increasing stress from individual factors.*

Reeves, M. C., Manning, M. E., DiBenedetto, J. P., Palmquist, K. A., Lauenroth, W. K., Bradford, J. B., & Schlaepfer, D. R. (2018) Effects of Climate Change on Rangeland Vegetation in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 97-114).

Research Tags: Grassland

Abstract: *A longer growing season with climate change is expected to increase net primary productivity of many rangeland types, especially those dominated by grasses, although responses will depend on local climate and soil conditions. Elevated atmospheric carbon dioxide may increase water use efficiency and productivity of some species. In many cases, increasing wildfire frequency and extent will be damaging for big sagebrush and other shrub species that are readily killed by fire. The widespread occurrence of cheatgrass and other nonnatives facilitates frequent fire through annual fuel accumulation. Shrub species that sprout following fire may be quite resilient to increased disturbance, but may be outcompeted by more drought tolerant species over time.*
Adaptation strategies for rangeland vegetation focus on increasing resilience of rangeland ecosystems, primarily through non-native species control and prevention. Ecologically based non-native plant management focuses on strategies to repair damaged ecological processes that facilitate invasion, and seeding of desired natives can be done where seed availability and dispersal of natives are low. Proactive management to prevent establishment of non-native species is also critical (early detection-rapid response), including tactics such as weed-free policies, education of employees and the public, and collaboration among multiple agencies to control weeds. Livestock grazing can also be managed through the development of site-specific indicators that inform livestock movement guides and allow for maintenance and enhancement of plant health.

Refatti, J. P., de Avila, L. A., Camargo, E. R., Ziska, L. H., Oliveira, C., Salas-Perez, R., . . . Roma-Burgos, N. (2019). High [CO<inf>2</inf>] and temperature increase resistance to cyhalofop-butyl in multiple-resistant echinochloa colona. *Frontiers in Plant Science, 10*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067353636&doi=10.3389%2ffpls.2019.00529&partnerID=40&md5=5a79ca3e7a08003776f4a6b1e9dc257b. doi:10.3389/fpls.2019.00529
Research Tags: Crops
Abstract: *Changes in the environment, specifically rising temperature and increasing atmospheric carbon dioxide concentration [CO2], can alter the growth and physiology of weedy plants. These changes could alter herbicide efficacy, crop-weed interaction, and weed management. The objectives of this research were to quantify the effects of increased atmospheric [CO2] and temperature on absorption, translocation and efficacy of cyhalofop-butyl on multiple-resistant (MR) and susceptible (S) Echinochloa colona genotypes. E. colona, or junglerice, is a troublesome weed in rice and in agronomic and horticultural crops worldwide. Cyhalofop-butyl is a grass herbicide that selectively controls Echinochloa spp. in rice. Maximum 14C-cyhalofop-butyl absorption occurred at 120 h after herbicide treatment (HAT) with >97% of cyhalofop-butyl retained in the treated leaf regardless of [CO2], temperature, or genotype. Neither temperature nor [CO2] affected herbicide absorption into the leaf. The translocation of herbicide was slightly reduced in the MR plants vs. S plants either under elevated [CO2] or high temperature. Although plants grown under high [CO2] or high temperature were taller than those in ambient conditions, neither high [CO2] nor high temperature reduced the herbicide efficacy on susceptible plants. However, herbicide efficacy was reduced on MR plants grown under high [CO2] or high temperature about 50% compared to MR plants at ambient conditions. High [CO2] and high temperature increased the resistance level of MR E. colona to cyhalofop-butyl. To mitigate rapid resistance evolution under a changing climate, weed management practitioners must implement measures to reduce the herbicide selection pressure. These measures include reduction of weed population size through reduction of the soil seedbank, ensuring complete control of current infestations with multiple herbicide modes of action in mixture and in sequence, augmenting herbicides with mechanical control where possible, rotation with weed-competitive crops, use of weed-competitive cultivars, use of weed-suppressive cover crops, and other practices recommended for integrated weed management.*

Rehkamp, S., & Canning, P. (2018). Measuring Embodied Blue Water in American Diets: An EIO Supply Chain Approach. *Ecological Economics, 147*, 179-188. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044465629&doi=10.1016%2fj.ecolecon.2017.12.028&partnerID=40&md5=1728452bff76d856c98fb592edf30198. doi:10.1016/j.ecolecon.2017.12.028
Research Tags: Water
Abstract: *Food systems worldwide rely on water resources that are facing demand from a growing population while regional water supplies are increasingly uncertain due to climate change. In this environment, dietary changes may have the potential to reduce water used in food production. At the same time, it is well*

established that American diets need to change in order to align with Federal healthy eating guidelines. In this article, we examine if there are synergies between healthier diets and blue water conservation in the U.S. food system. We estimate blue water use by supply chain stage using a multi-regional environmental input-output model. Then, we link this blue water to individual food items and use mathematical optimization to model healthy diet scenarios that meet the Dietary Guidelines for Americans. We find that while healthier U.S. diet outcomes and blue water conservation can be synergistic, these goals may also be competing. Making minimal changes from current American consumption to a healthy omnivore or vegetarian diet, blue water use increases by 16%, but the omnivore and vegetarian diets reduce embodied blue water by 63 and 66%, respectively, when the objective is to minimize water use.

Reichle, R. H., de Lannoy, G. J. M., Liu, Q., Koster, R. D., Kimball, J. S., Crow, W. T., . . . Smith, E. B. (2017). Global assessment of the SMAP Level-4 surface and root-zone soil moisture product using assimilation diagnostics. *Journal of Hydrometeorology, 18*(12), 3217-3237. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034763018&doi=10.1175%2fJHM-D-17-0130.1&partnerID=40&md5=c74c00d96e53aec5a7b8425a47772cdf. doi:10.1175/JHM-D-17-0130.1

Research Tags: Research, Soil

Abstract: *The Soil Moisture Active Passive (SMAP) mission Level-4 Soil Moisture (L4_SM) product provides 3-hourly, 9-km resolution, global estimates of surface (0–5 cm) and root-zone (0–100 cm) soil moisture and related land surface variables from 31 March 2015 to present with ~2.5-day latency. The ensemble-based L4_SM algorithm assimilates SMAP brightness temperature (Tb) observations into the Catchment land surface model. This study describes the spatially distributed L4_SM analysis and assesses the observation-minus-forecast (O − F) Tb residuals and the soil moisture and temperature analysis increments. Owing to the climatological rescaling of the Tb observations prior to assimilation, the analysis is essentially unbiased, with global mean values of ~0.37 K for the O − F Tb residuals and practically zero for the soil moisture and temperature increments. There are, however, modest regional (absolute) biases in the O − F residuals (under ~3 K), the soil moisture increments (under ~0.01 m3 m−3), and the surface soil temperature increments (under ~1 K). Typical instantaneous values are ~6 K for O − F residuals, ~0.01 (~0.003) m3 m−3 for surface (root zone) soil moisture increments, and ~0.6 K for surface soil temperature increments. The O − F diagnostics indicate that the actual errors in the system are overestimated in deserts and densely vegetated regions and underestimated in agricultural regions and transition zones between dry and wet climates. The O − F autocorrelations suggest that the SMAP observations are used efficiently in western North America, the Sahel, and Australia, but not in many forested regions and the high northern latitudes. A case study in Australia demonstrates that assimilating SMAP observations successfully corrects short-term errors in the L4_SM rainfall forcing.*

Reichmann, L. G., Collins, H. P., Jin, V. L., Johnson, M. V. V., Kiniry, J. R., Mitchell, R. B., . . . Fay, P. A. (2018). Inter-Annual Precipitation Variability Decreases Switchgrass Productivity from Arid to Mesic Environments. *Bioenergy Research, 11*(3), 614-622. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048659921&doi=10.1007%2fs12155-018-9922-3&partnerID=40&md5=85c72096427d43ff94216fb077e73157. doi:10.1007/s12155-018-9922-3

Research Tags: Energy, Weather, Crops

Abstract: *Cellulosic biofuels are an important source of renewable biomass within the alternative energy portfolio. Switchgrass (Panicum virgatum L.), a perennial C4 grass native to North America, is widely studied as a biofuel feedstock for its consistently high yields and minimal input requirements. The influences of precipitation amount and temporal variability on the fertilizer response of switchgrass productivity are not fully understood. Moreover, global climate models predict changes in rainfall patterns towards lower and increasingly variable soil water availability in several productive areas worldwide, which may impact net primary production of biofuel crops. We conducted a meta-analysis of aboveground net primary production of switchgrass from 48 publications encompassing 82 different locations, 11 soil types, 52 switchgrass cultivars, fertilizer inputs between 0 to 896 kg N ha−1 year−1, and 1 to 6 years of annual productivity measures repeated on the same stand. Productivity of the lowland ecotype doubled with N rates > 131 kg N ha−1 year−1, but upland ecotype productivity increased only by 50%. Results showed an optimum N rate of 30 to 60 kg N ha−1 year−1 for both ecotypes, after which biomass gain per unit of N added decreased. Growing season* *precipitation (GSPPT) and inter-annual precipitation variability (inter-PPTvar) affected both ecotypes similarly. Long-term mean annual precipitation (MAP) differentially affected lowland and upland productivity, depending on the N level. Productivity responses to MAP and GSPPT were similar for both upland and lowland ecotypes at none or low N rates. When N increased beyond 60 kg N ha−1 year−1, lowland cultivars had a greater growth response to MAP than uplands. Productivity increased with increasing GSPPT and MAP and had a positive linear response to MAP ranging from 600 to 1200 mm year−1. One third of the variability in switchgrass production was accounted for by inter-PPTvar. After accounting for MAP, sites with higher inter-PPTvar had lower switchgrass productivity than sites with lower inter-PPTvar. Increased inter-annual variation in precipitation reduced production of both ecotypes. Predicted changes in the amount and timing of precipitation thus likely will exert greater influence on production of upland than lowland ecotypes of switchgrass.*

Reinmann, A. B., Susser, J. R., Demaria, E. M. C., & Templer, P. H. (2019). Declines in northern forest tree growth following snowpack decline and soil freezing. *Global Change Biology, 25*(2), 420-430. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057772879&doi=10.1111%2fgcb.14420&partnerID=40&md5=7e40468220fef5e4c49a324369bba528. doi:10.1111/gcb.14420

Research Tags: Weather, Forestry

Abstract: *Changes in growing season climate are often the foci of research exploring forest response to climate change. By contrast, little is known about tree growth response to projected declines in winter snowpack and increases in soil freezing in seasonally snow-covered forest ecosystems, despite extensive documentation of the importance of winter climate in mediating ecological processes. We conducted a 5-year snow-removal experiment whereby snow was removed for the first 4–5 weeks of winter in a northern hardwood forest at the Hubbard Brook Experimental Forest in New Hampshire, USA. Our results indicate that adverse impacts of reduced snowpack and increased soil freezing on the physiology of Acer saccharum (sugar maple), a dominant species across northern temperate forests, are accompanied by a 40 ± 3% reduction in aboveground woody biomass increment, averaged across the 6 years following the start of the experiment. Further, we find no indication of growth recovery 1 year after cessation of the experiment. Based on these findings, we integrate spatial modeling of snowpack depth with forest inventory data to develop a spatially explicit, regional-scale assessment of the vulnerability of forest aboveground growth to projected declines in snowpack depth and increased soil frost. These analyses indicate that nearly 65% of sugar maple basal area in the northeastern United States resides in areas that typically experience insulating snowpack. However, under the RCP 4.5 and 8.5 emissions scenarios, we project a 49%–95% reduction in forest area experiencing insulating snowpack by the year 2099 in the northeastern United States, leaving large areas of northern forest vulnerable to these changes in winter climate, particularly along the northern edge of the region. Our study demonstrates that research focusing on growing season climate alone overestimates the stimulatory effect of warming temperatures on tree and forest growth in seasonally snow-covered forests.*

Renkenberger, J., Montas, H., Leisnham, P. T., Chanse, V., Shirmohammadi, A., Sadeghi, A., . . . Lansing, D. (2017). Effectiveness of best management practices with changing climate in a Maryland watershed. *Transactions of the ASABE, 60*(3), 769-782. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022331200&doi=10.13031%2ftrans.11691&partnerID=40&md5=1f90abff4aa48c9d40eac6a592bd1f01. doi:10.13031/trans.11691

Research Tags: Water

Abstract: *The potential impacts of climate change on BMP effectiveness were investigated using SWAT simulations for an agricultural watershed that drains into the Chesapeake Bay in the U.S. Northeast climate region. Critical source areas (CSAs) for sediments, nitrogen, and phosphorus, identified for current and future climate (SRES scenarios A1B and A2), were classified by density to support BMP prioritization schemes. BMPs were designed for these CSAs and tested against current and future climate using SWAT simulations to evaluate their robustness. A second set of BMPs was designed by optimization for all agricultural and urban lands in the study watershed and was similarly tested for robustness. In both cases, the design goal was for the watershed's water quality response to meet the bay TMDLs once BMPs were implemented. Results indicated that density 2 and 3 CSAs (hotspots exporting excess amounts of 2 or 3 constituents) may be good prioritization targets, but reaching the bay TMDLs would still require targeting all CSAs. BMPs designed for CSAs under current climate were effective to reach bay TMDLs under current climate but not under scenarios A1B and A2.*

BMPs designed for CSAs under scenario A2 were effective to reach the bay TMDLs under all climates, except for nitrogen under A2. Similarly, BMPs optimized for agricultural and urban lands, when designed for current climate, were effective in meeting TMDLs for current climate only. Optimizing these BMPs for future climate produced a design that met TMDLs under both current and future climates, except for nitrogen with future climate. However, in this case, the nitrogen TMDL was exceeded by a smaller amount than in the CSA design. It was concluded that, in the U.S. Northeast, BMPs designed to remediate water quality problems under current climate will be insufficient to maintain water quality with climate change. Increased annual rainfall and storm intensity will increase the proportion of watershed area needing BMPs, and current hotspots will generate excess amounts of new constituents that will require re-design of existing BMPs. Community-based participatory strategies will likely be required to foster BMP adoption and sustain water quality gains in the Chesapeake Bay region.

Rens, H., Bera, T., & Alva, A. K. (2018). Effects of Biochar and Biosolid on Adsorption of Nitrogen, Phosphorus, and Potassium in Two Soils. *Water, Air, and Soil Pollution, 229*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051676533&doi=10.1007%2fs11270-018-3925-8&partnerID=40&md5=1f96464c4ba9f13c343cea7287356ecc. doi:10.1007/s11270-018-3925-8

Research Tags: Soil

Abstract: *Increasing the retention of nutrients by agricultural soils is of great interest to minimize losses of nutrients by leaching and/or surface runoff. Soil amendments play a role in nutrient retention by increasing the surface area and/or other chemical processes. Biochar (BC) is high carbon-containing by-product of pyrolysis of carbon-rich feedstocks to produce bioenergy. Biosolid is a by-product of wastewater treatment plant. Use of these by-products as amendments to agricultural soils is beneficial to improve soil properties, soil quality, and nutrient retention and enhance carbon sequestration. In this study, the adsorption of NH4-N, P, and K by a sandy soil (Quincy fine sand (QFS)) and a silty clay loam soil (Warden silty loam (WSL)) with BC (0, 22.4, and 44.8 mg ha−1) and biosolid (0 and 22.4 mg ha−1) amendments were investigated. Adsorption of NH4-N by the QFS soil increased with BC application at lower NH4-N concentrations in equilibrium solution. For the WSL soil, NH4-N adsorption peaked at 22.4 mg ha−1 BC rate. Biosolid application increased NH4-N adsorption by the WSL soil while decreased that in the QFS soil. Adsorption of P was greater by the WSL soil as compared to that by the QFS soil. Biosolid amendment significantly increased P adsorption capacity in both soils, while BC amendment had no significant effects. BC and biosolid amendments decreased K adsorption capacity by the WSL soil but had no effects on that by the QFS soil. Ca release with increasing addition of K was greater by the WSL soil as compared to that by the QFS soil. In both the soils, Ca release was not influenced by BC amendment while it increased with addition of biosolid. The fit of adsorption data for NH4-N, P, and K across all treatments and in two soils was better with the Freundlich model than that with the Langmuir model. The nutrients retained by BC or biosolid amended soils are easily released, therefore are readily available for the root uptake in cropped soils.*

Renwick, K. M., Fellows, A., Flerchinger, G. N., Lohse, K. A., Clark, P. E., Smith, W. K., . . . Poulter, B. (2019). Modeling phenological controls on carbon dynamics in dryland sagebrush ecosystems. *Agricultural and Forest Meteorology, 274*, 85-94. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064906404&doi=10.1016%2fj.agrformet.2019.04.003&partnerID=40&md5=e32115e38e660c02c2d8035d73e199e7. doi:10.1016/j.agrformet.2019.04.003

Research Tags: Grassland

Abstract: *Dryland ecosystems play an important role in determining how precipitation anomalies affect terrestrial carbon fluxes at regional to global scales. Thus, to understand how climate change may affect the global carbon cycle, we must also be able to understand and model its effects on dryland vegetation. Dynamic Global Vegetation Models (DGVMs) are an important tool for modeling ecosystem dynamics, but they often struggle to reproduce seasonal patterns of plant productivity. Because the phenological niche of many plant species is linked to both total productivity and competitive interactions with other plants, errors in how process-based models represent phenology hinder our ability to predict climate change impacts. This may be particularly problematic in dryland ecosystems where many species have developed a complex phenology in response to seasonal variability in both moisture and temperature. Here, we examine how uncertainty in key parameters as well as the structure of existing phenology routines affect the ability of a DGVM to match* *seasonal patterns of leaf area index (LAI) and gross primary productivity (GPP) across a temperature and precipitation gradient. First, we optimized model parameters using a combination of site-level eddy covariance data and remotely-sensed LAI data. Second, we modified the model to include a semi-deciduous phenology type and added flexibility to the representation of grass phenology. While optimizing parameters reduced model bias, the largest gains in model performance were associated with the development of our new representation of phenology. This modified model was able to better capture seasonal patterns of both leaf area index (R2 = 0.75) and gross primary productivity (R2 = 0.84), though its ability to estimate total annual GPP depended on using eddy covariance data for optimization. The new model also resulted in a more realistic outcome of modeled competition between grass and shrubs. These findings demonstrate the importance of improving how DGVMs represent phenology in order to accurately forecast climate change impacts in dryland ecosystems.*

Restaino, C., Young, D. J. N., Estes, B., Gross, S., Wuenschel, A., Meyer, M., & Safford, H. (2019). Forest structure and climate mediate drought-induced tree mortality in forests of the Sierra Nevada, USA. *Ecological Applications, 29*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066613116&doi=10.1002%2feap.1902&partnerID=40&md5=4bef48afa9ec822080093f186a43d9e4. doi:10.1002/eap.1902
Research Tags: Weather, Forestry, Wildlife
Abstract: *Extreme drought stress and associated bark beetle population growth contributed to an extensive tree mortality event in California, USA, resulting in more than 129 million trees dying between 2012 and 2016. Although drought is an important driver of this mortality event, past and ongoing fire suppression and the consequent densification of forests may have contributed. In some areas, land management agencies have worked to reduce stand density through mechanical treatments and prescribed fire to restore forests to less dense, more open conditions that are presumably more resilient to disturbance and changing climate. Here, we evaluate if stand structural conditions associated with treated (e.g., thinned and prescribed burned) forests in the Sierra Nevada of California conferred more resistance to the bark beetle epidemic and drought event of 2012–2016. We found that, compared to untreated units, treated units had lower stand densities, larger average tree diameters, and greater dominance of pines (Pinus), the historically dominant trees. For all tree species studied, mortality was substantially greater in climatically drier areas (i.e., lower elevations and latitudes). Both pine species studied (ponderosa pine [Pinus ponderosa] and sugar pine [Pinus lambertiana]) had greater mortality in areas where their diameters were larger, suggesting a size preference for their insect mortality agents. For ponderosa pine, the tree species experiencing greatest mortality, individual-tree mortality probability (for a given tree diameter) was significantly lower in treated stands. Ponderosa pine mortality was also positively related to density of medium- to large-sized conspecific trees, especially in areas with lower precipitation, suggesting that abundance of nearby host trees for insect mortality agents was an important determinant of pine mortality. Mortality of incense cedar (Calocedrus decurrens) and white fir (Abies concolor) was positively associated with basal area, suggesting sensitivity to competition during drought, but overall mortality was lower, likely because the most prevalent and effective mortality agents (the bark beetles Dendroctonus brevicomis and D. ponderosae) are associated specifically with pine species within our study region. Our findings suggest that forest thinning treatments are effective in reducing drought-related tree mortality in forests, and they underscore the important interaction between water and forest density in mediating bark beetle-caused mortality.*

Reyes, J. J., Tague, C. L., Evans, R. D., & Adam, J. C. (2017). Assessing the Impact of Parameter Uncertainty on Modeling Grass Biomass Using a Hybrid Carbon Allocation Strategy. *Journal of Advances in Modeling Earth Systems, 9*(8), 2968-2992. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040719783&doi=10.1002%2f2017MS001022&partnerID=40&md5=0a45606e7470ddf0e27d7bb9a2310509. doi:10.1002/2017MS001022
Research Tags: Research, Grassland
Abstract: *Grasslands play an important role in feeding the growing human population by supporting dairy and livestock production. The purpose of this paper was to improve the representation of carbon (C) allocation processes in ecosystem models, and to understand the sensitivity of simulated grass biomass to model parameters, providing guidance for future environmental change research. We used the Regional*

Hydro-Ecologic Simulation System to compare estimates of above and belowground biomass for C allocation strategies based on plant growth, resource use, and a newly developed HYBRID approach that integrates the first two allocation schemes. Observed values of biomass at seven grassland sites are used to compare performance of these three allocation strategies. Partial ranked correlation coefficients are then calculated to assess parameter importance and sensitivity under current and future climate conditions. We found that both resource use and plant growth play a role in simulating dynamic C allocation in grass biomass over time, indicating the need for the HYBRID approach to capture grassland C allocation. Parameter importance was site-specific under increased temperatures, enhanced carbon dioxide, and changed precipitation. Site-specific parameter importance also yielded insight into limiting resources (i.e., energy, moisture) at sites and subsequent effects on ecological processes like photosynthesis and allocation. This work increases our understanding of C allocation in ecosystem models related to grasses, and guides what model parameters may require further research.

Reyes, J. J., Wiener, J. D., Doan-Crider, D., & Novak, R. (2018). Building collaborative capacity: Supporting tribal agriculture and natural resources in a changing climate. *Renewable Agriculture and Food Systems, 33*(3), 222-224. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041584468&doi=10.1017%2fS1742170517000801&partnerID=40&md5=bbf04ca3c0fdf7a16a07325efdb0f998. doi:10.1017/S1742170517000801
Research Tags: Research, Crops
Abstract: *A working group was held during the 2017 National Adaptation Forum to build collaborative capacity on issues related to Tribal agriculture and natural resource management in a changing climate. We developed three synthetic themes from these discussions and dialogue to highlight on-going opportunities, but also demonstrate areas for continued engagement with Tribes related to effective agricultural and natural resource management. We hope this forum demonstrates the critical importance of partnerships, and motivates further coordination and collaboration among Tribes, universities and Federal agencies.*

Rice, J., Bardsley, T., Gomben, P., Bambrough, D., Weems, S., Leahy, S., . . . Joyce, L. A. (2017). Assessment of watershed vulnerability to climate change for the Uinta-Wasatch-Cache and Ashley National Forests, Utah. *USDA Forest Service - General Technical Report RMRS-GTR, 2017*(362). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022188614&partnerID=40&md5=89fd33b5b049c9bd9132877b34158014.
Research Tags: Water
Abstract: *Watersheds on the Uinta-Wasatch-Cache and Ashley National Forests provide many ecosystem services, and climate change poses a risk to these services. We developed a watershed vulnerability assessment to provide scientific information for land managers facing the challenge of managing these watersheds. Literature-based information and expert elicitation is used to define components of watershed sensitivity and exposure to climate change. We also define the capacity of watershed function, habitats, and biota to adapt to the expected changes. Watershed vulnerability is scored high for the Wasatch Mountain Range and moderate to high for the Uinta Mountains. These watersheds are driven by a snow-dominated hydrologic regime, and they have a high sensitivity to the projected increases in drought, heat, and flooding. More evaporation, snowpack loss, and earlier snowmelt are expected to shift the timing of runoff earlier and lower streamflow. The loss of snowpack is projected to be especially pronounced in the Wasatch Range. The effects from climate change can be compounded by the non-climate stressors of fire and land uses. Adaptation to these changes is enhanced when watersheds are in good functioning condition. Management actions can serve as an iterative process that builds resilience and can assist transitions to new states under a changing climate.*

Richard, R. P., Potvin, L. R., Kane, E. S., Handler, S. D., Smith, P. J., & Peterson, D. (2018). Biochar and wood ash amendments for forestry in the Lake States: Field report and initial results. *Journal of Forestry, 116*(3), 222-227. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046995549&doi=10.5849%2fjof.JOF-2016-060R2&partnerID=40&md5=4c322550f4c6f68f5fce9267a6384068. doi:10.5849/jof.JOF-2016-060R2
Research Tags: Soil, Forestry
Abstract: *Soil amendments are common in agriculture but are not widely used in Lake States forestry. Our*

objectives were to test the efficacy of operational-scale application of soil amendments on marginal sites as a management strategy for adaptation to drier conditions. Wood ash and biochar amendments were applied throughout 50 acres of recently harvested scrub oak stands, and red and jack pine seedlings were planted. Short-term results indicate increased water holding capacity and cation exchange capacity in soils amended with biochar and biochar with manure and significant increases in seedling production with wood ash amendment. Here we report on the feasibility of the application methods and their associated financial costs and present initial data on soil properties after amendment with wood ash and biochar.

Richardson, A. D., Hollinger, D. Y., Shoemaker, J. K., Hughes, H., Savage, K., & Davidson, E. A. (2019). Six years of ecosystem-atmosphere greenhouse gas fluxes measured in a sub-boreal forest. *Scientific Data, 6*(1), 117. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069269093&doi=10.1038%2fs41597-019-0119-1&partnerID=40&md5=80406de08f4fc610332629657e861b2d. doi:10.1038/s41597-019-0119-1

Research Tags: Emissions, Forestry

Abstract: *Carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) are the greenhouse gases largely responsible for anthropogenic climate change. Natural plant and microbial metabolic processes play a major role in the global atmospheric budget of each. We have been studying ecosystem-atmosphere trace gas exchange at a sub-boreal forest in the northeastern United States for over two decades. Historically our emphasis was on turbulent fluxes of CO2 and water vapor. In 2012 we embarked on an expanded campaign to also measure CH4 and N2O. Here we present continuous tower-based measurements of the ecosystem-atmosphere exchange of CO2 and CH4, recorded over the period 2012–2018 and reported at a 30-minute time step. Additionally, we describe a five-year (2012–2016) dataset of chamber-based measurements of soil fluxes of CO2, CH4, and N2O (2013–2016 only), conducted each year from May to November. These data can be used for process studies, for biogeochemical and land surface model validation and benchmarking, and for regional-to-global upscaling and budgeting analyses.*

Richardson, B. A., & Chaney, L. (2018). Climate-based seed transfer of a widespread shrub: population shifts, restoration strategies, and the trailing edge. *Ecological Applications, 28*(8), 2165-2174. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057814099&doi=10.1002%2feap.1804&partnerID=40&md5=2eb2529f5a0f15f5630542d0ea2aab1f. doi:10.1002/eap.1804

Research Tags: Forestry

Abstract: *Genetic resources have to be managed appropriately to mitigate the impact of climate change. For many wildland plants, conservation will require knowledge of the climatic factors affecting intraspecific genetic variation to minimize maladaptation. Knowledge of the interaction between traits and climate can focus management resources on vulnerable populations, provide guidance for seed transfer, and enhance fitness and resilience under changing climates. In this study, traits of big sagebrush (Artemisia tridentata) were examined among common gardens located in different climates. We focus on two subspecies, wyomingensis and tridentata, that occupy the most imperiled warm-dry spectrum of the sagebrush biome. Populations collected across the sagebrush biome were recorded for flower phenology and survival. Mixed-effects models examined each trait to evaluate genetic variation, environmental effects, and adaptive breadth of populations. Climate variables derived from population-source locations were significantly associated with these traits (P < 0.0001), explaining 31% and 11% of the flower phenology and survival variation, respectively. To illustrate our model and assess variability in prediction, we examine fixed and focal point seed transfer approaches to map contemporary and climate model ensemble projections in two different regions of the sagebrush biome. A comparison of seed transfer areas predicts that populations from warmer climates become more prevalent, replacing colder-adapted populations by mid-century. However, these warm-adapted populations are often located along the trailing edge, margins of the species range predicted to be lost due to a contraction of the climatic niche. Management efforts should focus on the collection and conservation of vulnerable populations and prudent seed transfer to colder regions where these populations are projected to occur by mid-century. Our models provide the foundation to develop an empirical, climate-based seed transfer system for current and future restoration of big sagebrush.*

Richardson, B. A., Chaney, L., Shaw, N. L., & Still, S. M. (2017). Will phenotypic plasticity affecting flowering phenology

keep pace with climate change? *Global Change Biology, 23*(6), 2499-2508. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84999622155&doi=10.1111%2fgcb.13532&partnerID=40&md5=b267e5db7a1fa15e7a5069237f9aceed. doi:10.1111/gcb.13532
Research Tags: Weather, Grassland
Abstract: *Rising temperatures have begun to shift flowering time, but it is unclear whether phenotypic plasticity can accommodate projected temperature change for this century. Evaluating clines in phenological traits and the extent and variation in plasticity can provide key information on assessing risk of maladaptation and developing strategies to mitigate climate change. In this study, flower phenology was examined in 52 populations of big sagebrush (Artemisia tridentata) growing in three common gardens. Flowering date (anthesis) varied 91 days from late July to late November among gardens. Mixed-effects modeling explained 79% of variation in flowering date, of which 46% could be assigned to plasticity and genetic variation in plasticity and 33% to genetics (conditional R2 = 0.79, marginal R2 = 0.33). Two environmental variables that explained the genetic variation were photoperiod and the onset of spring, the Julian date of accumulating degree-days >5 °C reaching 100. The genetic variation was mapped for contemporary and future climates (decades 2060 and 2090), showing flower date change varies considerably across the landscape. Plasticity was estimated to accommodate, on average, a ±13-day change in flowering date. However, the examination of genetic variation in plasticity suggests that the magnitude of plasticity could be affected by variation in the sensitivity to photoperiod and temperature. In a warmer common garden, lower-latitude populations have greater plasticity (+16 days) compared to higher-latitude populations (+10 days). Mapped climatypes of flowering date for contemporary and future climates illustrate the wide breadth of plasticity and large geographic overlap. Our research highlights the importance of integrating information on genetic variation, phenotypic plasticity and climatic niche modeling to evaluate plant responses and elucidate vulnerabilities to climate change.*

Riginos, C., Porensky, L. M., Veblen, K. E., & Young, T. P. (2018). Herbivory and drought generate short-term stochasticity and long-term stability in a savanna understory community. *Ecological Applications, 28*(2), 323-335. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042718941&doi=10.1002%2feap.1649&partnerID=40&md5=43c5ff95a118de0ad485ab7c267f9bc5. doi:10.1002/eap.1649
Research Tags: Grassland, Weather, Wildlfie
Abstract: *Rainfall and herbivory are fundamental drivers of grassland plant dynamics, yet few studies have examined long-term interactions between these factors in an experimental setting. Understanding such interactions is important, as rainfall is becoming increasingly erratic and native wild herbivores are being replaced by livestock. Livestock grazing and episodic low rainfall are thought to interact, leading to greater community change than either factor alone. We examined patterns of change and stability in herbaceous community composition through four dry periods, or droughts, over 15 years of the Kenya Long-term Exclosure Experiment (KLEE), which consists of six different combinations of cattle, native wild herbivores (e.g., zebras, gazelles), and mega-herbivores (giraffes, elephants). We used principal response curves to analyze the trajectory of change in each herbivore treatment relative to a common initial community and asked how droughts contributed to community change in these treatments. We examined three measures of stability (resistance, variability, and turnover) that correspond to different temporal scales and found that each had a different response to grazing. Treatments that included both cattle and wild herbivores had higher resistance (less net change over 15 years) but were more variable on shorter time scales; in contrast, the more lightly grazed treatments (no herbivores or wild herbivores only) showed lower resistance due to the accumulation of consistent, linear, short-term change. Community change was greatest during and immediately after droughts in all herbivore treatments. But, while drought contributed to directional change in the less grazed treatments, it contributed to both higher variability and resistance in the more heavily grazed treatments. Much of the community change in lightly grazed treatments (especially after droughts) was due to substantial increases in cover of the palatable grass Brachiaria lachnantha. These results illustrate how herbivory and drought can act together to cause change in grassland communities at the moderate to low end of a grazing intensity continuum. Livestock grazing at a moderate intensity in a system with a long evolutionary history of grazing contributed to long-term stability. This runs counter to often-held assumptions that livestock grazing leads to directional, destabilizing shifts in grassland systems.*

Riley, K. L., Thompson, M. P., Scott, J. H., & Gilbertson-Day, J. W. (2018). A model-based framework to evaluate alternative wildfire suppression strategies. *Resources, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044137343&doi=10.3390%2fresources7010004&partnerID=40&md5=eab19e984044c34b791561e34349c8ea. doi:10.3390/resources7010004

Research Tags: Forestry, Weather

Abstract: *The complexity and demands of wildland firefighting in the western U.S. have increased over recent decades due to factors including the expansion of the wildland-urban interface, lengthening fire seasons associated with climate change, and changes in vegetation due to past fire suppression and timber harvest. In light of these changes, the use of more wildland fire on the landscape could reduce fuels and form barriers to the spread of future fires while performing forest restoration in some areas. However, the risks, costs and benefits of changing fire response strategy have not been quantified. Here, we identify gaps regarding the ability to simulate alternative wildfire suppression strategies, due to a number of factors including limited data collected on fireline construction, as well as synergies between firefighting resources and resource effectiveness. We present a fire management continuum: at one end lies full suppression of all fires under all circumstances, and at the opposite end lies no suppression of any fires regardless of location or time in season, with a wide array of managed fire options falling in between. Next, we demonstrate the proof-of-concept using a stochastic fire simulation model, FSim, to simulate two alternative fire suppression strategies close to opposite ends of this continuum for the Sierra National Forest of California: (1) business-as-usual, which equates to nearly full fire suppression; and (2) full suppression of human-caused fires and no suppression actions on lightning-caused fires. Results indicate that fire management strategy can substantially affect the number of large fires and landscape burn probabilities, both of which were shown to increase under the second scenario. However, temporal feedbacks are expected to play an important role: we show that increases in burned area substantially limit ignition potential and the extent of subsequent fires within the first five to ten years, especially under the second scenario. While subject to current data gaps and limitations in fire modeling, the methodology presented here can be used to simulate a number of alternative fire suppression strategies, including decisions to suppress or not suppress fires based on location, time of season or other factors. This method also provides basic inputs needed to estimate risks, costs and benefits of various alternative suppression strategies in future work. In future work, uncertainties resulting from current limitations in knowledge can be addressed using techniques such as scenario planning in order to provide land managers with a set of possible fire outcomes.*

Riley, K. L., Williams, A. P., Urbanski, S. P., Calkin, D. E., Short, K. C., & O'Connor, C. D. (2019). Will Landscape Fire Increase in the Future? A Systems Approach to Climate, Fire, Fuel, and Human Drivers. *Current Pollution Reports, 5*(2), 9-24. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061298326&doi=10.1007%2fs40726-019-0103-6&partnerID=40&md5=3db60a210bbc2697b2c19100a2f83a44. doi:10.1007/s40726-019-0103-6

Research Tags: Weather

Abstract: *The extent of the Earth's surface burned annually by fires is affected by a number of drivers, including but not limited to climate. Other important drivers include the amount and type of vegetation (fuel) available and human impacts, including fire suppression, ignition, and conversion of burnable land to crops. Prior to the evolution of hominids, area burned was dictated by climate via direct influences on vegetation, aridity, and lightning. In the future, warming will be accompanied by changes in distribution, frequency, intensity, and timing of precipitation that may promote or suppress fire activity depending on location. Where area burned increases, fire may become self-regulating by reducing fuel availability. The effects of climate change on fire regimes will be strongly modulated by humans in many areas. Here, we use a systems approach to outline major drivers of changes in area burned. Due to the array of interacting drivers working in concert with climate's influence on burned area, and uncertainty in the direction and magnitude of changes in these drivers, there is very high uncertainty for much of the globe regarding how fire activity and accompanying smoke emissions will change in the coming decades.*

Ringo, C., Bennett, K., Noller, J., Jiang, D., & Moore, D. (2018). Modeling droughty soils at regional scales in Pacific Northwest Forests, USA. *Forest Ecology and Management, 424*, 121-135. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046713931&doi=10.1016%2fj.foreco.2018.04.019&

partnerID=40&md5=ab857a59a0be0a6d83ac295a987abe75. doi:10.1016/j.foreco.2018.04.019
Research Tags: Soil, Weather, Forestry
Abstract: *Natural resource managers need better estimates of water storage and supply in forested landscapes. These estimates would aid planning for management activities that maintain and enhance forest health and productivity and help prepare forested landscapes for a changing climate. In particular, low soil moisture in combination with high evaporative demands can induce significant stresses on forests, increasing vulnerability to attacks of insect and disease, as well as increasing wildfire risk. Although high-resolution soils data exist for much of the Pacific Northwest, regional-scale datasets that identify forested areas potentially vulnerable to soil moisture-related drought do not exist. In this study, we used readily available spatial datasets depicting available water supply, soil depth, and evapotranspiration to model the likelihood that soils experience prolonged summer drying. To calibrate the model, we examined soil profile descriptions, lab data, and soil moisture curves for 25 sites throughout the Pacific Northwest and estimated the average annual number of days that soil moisture drops to levels at or below the permanent wilting point, a theoretical lower limit of plant-available water. Using this approach, we found statistically significant relationships between the independent variables and broad classes of soil moisture levels representing the highest and lowest levels of plant-available moisture. We then used these relationships to create a landscape-level droughty soil index for the Pacific Northwest. We expect that this approach can be further developed to include additional soil moisture data outside Washington and Oregon and enhanced with other explanatory variables such as topographic position, elevation, and vegetation type. With the addition of vegetation-related data, in particular, the current modeling approach can aid in identifying vulnerable landscapes in the context of managing for increased forest resiliency in the Pacific Northwest.*

Rivero, R. M., Oliver, M. J., & Mittler, R. (2019). Editorial. *Physiologia Plantarum, 165*(2), 125-127. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060546896&doi=10.1111%2fppl.12884&partnerID=40&md5=0a3818a05ff4035c92c703ec94048626. doi:10.1111/ppl.12884
Research Tags: Weather
No Abstract:

Robertson, A. D., Zhang, Y., Sherrod, L. A., Rosenzweig, S. T., Ma, L., Ahuja, L., & Schipanski, M. E. (2018). Climate change impacts on yields and soil carbon in row crop dryland agriculture. *Journal of Environmental Quality, 47*(4), 684-694. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049433114&doi=10.2134%2fjeq2017.08.0309&partnerID=40&md5=1865f532a11aac29f58015dc5704e4b3. doi:10.2134/jeq2017.08.0309
Research Tags: Crops, Soil
Abstract: *Dryland agroecosystems could be a sizable sink for atmospheric carbon (C) due to their spatial extent and level of degradation, providing climate change mitigation. We examined productivity and soil C dynamics under two climate change scenarios (moderate warming, representative concentration pathway [RCP] 4.5; and high warming, RCP 8.5), using long-term experimental data and the DayCent process-based model for three sites with varying climates and soil conditions in the US High Plains. Each site included a no-till cropping intensity gradient introduced in 1985, with treatments ranging from wheat–fallow (Triticum aestivum L.) to continuous annual cropping and perennial grass. Simulations were extended to 2100 using data from 16 global circulation models to estimate uncertainty. Simulated yields declined for all crops (up to 50% for wheat), with small changes after 2050 under RCP 4.5 and continued losses to 2100 under RCP 8.5. Of the cropped systems, continuous cropping had the highest average productivity and soil C sequestration rates (78.1 kg C ha−1 yr−1 from 2015 to 2045 under RCP 4.5). Any increase in soil C for cropped rotations was realized by 2050, but grassland treatments increased soil C (up to 69%) through 2100, even under RCP 8.5. Our simulations indicate that reduced frequency of summer fallow can both increase annualized yields and store more soil C. As evapotranspiration is likely to increase, reducing fallow periods without live vegetation from dryland agricultural rotations may enhance the resilience of these systems to climate change while also increasing soil C storage and mitigating carbon dioxide emissions.*

Roche, J. W., Bales, R. C., Rice, R., & Marks, D. G. (2018). Management Implications of Snowpack Sensitivity to Temperature and Atmospheric Moisture Changes in Yosemite National Park, CA. *Journal of the American*

Water Resources Association, 54(3), 724-741. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045414100&doi=10.1111%2f1752-1688.12647&partnerID=40&md5=7cdbe8f1e18070154008ce1519baa564. doi:10.1111/1752-1688.12647
Research Tags: Weather, Water
Abstract: *In order to investigate snowpack sensitivity to temperature increases and end-member atmospheric moisture conditions, we applied a well-constrained energy- and mass-balance snow model across the full elevation range of seasonal snowpack using forcing data from recent wet and dry years. Humidity scenarios examined were constant relative humidity (high) and constant vapor pressure between storms (low). With minimum calibration, model results captured the observed magnitude and timing of snowmelt. April 1 snow water equivalent (SWE) losses of 38%, 73%, and 90% with temperature increases of 2, 4, and 6°C in a dry year centered on areas of greatest SWE accumulation. Each 2°C increment of warming also resulted in seasonal snowline moving upslope by 300 m. The zone of maximum melt was compressed upward 100–500 m with 6°C warming, with the range reflecting differences in basin hypsometry. Melt contribution by elevations below 2,000 m disappeared with 4°C warming. The constant-relative-humidity scenario resulted in 0–100 mm less snowpack in late spring vs. the constant-vapor-pressure scenario in a wet year, a difference driven by increased thermal radiation (+1.2 W/m2) and turbulent energy fluxes (+1.2 W/m2) to the snowpack for the constant-relative-humidity case. Loss of snowpack storage and potential increases in forest evapotranspiration due to warming will result in a substantial shift in forest water balance and present major challenges to land management in this mountainous region.*

Rockweit, J. T., Franklin, A. B., & Carlson, P. C. (2017). Differential impacts of wildfire on the population dynamics of an old-forest species. *Ecology, 98*(6), 1574-1582. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018997707&doi=10.1002%2fecy.1805&partnerID=40&md5=57f2c6720c63285e297ce19e2bdea74b. doi:10.1002/ecy.1805
Research Tags: Forestry, Weather
Abstract: *Ecological disturbances shape and maintain natural communities, but climate change and human land use can alter disturbance regimes and affect population persistence and vital rates in unpredictable ways. Species inhabiting landscapes shaped by wildfire have evolved mechanisms allowing them to persist under this dynamic disturbance type, which creates habitats of varying quality for these species. We utilized data from a 26-yr demographic study of northern spotted owls to analyze the influence of wildfire on apparent survival and recruitment rates. Wildfires occurred across different years and affected different spotted owl territories, which allowed us to implement a retrospective Before-After-Control-Impact (BACI) analysis and model the potential effect of wildfire extent and severity. Our results indicated that mixed-severity fires that burned at predominantly low-severity had little effect on survival and recruitment while fires characterized by more medium to high burn severities negatively affected spotted owl survival, with varying effects on recruitment. Reduced survival and increased recruitment rates on some territories affected by medium to high severity fires suggested that post-fire habitat quality was reduced resulting in territories that were marginally capable of supporting owls. We hypothesize these territories may have represented "sinks" that were supported by nearby "source" territories in a spatially heterogeneous landscape created by the mixed-severity fire regime of the region.*

Rockwell, S. M., Wunderle, J. M., Sillett, T. S., Bocetti, C. I., Ewert, D. N., Currie, D., . . . Marra, P. P. (2017). Seasonal survival estimation for a long-distance migratory bird and the influence of winter precipitation. *Oecologia, 183*(3), 715-726. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85003874716&doi=10.1007%2fs00442-016-3788-x&partnerID=40&md5=1f2b0220841079c01b84113ceb529faa. doi:10.1007/s00442-016-3788-x
Research Tags: Weather, Wildlfie
Abstract: *Conservation of migratory animals requires information about seasonal survival rates. Identifying factors that limit populations, and the portions of the annual cycle in which they occur, are critical for recognizing and reducing potential threats. However, such data are lacking for virtually all migratory taxa. We investigated patterns and environmental correlates of annual, oversummer, overwinter, and migratory survival for adult male Kirtland's warblers (Setophaga kirtlandii), an endangered, long-distance migratory songbird. We used Cormack–Jolly–Seber models to analyze two mark–recapture datasets: 2006–2011 on Michigan breeding*

grounds, and 2003–2010 on Bahamian wintering grounds. The mean annual survival probability was 0.58 ± 0.12 SE. Monthly survival probabilities during the summer and winter stationary periods were relatively high (0.963 ± 0.005 SE and 0.977 ± 0.002 SE, respectively). Monthly survival probability during migratory periods was substantially lower (0.879 ± 0.05 SE), accounting for ~44% of all annual mortality. March rainfall in the Bahamas was the best-supported predictor of annual survival probability and was positively correlated with apparent annual survival in the subsequent year, suggesting that the effects of winter precipitation carried over to influence survival probability of individuals in later seasons. Projection modeling revealed that a decrease in Bahamas March rainfall >12.4% from its current mean could result in negative population growth in this species. Collectively, our results suggest that increased drought during the non-breeding season, which is predicted to occur under multiple climate change scenarios, could have important consequences on the annual survival and population growth rate of Kirtland's warbler and other Neotropical–Nearctic migratory bird species.

Rodhouse, T. J., Jeffress, M. R., Sherrill, K. R., Mohren, S. R., Nordensten, N. J., Magnuson, M. L., . . . Epps, C. W. (2018). Geographical variation in the influence of habitat and climate on site occupancy turnover in American pika (Ochotona princeps). *Diversity and Distributions, 24*(11), 1506-1520. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055294277&doi=10.1111%2fddi.12791&partnerID=40&md5=42ad1c658a41b6d4ef7a5a065789d267. doi:10.1111/ddi.12791

Research Tags: Wildlife

Abstract: *Aim*

Environmental changes that amplify rates of site or patch occupancy turnover can increase risks of decline in spatially structured populations. We asked whether local habitat and meso-scale climate influenced site occupancy turnover rates in four American pika (Ochotona princeps) metapopulations. We focused on winter cold stress, which is a proposed driver of American pika extinction risk but has been rarely studied.

Location

Oregon, Northern California, and Idaho.

Methods

We developed Bayesian hierarchical multiseason site occupancy models that accounted for both false-negative and false-positive survey detection errors to explore the winter stress turnover hypothesis. We used remotely sensed meso-scale (1 km) snowpack and temperature data and fine-grained local habitat attributes as covariates to model site persistence and colonization rates.

Results

The estimated magnitude of imperfect detection was greater than previously reported for the species. After accounting for imperfect detection, we found no evidence of declines in site occupancy over the 5-year study period, but our models provided evidence that pika site occupancy turnover can be high (>50% between some years) and apparently exacerbated by winter cold stress, summer heat stress and variation in site habitat quality. However, strength of evidence varied among metapopulations, suggesting influential local contingencies, as reported previously for the species.

Main conclusions

Our empirical results suggest that the American pika may be vulnerable to wintertime turnover, negatively exacerbated by climatic events, with implications for future persistence given forecasted snowpack declines across the species' range. Our models suggest a more nuanced dynamism to persistence and extinction risk than the simple scenario of inexorable, monotonic range contraction offered by static range-wide distribution models, and we suggest several ways to strengthen these insights with future studies.

Roesch-McNally, G. E., Arbuckle, J. G., & Tyndall, J. C. (2018). Barriers to implementing climate resilient agricultural strategies: The case of crop diversification in the U.S. Corn Belt. *Global Environmental Change, 48*, 206-215. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038923139&doi=10.1016%2fj.gloenvcha.2017.12.002&partnerID=40&md5=4ff454087a399a0d56064eaf4c02cafa. doi:10.1016/j.gloenvcha.2017.12.002

Research Tags: Crops

Abstract: *Cropping system diversity can help build greater agroecosystem resilience by suppressing insect, weed, and disease pressures while also mitigating effects of extreme and more variable weather. Despite the* *potential benefits of cropping systems diversity, few farmers in the US Corn Belt use diverse rotations. This study examines factors that may influence farmers' decisions to use more diversified crop rotations in the US Corn Belt through a parallel convergent mixed methods approach, using a multi-level analysis of Corn Belt farmer survey data (n = 4,778) and in-depth interviews (n = 159). Analyses were conducted to answer questions regarding what factors influence farmers' use of extended crop rotations in intensive corn-based cropping systems and to explore whether farmers in the Corn Belt might use extended crop rotations in response to climatic changes. Findings suggest that path dependency associated with the intensive corn-based cropping system in the region limits farmers' ability to integrate more diverse crop rotations. However, farmers in more diversified watersheds, those who farm marginal land, and those with livestock are more likely to use extended rotations. Additionally, farmers who currently use more diverse rotations are also more likely to plan to use crop rotations as a climate change adaptation strategy. If more diverse cropping systems are desired to reduce climate risks, in addition to reducing the negative impacts associated with industrial agricultural production, then further efforts must be made to facilitate more diverse crop rotations in the U.S. Corn Belt. This may be achieved by adjusting policy and economic incentives that presently discourage cropping system diversity in the region.*

Roesch-Mcnally, G. E., Basche, A., & Schewe, R. (2018). Climate change challenges require collaborative research to drive agrifood system transformation. *Renewable Agriculture and Food Systems, 33*(3), 195-196. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044772857&doi=10.1017%2fS1742170518000157&partnerID=40&md5=b53c1e869cc02eb8c67616fe419c837e. doi:10.1017/S1742170518000157

Research Tags: Crops, Livestock, Economics

Abstract: *The recent Climate Science Special Report released as part of the Fourth National Climate Assessment confirms that we are living through the warmest period in modern civilization and that human activities are the primary driver of this warming (Wuebbles et al., 2017). These climatic changes have and will continue to impact global agricultural production, with food security and production consequences that will be felt unequally across the planet. Agricultural activities contribute to global warming emissions, while also offering opportunities for greenhouse gas mitigation. It is clear that the agrifood system will have to adapt to a changing climate. To better assess climate influences on agricultural systems in this themed issue of Renewable Agriculture and Food Systems, we challenged authors to submit interdisciplinary research that examines climate change adaptation and mitigation in agriculture and subsequent interconnected impacts to the food system. Indeed, agrifood systems provide a fertile context for examining climate change from multiple disciplines.*

Roesch-McNally, G. E., Gordon Arbuckle, J., & Tyndall, J. C. (2017). What would farmers do? Adaptation intentions under a Corn Belt climate change scenario. *Agriculture and Human Values, 34*(2), 333-346. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84981554806&doi=10.1007%2fs10460-016-9719-y&partnerID=40&md5=cc084f5615c9cc7c5abad55106c2346c. doi:10.1007/s10460-016-9719-y

Research Tags: Research, Economics

Abstract: *This paper examines farmer intentions to adapt to global climate change by analyzing responses to a climate change scenario presented in a survey given to large-scale farmers (n = 4778) across the US Corn Belt in 2012. Adaptive strategies are evaluated in the context of decision making and farmers' intention to increase their use of three production practices promoted across the Corn Belt: no-till farming, cover crops, and tile drainage. This paper also provides a novel conceptual framework that bridges a typology of adaptation with concepts that help predict intentionality in behavior change models. This conceptual framework was developed to facilitate examination of adaptive decision making in the context of agriculture. This research effort examines key factors that influence farmers' intentions to increase their use of the practices evaluated given a climate change scenario. Twenty-two covariates are examined across three models developed for no-till farming, cover crops, and tile drainage. Findings highlight that farmers who believed they should adjust their practices to protect their farm from the negative impacts of increased weather variability were more likely to indicate that they would increase their use of each of the practices in response to climate change. Additionally, visiting with other farmers to observe their practices was positively associated with farmers' intentions to increase their use of the adaptive strategies examined. Farmers who were currently using no-till farming, cover* *crops, and tile drainage were also more likely to plan to increase their use of these practices in response to increased weather variability associated with climate change. However, farmers who reported high levels of confidence in their current practices were less likely to plan on changing their use of these practices in response to climatic changes.*

Rogosch, J. S., Tonkin, J. D., Lytle, D. A., Merritt, D. M., Reynolds, L. V., & Olden, J. D. (2019). Increasing drought favors nonnative fishes in a dryland river: evidence from a multispecies demographic model. *Ecosphere, 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065020928&doi=10.1002%2fecs2.2681&partnerID=40&md5=44eec6dd58154b11b7792d8c20306f51. doi:10.1002/ecs2.2681

Research Tags: Weather, Water, Wildlife

Abstract: *Understanding how novel biological assemblages are structured in relation to dynamic environmental regimes remains a central challenge in ecology. Demographic approaches to modeling species assemblages show promise because they seek to represent fundamental relationships between population dynamics and environmental conditions. In dryland rivers, rapidly changing climate conditions have shifted drought and flooding regimes with implications for fish communities. Our goals were to (1) develop a mechanistic multispecies demographic model that links native and nonnative species with river flow regimes, and (2) evaluate demographic responses in population and community structure to changing flow regimes. Each fish species was represented by a stage-structured matrix, and species were coupled together into a multispecies framework through density-dependent relationships in reproduction. Then, community dynamics were simulated through time using annual flow events classified from gaged streamflow data. We parameterized the model with vital rates and flow–response relationships for a community of native and nonnative fishes using literature-derived values. We applied the simulation model to the Verde River (Arizona, USA), a major tributary within the Colorado River Basin, for the past half century (1964–2017). Model validation revealed a match between model projections and relative abundance trends observed in a long-term fish monitoring dataset (1994–2008). At the beginning of the validation period (1994), model and survey observations showed that native species comprised approximately 80% of total abundance. Model projections beyond the survey data (2008–2017) predicted a shift from a native dominant to a nonnative dominant assemblage, coinciding with increasing drought frequency. Trade-offs between native and nonnative species dominance emerged from differences in mortality in response to the changing sequence of major flow events including spring floods, summer high flows, and droughts. In conclusion, the demographic approach presented here provides a flexible modeling framework that is readily applied to other stream systems and species by adjusting or transferring, when appropriate, species vital rates and flow-event thresholds.*

Roitman, I., Bustamante, M. M. C., Haidar, R. F., Shimbo, J. Z., Abdala, G. C., Eiten, G., . . . Sampaio, J. M. (2018). Optimizing biomass estimates of savanna woodland at different spatial scales in the Brazilian Cerrado: Re-evaluating allometric equations and environmental influences. *PLoS ONE, 13*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050957733&doi=10.1371%2fjournal.pone.0196742&partnerID=40&md5=d11a865244c4a44d4f3637762173abf2. doi:10.1371/journal.pone.0196742

Research Tags: Grassland

Abstract: *Cerrado is the second largest biome in South America and accounted for the second largest contribution to carbon emissions in Brazil for the last 10 years, mainly due to land-use changes. It comprises approximately 2 million km2 and is divided into 22 ecoregions, based on environmental conditions and vegetation. The most dominant vegetation type is cerrado sensu stricto (cerrado ss), a savanna woodland. Quantifying variation of biomass density of this vegetation is crucial for climate change mitigation policies. Integrating remote sensing data with adequate allometric equations and field-based data sets can provide large-scale estimates of biomass. We developed individual-tree aboveground biomass (AGB) allometric models to compare different regression techniques and explanatory variables. We applied the model with the strongest fit to a comprehensive ground-based data set (77 sites, 893 plots, and 95,484 trees) to describe AGB density variation of cerrado ss. We also investigated the influence of physiographic and climatological variables on AGB density; this analysis was restricted to 68 sites because eight sites could not be classified into a specific ecoregion, and one site had no soil texture data. In addition, we developed two models to estimate plot AGB density based on plot basal area. Our data show that for individual-tree AGB models a) log-log linear models*

provided better estimates than nonlinear power models; b) including species as a random effect improved model fit; c) diameter at 30 cm above ground was a reliable predictor for individual-tree AGB, and although height significantly improved model fit, species wood density did not. Mean tree AGB density in cerrado ss was 22.9 tons ha-1 (95% confidence interval = ± 2.2) and varied widely between ecoregions (8.8 to 42.2 tons ha-1), within ecoregions (e.g. 4.8 to 39.5 tons ha-1), and even within sites (24.3 to 69.9 tons ha-1). Biomass density tended to be higher in sites close to the Amazon. Ecoregion explained 42% of biomass variation between the 68 sites (P < 0.01) and shows strong potential as a parameter for classifying regional biomass variation in the Cerrado.

Roman, L. A., Pearsall, H., Eisenman, T. S., Conway, T. M., Fahey, R. T., Landry, S., . . . Staudhammer, C. (2018). Human and biophysical legacies shape contemporary urban forests: A literature synthesis. *Urban Forestry and Urban Greening, 31*, 157-168. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043465847&doi=10.1016%2fj.ufug.2018.03.004&partnerID=40&md5=24eb140c947b343c66d29e83475ae270. doi:10.1016/j.ufug.2018.03.004

Research Tags: Economics, Forestry

Abstract: *Understanding how urban forests developed their current patterns of tree canopy cover, species composition, and diversity requires an appreciation of historical legacy effects. However, analyses of current urban forest characteristics are often limited to contemporary socioeconomic factors, overlooking the role of history. The institutions, human communities, and biophysical conditions of cities change over time, creating layers of legacies on the landscape, shifting urban forests through complex interactive processes and feedbacks. Urban green spaces and planted trees can persist long after their establishment, meaning that today's mature canopy reflects conditions and decisions from many years prior. In this synthesis article, we discuss some of the major historical human and biophysical drivers and associated legacy effects expressed in present urban forest patterns, highlighting examples in the United States and Canada. The bioregional context – native biome, climate, topography, initial vegetation, and pre-urbanization land use – represents the initial conditions in which a city established and grew, and this context influences how legacy effects unfold. Human drivers of legacy effects can reflect specific historical periods: colonial histories related to the symbolism of certain species, and the urban parks and civic beautification movements. Other human drivers include phenomena that cut across time periods such as neighborhood urban form and socioeconomic change. Biophysical legacy effects include the consequences of past disturbances such as extreme weather events and pest and disease outbreaks. Urban tree professionals play a major role in many legacy effects by mediating the interactions and feedbacks between biophysical and human drivers. We emphasize the importance of historical perspectives to understand past drivers that have produced current urban forest patterns, and call for interdisciplinary and mixed methods research to unpack the mechanisms of long-term urban forest change at intra- and inter-city scales.*

Rong, Y., Johnson, D. A., Wang, Z., & Zhu, L. (2017). Grazing effects on ecosystem CO <inf>2</inf> fluxes regulated by interannual climate fluctuation in a temperate grassland steppe in northern China. *Agriculture, Ecosystems and Environment, 237*, 194-202. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007560865&doi=10.1016%2fj.agee.2016.12.036&partnerID=40&md5=ceb562508a15519a94855ee2c687ac9c. doi:10.1016/j.agee.2016.12.036

Research Tags: Grassland, Livestock

Abstract: *The dynamics of CO2 fluxes on grassland ecosystem can be highly affected by grazing intensity and climate variation. To determine the role of grazing intensity on grassland ecosystem CO2 fluxes, we used static chamber methods to measure net ecosystem exchange for CO2 (NEE) and its two components, gross ecosystem production (GEP) and ecosystem respiration (Re), during three growing seasons on a steppe site located at the southeastern edge of the Mongolian Plateau in China. Objectives were to document how NEE, GEP and Re varied seasonally and interannually, and to examine how environmental factors and grazing intensity influenced the C budget. Sheep grazed during the growing seasons of 2012–14 at a stocking rate of 0, 1.43 and 2.33 sheep units ha −1year−1 for ungrazed (UG), moderately grazed (MG) and heavily grazed (HG) sites, respectively. Results showed that both grazing intensity and climatic variability significantly affected NEE, GEP and Re. Precipitation or soil water content and aboveground biomass (AGB) critically controlled NEE and GEP. Precipitation during the growing season of 2013 was 34% greater than that in 2014 and 2012, and 38% higher than long-term mean precipitation (244 mm, 1953–2012). Precipitation was low between days 150–260 in*

2012 and 2013 compared to that in 2014 with lower precipitation during days 205–260. Despite strong intra- and interannual influences on ecosystem CO_2 fluxes, interaction of year and grazing intensity only affected NEE (P = 0.026) and not GEP (P = 0.286) or Re (P = 0.984). Seasonal values of NEE (-7.5 μmol CO_2 $m^{-2}s^{-1}$), GEP (-12.2 μmol CO_2 $m^{-2}s^{-1}$), and Re (3.4 μmol CO_2 $m^{-2}s^{-1}$) in 2013 were approximately 47% (46–48%), 34% (33–35%), and 22% (6–38%) higher than those in 2012 and 2014, respectively. The temperate steppe in northern China was a sink for C during the growing season for the grazing intensities evaluated in our study with the MG site exhibiting the greatest NEE and GEP. Mean cumulative carbon uptake for MG was 1005 ± 45 g C m^{-2}, which was 31 and 98% greater than that for UG and HG, respectively. Results from our study suggested that both no grazing and heavy grazing significantly decreased C fixation of the steppe grassland (P < 0.05) in northern China. In addition, annual precipitation and its associated distribution mediated the magnitude of reduction in C fluxes.

Roper, B. B., Capurso, J. M., Paroz, Y., & Young, M. K. (2018). Conservation of Aquatic Biodiversity in the Context of Multiple-Use Management on National Forest System Lands. *Fisheries, 43*(9), 396-405. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054363218&doi=10.1002%2ffsh.10168&partnerID=40&md5=fb58a93059657c30be6104a6db6da620. doi:10.1002/fsh.10168

Research Tags: Forestry, Wildlife

Abstract: *The U.S. Department of Agriculture Forest Service (USFS) manages 193 million acres of public lands across 43 states and Puerto Rico. The original intent behind reserving lands managed by the USFS was to improve and protect forests, secure favorable conditions for water flows, and furnish a continuous supply of timber for the nation. Through time national forests have evolved, so they are managed for a broad array of uses. Differing expectations have led to conflicts between aquatic conservation and other aspects of the USFS' mandate. In the 1990s, these conflicting goals came to a head with the listing of the northern spotted owl Strix occidentalis caurina and the need to better protect streams that fostered populations of anadromous salmonids. To better balance these conflicting uses, the agency placed additional emphasis on conserving and restoring aquatic systems by integrating conservation concepts into the forest planning process. If the USFS is to succeed in protecting and restoring aquatic biodiversity, it must continue to address traditional challenges such as minimizing the effects of timber harvest, roads, grazing, and mining on aquatic systems while improving policies and practices regarding contemporary challenges such as climate change and invasive species.*

Rosenberger, D. W., Venette, R. C., Maddox, M. P., & Aukema, B. H. (2017). Colonization behaviors of mountain pine beetle on novel hosts: Implications for range expansion into Northeastern North America. *PLoS ONE, 12*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018328476&doi=10.1371%2fjournal.pone.0176269&partnerID=40&md5=5214fd39570f012d290cfaadff37b7dd. doi:10.1371/journal.pone.0176269

Research Tags: Forestry, Wildlfie

Abstract: *As climates change, thermal limits may no longer constrain some native herbivores within their historical ranges. The mountain pine beetle, Dendroctonus ponderosae Hopkins, is a tree-killing bark beetle native to western North America that is currently expanding its range. Continued eastward expansion through the newly invaded and novel jack pine (Pinus banksiana Lamb.) trees of the Canadian boreal forest could result in exposure of several species of novel potential host pines common in northeastern North America to this oligophagous herbivore. Due to the tightly co-evolved relationship between mountain pine beetle and western pine hosts, in which the insect utilizes the defensive chemistry of the host to stimulate mass attacks, we hypothesized that lack of co-evolutionary association would affect the host attraction and acceptance behaviors of this insect among novel hosts, particularly those with little known historical association with an aggressive stem-infesting insect. We studied how beetle behavior differed among the various stages of colonization on newly cut logs of four novel potential pine host species; jack, red (P. resinosa Ait.), eastern white (P. strobus L.) and Scots (P. sylvestris L.) pines, as well as two historical hosts, ponderosa (P. ponderosa Dougl. ex. Laws. var. scopulorum Engelm.) and lodgepole (P. contorta Dougl. var. latifolia Engelm.) pines. Overall, we found that beetle colonization behaviors at each stage in the colonization process differ between pine hosts, likely due to differing chemical and physical bark traits. Pines without co-evolved constitutive defenses against mountain pine beetle exhibited reduced amounts of defensive monoterpenoid chemicals; however, such patterns also reduced beetle attraction and colonization. Neither chemical nor physical defenses fully defended trees against* *the various stages of host procurement that can result in tree colonization and death.*

Rosenzweig, C., Ruane, A. C., Antle, J., Elliott, J., Ashfaq, M., Chatta, A. A., . . . Wiebe, K. (2018). Coordinating AgMIP data and models across global and regional scales for 1.5°C and 2.0°C assessments. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 376*(2119). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045541816&doi=10.1098%2frsta.2016.0455&partnerID=40&md5=71b6daafb8c571fa559dc27402448089. doi:10.1098/rsta.2016.0455
Research Tags: Research
Abstract: *The Agricultural Model Intercomparison and Improvement Project (AgMIP) has developed novel methods for Coordinated Global and Regional Assessments (CGRA) of agriculture and food security in a changing world. The present study aims to perform a proof of concept of the CGRA to demonstrate advantages and challenges of the proposed framework. This effort responds to the request by the UN Framework Convention on Climate Change (UNFCCC) for the implications of limiting global temperature increases to 1.5°C and 2.0°C above pre-industrial conditions. The protocols for the 1.5°C/2.0°C assessment establish explicit and testable linkages across disciplines and scales, connecting outputs and inputs from the Shared Socio-economic Pathways (SSPs), Representative Agricultural Pathways (RAPs), Half a degree Additional warming, Prognosis and Projected Impacts (HAPPI) and Coupled Model Intercomparison Project Phase 5 (CMIP5) ensemble scenarios, global gridded crop models, global agricultural economics models, site-based crop models and within-country regional economics models. The CGRA consistently links disciplines, models and scales in order to track the complex chain of climate impacts and identify key vulnerabilities, feedbacks and uncertainties in managing future risk. CGRA proof-of-concept results show that, at the global scale, there are mixed areas of positive and negative simulated wheat and maize yield changes, with declines in some breadbasket regions, at both 1.5°C and 2.0°C. Declines are especially evident in simulations that do not take into account direct CO2 effects on crops. These projected global yield changes mostly resulted in increases in prices and areas of wheat and maize in two global economics models. Regional simulations for 1.5°C and 2.0°C using site-based crop models had mixed results depending on the region and the crop. In conjunction with price changes from the global economics models, productivity declines in the Punjab, Pakistan, resulted in an increase in vulnerable households and the poverty rate.*

Rottler, C. M., Burke, I. C., Palmquist, K. A., Bradford, J. B., & Lauenroth, W. K. (2018). Current reclamation practices after oil and gas development do not speed up succession or plant community recovery in big sagebrush ecosystems in Wyoming. *Restoration Ecology, 26*(1), 114-123. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85024910977&doi=10.1111%2frec.12543&partnerID=40&md5=465d5fb8b01ce2d6ad999f1f5e7ea7f3. doi:10.1111/rec.12543
Research Tags: Grassland
Abstract: *Reclamation is an application of treatment(s) following disturbance to promote succession and accelerate the return of target conditions. Previous studies have framed reclamation in the context of succession by studying its effectiveness in reestablishing late-successional plant communities. Reestablishment of plant communities is especially important and challenging in drylands such as shrub steppe ecosystems where succession proceeds slowly. These ecosystems face threats from climate change, invasive species, altered fire regimes, and land-use change, as well as fossil-fuel extraction and associated disturbance. As such, the need for effective reclamation after this type of energy development is great. However, past research regarding this type of reclamation has focused on mining rather than oil and gas development. To better understand the effect of reclamation on rates of succession in dryland shrub steppe ecosystems, we sampled oil and gas wellpads and adjacent undisturbed big sagebrush plant communities in Wyoming, U.S.A., and quantified the extent of recovery for forbs, grasses, and shrubs on reclaimed and unreclaimed wellpads relative to undisturbed plant communities. Reclamation increased the recovery rate for early-successional types, including combined forbs and grasses and perennial grasses, but did not affect recovery rate of late-successional types, particularly big sagebrush and perennial forbs. Rather, subsequent analyses showed that recovery of late-successional types was affected by soil texture and time since wellpad abandonment. This is consistent with studies in other ecosystems where reclamation has been implemented, suggesting that reclamation may not help reestablish late-successional plant communities more quickly than they would reestablish naturally.*

Rotz, C. A. (2018). Modeling greenhouse gas emissions from dairy farms. *Journal of Dairy Science, 101*(7), 6675-6690. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033771832&doi=10.3168%2fjds.2017-13272&partnerID=40&md5=dfb887931b38cb1c26b1fecfb9ba3853. doi:10.3168/jds.2017-13272

Research Tags: Livestock, Emissions

Abstract: *Dairy farms have been identified as an important source of greenhouse gas emissions. Within the farm, important emissions include enteric CH4 from the animals, CH4 and N2O from manure in housing facilities during long-term storage and during field application, and N2O from nitrification and denitrification processes in the soil used to produce feed crops and pasture. Models using a wide range in level of detail have been developed to represent or predict these emissions. They include constant emission factors, variable process-related emission factors, empirical or statistical models, mechanistic process simulations, and life cycle assessment. To fully represent farm emissions, models representing the various emission sources must be integrated to capture the combined effects and interactions of all important components. Farm models have been developed using relationships across the full scale of detail, from constant emission factors to detailed mechanistic simulations. Simpler models, based upon emission factors and empirical relationships, tend to provide better tools for decision support, whereas more complex farm simulations provide better tools for research and education. To look beyond the farm boundaries, life cycle assessment provides an environmental accounting tool for quantifying and evaluating emissions over the full cycle, from producing the resources used on the farm through processing, distribution, consumption, and waste handling of the milk and dairy products produced. Models are useful for improving our understanding of farm processes and their interacting effects on greenhouse gas emissions. Through better understanding, they assist in the development and evaluation of mitigation strategies for reducing emissions and improving overall sustainability of dairy farms.*

Rotz, C. A., Asem-Hiablie, S., Place, S., & Thoma, G. (2019). Environmental footprints of beef cattle production in the United States. *Agricultural Systems, 169*, 1-13. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057142776&doi=10.1016%2fj.agsy.2018.11.005&partnerID=40&md5=11e652ed7435511d7d1c7e93d18a9b04. doi:10.1016/j.agsy.2018.11.005

Research Tags: Livestock

Abstract: *The environmental impacts of beef cattle production and their effects on the overall sustainability of beef have become a national and international concern. Our objective was to quantify important environmental impacts of beef cattle production in the United States. Surveys and visits of farms, ranches and feedlots were conducted throughout seven regions (Northeast, Southeast, Midwest, Northern Plains, Southern Plains, Northwest and Southwest) to determine common practices and characteristics of cattle production. These data along with other information sources were used to create about 150 representative production systems throughout the country, which were simulated with the Integrated Farm System Model using local soil and climate data. The simulations quantified the performance and environmental impacts of beef cattle production systems for each region. A farm-gate life cycle assessment was used to quantify resource use and emissions for all production systems including traditional beef breeds and cull animals from the dairy industry. Regional and national totals were determined as the sum of the production system outputs multiplied by the number of cattle represented by each simulated system. The average annual greenhouse gas and reactive N emissions associated with beef cattle production over the past five years were determined to be 243 ± 26 Tg carbon dioxide equivalents (CO2e) and 1760 ± 136 Gg N, respectively. Total fossil energy use was found to be 569 ± 53 PJ and blue water consumption was 23.2 ± 3.5 TL. Environmental intensities expressed per kg of carcass weight produced were 21.3 ± 2.3 kg CO2e, 155 ± 12 g N, 50.0 ± 4.7 MJ, and 2034 ± 309 L, respectively. These farm-gate values are being combined with post farm-gate sources of packing, processing, distribution, retail, consumption and waste handling to produce a full life cycle assessment of U.S. beef. This study is the most detailed, yet comprehensive, study conducted to date to provide baseline measures for the sustainability of U.S. beef.*

Roundy, B. A., Chambers, J. C., Pyke, D. A., Miller, R. F., Tausch, R. J., Schupp, E. W., . . . Gruell, T. (2018). Resilience and resistance in sagebrush ecosystems are associated with seasonal soil temperature and water availability. *Ecosphere, 9*(9). Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054795951&doi=10.1002%2fecs2.2417&partnerID=40&md5=ece2e0d0e506be6930736cae6c99d6a8. doi:10.1002/ecs2.2417
Research Tags: Weather, Grassland
Abstract: *Invasion and dominance of exotic grasses and increased fire frequency threaten native ecosystems worldwide. In the Great Basin region of the western United States, woody and herbaceous fuel treatments are implemented to decrease the effects of wildfire and increase sagebrush (Artemisia spp.) ecosystem resilience to disturbance and resistance to exotic annual grasses. High cover of the exotic annual cheatgrass (Bromus tectorum) after treatments increases fine fuels, which in turn increases the risk of passing over a biotic threshold to a state of increased wildfire frequency and conversion to cheatgrass dominance. Sagebrush ecosystem resilience to wildfire and resistance to cheatgrass depend on climatic conditions and abundance of perennial herbaceous species that compete with cheatgrass. In this study, we used longer-term data to evaluate the relationships among soil climate conditions, perennial herbaceous cover, and cheatgrass cover following fuel management treatments across the environmental gradients that characterize sagebrush ecosystems in the Great Basin. We examined the effects of woody and herbaceous fuel treatments on soil temperature, soil water availability (13–30 and 50 cm depths), and native and exotic plant cover on six sagebrush sites lacking piñon (Pinus spp.) or juniper (Juniperus spp.) tree expansion and 11 sagebrush sites with tree expansion. Both prescribed fire and mechanical treatments increased soil water availability on woodland sites and perennial herbaceous cover on some woodland and sagebrush sites. Prescribed fire also slightly increased soil temperatures and especially increased cheatgrass cover compared to no treatment and mechanical treatments on most sites. Non-metric dimensional scaling ordination and decision tree partition analysis indicated that sites with warmer late springs and warmer and wetter falls had higher cover of cheatgrass. Sites with wetter winters and early springs (March–April) had higher cover of perennial herbs. Our findings suggest that site resistance to cheatgrass after fire and fuel control treatments decreases with a warmer and drier climate. This emphasizes the need for management actions to maintain and enhance perennial herb cover, such as implementing appropriate grazing management, and revegetating sites that have low abundance of perennial herbs in conjunction with fuel control treatments.*

Roy, T., Valdés, J. B., Lyon, B., Demaria, E. M. C., Serrat-Capdevila, A., Gupta, H. V., . . . Durcik, M. (2018). Assessing hydrological impacts of short-term climate change in the Mara River basin of East Africa. *Journal of Hydrology, 566*, 818-829. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054314743&doi=10.1016%2fj.jhydrol.2018.08.051&partnerID=40&md5=6edd8658dc3cdeab33d5b8c4e8a13344. doi:10.1016/j.jhydrol.2018.08.051
Research Tags: Water
Abstract: *We assess the impacts of a range of short-term climate change scenarios (2020–2050) on the hydrology of the Mara River Basin in East Africa using a new high-resolution (0.25°) daily climate dataset. The scenarios combine natural climate variability, as captured by a vector autoregressive (VAR) model, with a range of climate trends calculated from 31 models in the Coupled Model Intercomparison Project Phase 5 (CMIP5). The methodology translates these climate scenarios into plausible daily sequences of climate variables utilizing the Agricultural Modern-Era Retrospective Analysis for Research and Applications (AgMERRA) dataset. The new dataset (VARAG) has several advantages over traditional general circulation model outputs, such as, the statistical representation of short-term natural climate variability, availability at a daily time scale and high spatial resolution, not requiring additional downscaling, and the use of the AgMERRA data which is bias-corrected extensively. To assess the associated impacts on basin hydrology, the semi-distributed Variable Infiltration Capacity (VIC) land-surface model is forced with the climate scenarios, after being calibrated for the study area using the fine-resolution (0.05°) merged satellite and in-situ observation-based dataset, Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS). The climate data are further bias-corrected by applying a non-parametric quantile mapping scheme, where the cumulative distribution functions are approximated using kernel densities. Three different wetness scenarios (dry, average, and wet) are analyzed to see the potential short-term changes in the basin. We find that the precipitation bias correction is more in effect in the mountainous sub-basins, one of which also shows the maximum difference between the wet and dry scenario streamflows. Precipitation, evapotranspiration, and soil moisture show increasing trends mostly during the primary rainy season, while no trend is found in the corresponding streamflows. The annual values of these variables also do not change much in the coming three decades. The methodology implemented in this study*

provides a reliable range of possibilities which can greatly benefit risk analysis and infrastructure designing, and shows potential to be applied to other basins.

Ruane, A. C., Antle, J., Elliott, J., Folberth, C., Hoogenboom, G., Mason-D'Croz, D., . . . Rosenzweig, C. (2018). Biophysical and economic implications for agriculture of +1.5° and +2.0°C global warming using AgMIP Coordinated Global and Regional Assessments. *Climate Research, 76*(1), 17-39. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047785356&doi=10.3354%2fcr01520&partnerID=40&md5=ac600835ce747683929686c1c545ddf3. doi:10.3354/cr01520
Research Tags: Economics, Weather
Abstract: *This study presents results of the Agricultural Model Intercomparison and Improvement Project (AgMIP) Coordinated Global and Regional Assessments (CGRA) of +1.5° and +2.0°C global warming above pre-industrial conditions. This first CGRA application provides multi-discipline, multi-scale, and multi-model perspectives to elucidate major challenges for the agricultural sector caused by direct biophysical impacts of climate changes as well as ramifications of associated mitigation strategies. Agriculture in both target climate stabilizations is characterized by differential impacts across regions and farming systems, with tropical maize Zea mays experiencing the largest losses, while soy Glycine max mostly benefits. The result is upward pressure on prices and area expansion for maize and wheat Triticum aestivum, while soy prices and area decline (results for rice Oryza sativa are mixed). An example global mitigation strategy encouraging bioenergy expansion is more disruptive to land use and crop prices than the climate change impacts alone, even in the +2.0°C scenario which has a larger climate signal and lower mitigation requirement than the +1.5°C scenario. Coordinated assessments reveal that direct biophysical and economic impacts can be substantially larger for regional farming systems than global production changes. Regional farmers can buffer negative effects or take advantage of new opportunities via mitigation incentives and farm management technologies. Primary uncertainties in the CGRA framework include the extent of CO2 benefits for diverse agricultural systems in crop models, as simulations without CO2 benefits show widespread production losses that raise prices and expand agricultural area.*

Ruiz-Vera, U. M., De Souza, A. P., Long, S. P., & Ort, D. R. (2017). The role of sink strength and nitrogen availability in the down-regulation of photosynthetic capacity in field-grown Nicotiana tabacum L. at elevated CO<inf>2</inf> concentration. *Frontiers in Plant Science, 8*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021058500&doi=10.3389%2ffpls.2017.00998&partnerID=40&md5=b6e2e23a25fe1462693e73ae338e0a7b. doi:10.3389/fpls.2017.00998
Research Tags: Crops
Abstract: *Down-regulation of photosynthesis is among the most common responses observed in C3 plants grown under elevated atmospheric CO2 concentration ([CO2]). Down-regulation is often attributed to an insufficient capacity of sink organs to use or store the increased carbohydrate production that results from the stimulation of photosynthesis by elevated [CO2]. Down-regulation can be accentuated by inadequate nitrogen (N) supply, which may limit sink development. While there is strong evidence for down-regulation of photosynthesis at elevated [CO2] in enclosure studies most often involving potted plants, there is little evidence for this when [CO2] is elevated fully under open-air field treatment conditions. To assess the importance of sink strength on the down-regulation of photosynthesis and on the potential of N to mitigate this down-regulation under agriculturally relevant field conditions, two tobacco cultivars (Nicotiana tabacum L. cv. Petit Havana; cv. Mammoth) of strongly contrasting ability to produce the major sink of this crop, leaves, were grown under ambient and elevated [CO2] and with two different N additions in a free air [CO2] (FACE) facility. Photosynthetic down-regulation at elevated [CO2] reached only 9% in cv. Mammoth late in the season likely reflecting sustained sink strength of the rapidly growing plant whereas down-regulation in cv. Petit Havana reached 25%. Increased N supply partially mitigated down-regulation of photosynthesis in cv. Petit Havana and this mitigation was dependent on plant developmental stage. Overall, these field results were consistent with the hypothesis that sustained sink strength, that is the ability to utilize photosynthate, and adequate N supply will allow C3 crops in the field to maintain enhanced photosynthesis and therefore productivity as [CO2] continues to rise.*

Ruiz-Vera, U. M., Siebers, M. H., Jaiswal, D., Ort, D. R., & Bernacchi, C. J. (2018). Canopy warming accelerates development in soybean and maize, offsetting the delay in soybean reproductive development by elevated CO<inf>2</inf> concentrations. *Plant Cell and Environment, 41*(12), 2806-2820. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052403908&doi=10.1111%2fpce.13410&partnerID=40&md5=ec1224f48c0817613990af8c45f1e8a2. doi:10.1111/pce.13410

Research Tags: Crops

Abstract: *Increases in atmospheric CO2 concentrations ([CO2]) and surface temperature are known to individually have effects on crop development and yield, but their interactive effects have not been adequately investigated under field conditions. We evaluated the impacts of elevated [CO2] with and without canopy warming as a function of development in soybean and maize using infrared heating arrays nested within free air CO2 enrichment plots over three growing seasons. Vegetative development accelerated in soybean with temperature plus elevated [CO2] resulting in higher node number. Reproductive development was delayed in soybean under elevated [CO2], but warming mitigated this delay. In maize, both vegetative and reproductive developments were accelerated by warming, whereas elevated [CO2] had no apparent effect on development. Treatment-induced changes in the leaf carbohydrates, dark respiration rate, morphological parameters, and environmental conditions accompanied the changes in plant development. We used two thermal models to investigate their ability to predict the observed development under warming and elevated [CO2]. Whereas the growing degree day model underestimated the thermal threshold to reach each developmental stage, the alternative process-based model used (β function) was able to predict crop development under climate change conditions.*

Russell, M. B., & Woodall, C. W. (2017). Development of a downed woody debris forecasting tool using strategic-scale multiresource forest inventories. *Journal of Forestry, 115*(4), 276-282. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022230880&doi=10.5849%2fjof.15-113&partnerID=40&md5=d86e25d13b2a72b1427b4d166d4c27f5. doi:10.5849/jof.15-113

Research Tags: Research

Abstract: *The increasing interest in forest biomass for energy or carbon cycle purposes has raised the need for forest resource managers to refine their understanding of downed woody debris (DWD) dynamics. We developed a DWD forecasting tool using field measurements (mean size and stage of stage of decay) for three common forest types across the eastern United States using field observations of DWD from the US Department of Agriculture Forest Service's Forest Inventory and Analysis program. Residence times for DWD ranged from as short as 20.3 ± 9.7 years (mean ± SD) for loblolly pine biomass in the southeastern United States to as long as 41.7 ± 20.9 years for aspen biomass in the Lake States. Although we suggest numerous improvements through refined DWD measurements and models, our proposed tool can be considered a rapid assessment technique to assist natural resource managers in forecasting DWD populations. Beginning with using log size and decay stage to understand deadwood dynamics, future researchers should seek to refine DWD metrics through implementing enhanced forest inventory information and exploring the impacts of forest disturbances on inputs to the DWD pool.*

Management and Policy Implications Downed woody debris (DWD) is an integral component of forest health and is of interest to managers involved in forest management, wildlife habitat, and forest fuel assessment and fire risk. The presence and abundance of woody debris encourages biodiversity by serving as cover and habitat for deadwood-dependent plants and animals. To date, the majority of research has focused on how to accurately assess forest DWD attributes at a given time period. Our study highlights the ability to inform DWD dynamics through the development of a forecasting tool that allows managers to forecast woody debris populations. We estimated shorter residence times in southeastern US forests than in northern forest types. Through a rapid assessment of average deadwood diameter and stage of decay, trends in future deadwood stocks can be understood. Applying these results can aid natural resource managers in meeting management objectives and policy requirements that seek to maintain and/or promote the abundance of forest DWD. These results can enhance the value of using existing forest inventory information to provide insights into future forest composition and structure as a part of forest management plans.

Ryan, S. F., Valella, P., Thivierge, G., Aardema, M. L., & Scriber, J. M. (2018). The role of latitudinal, genetic and temperature variation in the induction of diapause of Papilio glaucus (Lepidoptera: Papilionidae). *Insect Science, 25*(2), 328-336. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013477688&doi=10.1111%2f1744-7917.12423&partnerID=40&md5=108434d0995a594adf0425312da911a9. doi:10.1111/1744-7917.12423
Research Tags: Wildlife
Abstract: *A key adaptation in insects for dealing with variable environmental conditions is the ability to diapause. The tiger swallowtail butterflies, Papilio glaucus and P. canadensis are ideal species to explore the genetic causes and population genetic consequences of diapause because divergence in this trait is believed to be a salient factor in maintaining a hybrid zone between these species. Yet little is known about the factors that influence diapause induction in this system. Here we explored how spatial (latitudinal), environmental (temperature) and genetic (hybridization) factors affect diapause induction in this system. Specifically, a series of growth chamber experiments using wild caught individuals from across the eastern United States were performed to: (1) evaluate how critical photoperiod varies with latitude, (2) isolate the stage in which induction occurs, (3) test whether changes in temperature affected rates of diapause induction, and (4) explore how the incidence of diapause is affected in hybrid offspring. We find that induction occurs in the larval stage, is not sensitive to a relatively broad range of temperatures, appears to have a complex genetic basis (i.e., is not simply a dominant trait following a Mendelian inheritance pattern) and that the critical photoperiod increases by 0.4 h with each increasing degree in latitude. This work deepens our understanding of how spatial, environmental and genetic variation influences a key seasonal adaptation (diapause induction) in a well-developed ecological model system and will make possible future studies that explore how climatic variation affects the population dynamics and genetics of this system.*

Saia, S. M., Suttles, K. M., Cutts, B. B., Emanuel, R. E., Martin, K. L., Wear, D. N., . . . Vose, J. M. (2019). Applying Climate Change Risk Management Tools to Integrate Streamflow Projections and Social Vulnerability. *Ecosystems*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066040162&doi=10.1007%2fs10021-019-00387-5&partnerID=40&md5=fce143eb961b636190104965b426cdf2. doi:10.1007/s10021-019-00387-5
Research Tags: Water, Economics
Abstract: *Shifts in streamflow, due to future climate and land use change, may pose risks to nearby human communities. Projecting the spatial distribution and impacts of these risks requires consideration of biophysical and socioeconomic factors. Models like the Soil and Water Assessment Tool (SWAT) can project spatial distributions of hydrologic risk due to shifting biophysical factors like climate and land use, but cannot account for socioeconomic factors influencing a community's capacity to adapt to future streamflow changes. To address this limitation, we used a risk matrix to classify subbasins in a large river basin in the southeastern USA based on (1) percent increase in SWAT simulated 10-year and extreme high flows due to climate and land use change between baseline (1982–2002) and projected (2050–2070) periods and (2) degree of community vulnerability according to a Social Vulnerability Index (SVI). We compared spatial distributions of high-risk subbasins based on SWAT results, SVI results, and the integration of SWAT and SVI results using a risk matrix. Large increases in simulated 10-year and extreme high flows occurred in middle and lower parts of the river basin, and socially vulnerable communities were distributed throughout. We identified 16, 7, and 14 unique high-risk subbasins using SWAT results, SVI results, and SWAT and SVI results, respectively. By using a risk matrix, we identified subbasins with vulnerable communities that are projected to experience future increases in streamflow due to climate and land use change. These results serve as a starting point for subsequent climate change adaptation planning.*

Sainju, U. M., Allen, B. L., Lenssen, A. W., & Mikha, M. (2017). Root and soil total carbon and nitrogen under bioenergy perennial grasses with various nitrogen rates. *Biomass and Bioenergy, 107*, 326-334. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032721802&doi=10.1016%2fj.biombioe.2017.10.021&partnerID=40&md5=81fc0ad096dbd0c5fadd9de9830e7c29. doi:10.1016/j.biombioe.2017.10.021
Research Tags: Grassland, Soil
Abstract: *As aboveground biomass of perennial grasses is harvested for feedstock or bioenergy production, root biomass C and N become primary C and N inputs for enhancing soil C and N sequestration. Information is scanty about root biomass C and N and subsequent soil C and N stocks under bioenergy perennial grasses applied with various N fertilization rates in semiarid regions. We evaluated the effect of perennial grass species and N rates on root biomass C and N and soil total C (STC) and total N (STN) stocks at the 0–120 cm depth*

from 2011 to 2013, 2–4 yr after grass establishment, in the northern Great Plains, USA. Perennial grasses were intermediate wheatgrass (Thinopyrum intermedium [Host] Barkworth and Dewey), smooth bromegrass (Bromus inermis L.), and switchgrass (Panicum virgatum L.), and N fertilization rates were 0, 28, 56, and 84 kg N ha−1. Root biomass C and N at 0–15 and 0–120 cm were greater with intermediate wheatgrass and switchgrass than smooth bromegrass in 2011, but the trend reversed for root biomass C at 0–15 cm in 2012. Root biomass C at both depths among N rates and years. The STC at 0–15, 30–60, and 0–120 cm also varied among grass species and years. At 30–60 cm, STC increased with increased N rates under intermediate wheatgrass and switchgrass, but decreased under smooth bromegrass. At 60–90 cm, the trend for STC reversed. The STN at 15–30 cm was greater under intermediate wheatgrass than smooth bromegrass and switchgrass and at most depths was greater in 2012 than 2013. Overall root biomass C and N at 0–120 cm were 12–16 times greater and STC and STN 8–9% greater under perennial grasses than adjacent annual spring wheat. Although intermediate wheatgrass returned more root C and N to the soil than other grasses, both STC and STN varied among grass species and N rates. Increased root C and N inputs, however, increased STC and STN under perennial grasses compared with annual spring wheat.

Sainju, U. M., Singh, H. P., & Singh, B. P. (2017). Soil Carbon and Nitrogen in Response to Perennial Bioenergy Grass, Cover Crop and Nitrogen Fertilization. *Pedosphere, 27*(2), 223-235. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014387872&doi=10.1016%2fS1002-0160%2817%2960312-6&partnerID=40&md5=a51cf39e7d825c03c69fbcdf5f6fa883. doi:10.1016/S1002-0160(17)60312-6

Research Tags: Soil, Energy

Abstract: *Cover crop and nitrogen (N) fertilization may maintain soil organic matter under bioenergy perennial grass where removal of aboveground biomass for feedstock to produce cellulosic ethanol can reduce soil quality. We evaluated the effects of cover crops and N fertilization rates on soil organic carbon (C) (SOC), total N (STN), ammonium N (NH4-N), and nitrate N (NO3-N) contents at the 0–5, 5–15, and 15–30 cm depths under perennial bioenergy grass from 2010 to 2014 in the southeastern USA. Treatments included unbalanced combinations of perennial bioenergy grass, energy cane (Saccharum spontaneum L.) or elephant grass (Pennisetum purpureum Schumach.), cover crop, crimson clover (Trifolium incarnatum L.), and N fertilization rates (0, 100, and 200 kg N ha−1). Cover crop biomass and C and N contents were greater in the treatment of energy cane with cover crop and 100 kg N ha−1 than in the treatment of energy cane and elephant grass. The SOC and STN contents at 0–5 and 5–15 cm were 9%–20% greater in the treatments of elephant grass with cover crop and with or without 100 kg N ha−1 than in most of the other treatments. The soil NO3-N content at 0–5 cm was 31%–45% greater in the treatment of energy cane with cover crop and 100 kg N ha−1 than in most of the other treatments. The SOC sequestration increased from 0.1 to 1.0 Mg C ha−1 year−1 and the STN sequestration from 0.03 to 0.11 Mg N ha−1 year−1 from 2010 to 2014 for various treatments and depths. In contrast, the soil NH4-N and NO3-N contents varied among treatments, depths, and years. Soil C and N storages can be enriched and residual NO3-N content can be reduced by using elephant grass with cover crop and with or without N fertilization at a moderate rate.*

Saksa, P., Safeeq, M., & Dymond, S. (2017). Recent patterns in climate, vegetation, and forest water use in California montane watersheds. *Forests, 8*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027464346&doi=10.3390%2ff8080278&partnerID=40&md5=447a2481722bd3321e7904bee66dd40a. doi:10.3390/f8080278

Research Tags: Weather, Forest

Abstract: *California has recently experienced one of the worst droughts on record, negatively impacting forest ecosystems across the state. As a major source of the region's water supply, it is important to evaluate the vegetation and water balance response of these montane forested watersheds to climate variability across the range of rain- to snow-dominated precipitation regimes. The Standardized Precipitation Index (SPI) and the Standardized Runoff Index (SRI) were used to capture the hydrologic drought signal, and MODIS vegetation indices (i.e., the normalized difference vegetation index and the enhanced vegetation index) were used to evaluate the vegetation and evapotranspiration response in three headwater catchments. The study catchments comprised a low elevation rain-dominated site (Caspar Creek) on the northern California coast, a mid-elevation site with a mix of rain and snow (Providence Creek) in the California Sierra Nevada, and a high elevation snow-dominated site (Bull Creek) in the Sierra Nevada. Lowest SPI values occurred in the third drought year of*

2014 for all sites. Lowest SRI was in 2014 for Caspar, but in 2015 for Providence and Bull, reflecting differences in snowpack-delayed runoff and subsurface storage capacity between the lower and higher elevation watersheds. The most accurate water balance closure using evapotranspiration estimates from vegetation indices was within 10% of measured precipitation at snow-dominated Bull. The rain-dominated Caspar watershed had the highest vegetation index values and annual evapotranspiration, with the lowest variability over the previous 13 years (2004–2016). Vegetation index values and annual evapotranspiration decreased with increasing elevation and snow contribution to precipitation. Both snow-influenced Sierra Nevada watersheds showed elevated vegetation and evapotranspiration responses to interannual climate variability. There remains a need for institutional support to expand long-term observations in remote forested mountain watersheds to monitor and research these changing and extreme environmental conditions in source watershed regions.

Salas-Leiva, D. E., Meerow, A. W., Calonje, M., Francisco-Ortega, J., Patrick Griffith, M., Nakamura, K., . . . Knowles, D. (2017). Shifting Quaternary migration patterns in the Bahamian archipelago: Evidence from the Zamia pumila complex at the northern limits of the Caribbean island biodiversity hotspot. *American Journal of Botany, 104*(5), 757-771. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019713440&doi=10.3732%2fajb.1700054&partnerID=40&md5=d157d9628f0cc2a84b7d022b74642920. doi:10.3732/ajb.1700054

Research Tags: Forestry

Abstract: *PREMISE OF THE STUDY:*
The Bahamas archipelago is formed by young, tectonically stable carbonate banks that harbor direct geological evidence of global ice-volume changes. We sought to detect signatures of major changes on gene flow patterns and reconstruct the phylogeographic history of the monophyletic Zamia pumila complex across the Bahamas.
METHODS:
Nuclear molecular markers with both high and low mutation rates were used to capture two different time scale signatures and test several gene flow and demographic hypotheses.
KEY RESULTS:
Single-copy nuclear genes unveiled apparent ancestral admixture on Andros, suggesting a significant role of this island as main hub of diversity of the archipelago. We detected demographic and spatial expansion of the Zamia pumila complex on both paleo-provinces around the Piacenzian (Pliocene)/Gelasian (Pleistocene). Populations evidenced signatures of different migration models that have occurred at two different times. Populations on Long Island (Z. lucayana) may either represent a secondary colonization of the Bahamas by Zamia or a rapid and early-divergence event of at least one population on the Bahamas.
CONCLUSIONS:
Despite changes in migration patterns with global climate, expected heterozygosity with both marker systems remains within the range reported for cycads, but with significant levels of increased inbreeding detected by the microsatellites. This finding is likely associated with reduced gene flow between and within paleo-provinces, accompanied by genetic drift, as rising seas enforced isolation. Our study highlights the importance of the maintenance of the predominant direction of genetic exchange and the role of overseas dispersion among the islands during climate oscillations.

Saleh, A., Niraula, R., Marek, G. W., Gowda, P. H., Brauer, D. K., & Howell, T. A. (2018). Lysimetric evaluation of the apex model to simulate daily et for irrigated crops in the Texas high plains. *Transactions of the ASABE, 61*(1), 65-74. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042223256&doi=10.13031%2ftrans.11938&partnerID=40&md5=1f9052c1a3d1c51025b9caf02b1d956f. doi:10.13031/trans.11938

Research Tags: Crops, Water, Soil

Abstract: *The NTT (Nutrient Tracking Tool) was designed to provide an opportunity for all users, including producers, to run complex simulation models, such as APEX (Agricultural Policy Environmental eXtender), with the associated required databases. The APEX model currently nested within NTT provides estimates of the changes in nitrogen (N), phosphorus (P), and sediment losses that are associated with management practices specified by the user. Five methods (Penman-Monteith, Penman, Priestley-Taylor, Hargreaves-Samani, and Baier-Robertson) for determining potential evapotranspiration (PET) are available as inputs for estimating*

actual ET. This study was conducted to evaluate the accuracy of the ET values obtained from the five PET equations currently available in APEX using both onsite measured climate data and data from the NTT standard databases. The mean daily, monthly, and annual ET values predicted by each of the equations in APEX for a lysimeter field at the USDA-ARS Conservation and Production Research Laboratory at Bushland, Texas, was compared to values measured for the 2001-2010 period. APEX generally underestimated ET with all PET methods (mostly during growing seasons) at both the daily and monthly levels but overpredicted for years when cotton was grown as the major cash crop due to overprediction of leaf area index during the senescing stage for cotton. The underprediction of ET in growing seasons was possibly from underprediction of rainfall due to estimation of rainfall for missing data. Overall, APEX was able to adequately ($R2 \geq 0.82$ and $NSE \geq 0.80$) predict mean monthly ET for major crops grown in the semi-arid Texas High Plains region. These results should reinforce confidence in APEX's ability to simulate ET accurately for fully irrigated farms. ET predictions with the Hargreaves-Samani and Priestley-Taylor methods, which require limited data compared to the Penman and Penman-Monteith methods, were similar ($p > 0.05$, one-way ANOVA), with mean errors within 8.7% for measured weather data and 12.6% for NTT-generated weather data for both methods. This is encouraging because of the limited availability of measured climate data for the majority of locations in the world, including the U.S.

Samtani, J. B., Rom, C. R., Friedrich, H., Fennimore, S. A., Finn, C. E., Petran, A., . . . Bergefurd, B. (2019). The status and future of the strawberry industry in the United States. *HortTechnology, 29*(1), 11-24. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065226730&doi=10.21273%2fhorttech04135-18&partnerID=40&md5=2f38988aaf50acc0435e971283201c33. doi:10.21273/horttech04135-18

Research Tags: Crops

Abstract: *Strawberry (Fragaria ×ananassa) production practices followed by growers in the United States vary by region. Understanding the challenges, needs, and opportunities in each region is essential to guide research, policy, and marketing strategies for the strawberry industry across the country, and to enable the development of general and region-specific educational and production tools. This review divided the United States into eight distinct geographic regions and an indoor controlled or protected environment production system. Current production systems, markets, cultivars, trends, and future directions for each region are discussed. A common trend across all regions is the increasing use of protected culture strawberry production with both day-neutral and short-day cultivars for season extension to meet consumer demand for year-round availability. All regions experience challenges with pests and obtaining adequate harvest labor. Increasing consumer demand for berries, climate change-induced weather variability, high pesticide use, labor and immigration policies, and land availability impact regional production, thus facilitating the adoption of new technologies such as robotics and network communications to assist with strawberry harvesting in open-field production and production under controlled-environment agriculture and protected culture.*

Samuelson, L., Johnsen, K., Stokes, T., Anderson, P., & Nelson, C. D. (2018). Provenance variation in pinus palustris foliar δ13C. *Forests, 9*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054935636&doi=10.3390%2ff9080466&partnerID=40&md5=320cfe66583d92100fe3ab1415e73887. doi:10.3390/f9080466

Research Tags: Forestry

Abstract: *Longleaf pine forests are currently being restored in the southern U.S. To aid in the deployment of longleaf pine under current and future climate conditions, we tested the hypothesis that genetic variability in foliar carbon isotope composition (δ13C) exists in this species. Foliar δ13C, height and diameter were measured at ages of 5 and 6 years, and needle length, specific leaf weight (SLW) and foliar N concentration were measured at an age of 6 years in 16 longleaf pine families representing a large portion of the species' range. Families were grown in common garden tests in North Carolina and Mississippi and grouped for analysis into six provenances based on climate, soils, and discontinuities in the species' range. No genetic by environment interactions were observed. Greater foliar δ13C was observed in trees from the provenance consisting of the Piedmont and Montane Uplands than from the provenances representing the western and eastern Gulf Coastal Plains. Foliar δ13C was not significantly correlated to height at age 6, suggesting that it may be possible to select for improved foliar δ13C without sacrificing growth. These results represent a first step in identifying potential genetic variation in leaf water use efficiency and drought tolerance of longleaf pine.*

Samuelson, L. J., Stokes, T. A., Butnor, J. R., Johnsen, K. H., Gonzalez-Benecke, C. A., Martin, T. A., . . . Lewis, J. C. (2017). Ecosystem carbon density and allocation across a chronosequence of longleaf pine forests. *Ecological Applications, 27*(1), 244-259. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008350892&doi=10.1002%2feap.1439&partnerID=40&md5=2a67b17e46d650df5eb0b927b3ecedc9. doi:10.1002/eap.1439

Research Tags: Forestry

Abstract: *Forests can partially offset greenhouse gas emissions and contribute to climate change mitigation, mainly through increases in live biomass. We quantified carbon (C) density in 20 managed longleaf pine (Pinus palustris Mill.) forests ranging in age from 5 to 118 years located across the southeastern United States and estimated above- and belowground C trajectories. Ecosystem C stock (all pools including soil C) and aboveground live tree C increased nonlinearly with stand age and the modeled asymptotic maxima were 168 Mg C/ha and 80 Mg C/ha, respectively. Accumulation of ecosystem C with stand age was driven mainly by increases in aboveground live tree C, which ranged from <1 Mg C/ha to 74 Mg C/ha and comprised <1% to 39% of ecosystem C. Live root C (sum of below-stump C, ground penetrating radar measurement of lateral root C, and live fine root C) increased with stand age and represented 4–22% of ecosystem C. Soil C was related to site index, but not to stand age, and made up 39–92% of ecosystem C. Live understory C, forest floor C, downed dead wood C, and standing dead wood C were small fractions of ecosystem C in these frequently burned stands. Stand age and site index accounted for 76% of the variation in ecosystem C among stands. The mean root-to-shoot ratio calculated as the average across all stands (excluding the grass-stage stand) was 0.54 (standard deviation of 0.19) and higher than reports for other conifers. Long-term accumulation of live tree C, combined with the larger role of belowground accumulation of lateral root C than in other forest types, indicates a role of longleaf pine forests in providing disturbance-resistant C storage that can balance the more rapid C accumulation and C removal associated with more intensively managed forests. Although other managed southern pine systems sequester more C over the short-term, we suggest that longleaf pine forests can play a meaningful role in regional forest C management.*

Sanad, M. N. M. E., Smertenko, A., & Garland-Campbell, K. A. (2019). Differential dynamic changes of reduced trait model for analyzing the plastic response to drought phases: A case study in spring wheat. *Frontiers in Plant Science, 10*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067365730&doi=10.3389%2ffpls.2019.00504&partnerID=40&md5=266ac826fd05a40ff2265ba75709134c. doi:10.3389/fpls.2019.00504

Research Tags: Weather, Crops

Abstract: *Current limited water availability due to climate changes results in severe drought stress and desiccation in plants. Phenotyping drought tolerance remains challenging. In particular, our knowledge about the discriminating power of traits for capturing a plastic phenotype in high-throughput settings is scant. The study is designed to investigate the differential performance and broad-sense heritability of a battery set of morphological, physiological, and cellular traits to understand the adaptive phenotypic response to drought in spring wheat during the tillering stage. The potential of peroxisome abundance to predict the adaptive response under severe drought was assessed using a high-throughput technique for peroxisome quantification in plants. The research dissected the dynamic changes of some phenological traits during three successive phases of drought using two contrasting genotypes of adaptability to drought. The research demonstrates 5 main findings: (1) a reduction of the overall dimension of the phenological traits for robust phenotyping of the adaptive performance under drought; (2) the abundance of peroxisomes in response to drought correlate negatively with grain yield; (3) the efficiency of ROS homeostasis through peroxisome proliferation which seems to be genetically programmed; and (4) the dynamics of ROS homeostasis seems to be timing dependent mechanism, the tolerant genotype response is earlier than the susceptible genotype. This work will contribute to the identification of robust plastic phenotypic tools and the understanding of the mechanisms for adaptive behavior under drought conditions.*

Sanchez, G. M., Smith, J. W., Terando, A., Sun, G., & Meentemeyer, R. K. (2018). Spatial Patterns of Development Drive Water Use. *Water Resources Research, 54*(3), 1633-1649. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043376343&doi=10.1002%2f2017WR021730&part

nerID=40&md5=8700ccccc9cff41c1102b92c20bc6c00. doi:10.1002/2017WR021730
Research Tags: Water
Abstract: *Water availability is becoming more uncertain as human populations grow, cities expand into rural regions and the climate changes. In this study, we examine the functional relationship between water use and the spatial patterns of developed land across the rapidly growing region of the southeastern United States. We quantified the spatial pattern of developed land within census tract boundaries, including multiple metrics of density and configuration. Through non-spatial and spatial regression approaches we examined relationships and spatial dependencies between the spatial pattern metrics, socio-economic and environmental variables and two water use variables: a) domestic water use, and b) total development-related water use (a combination of public supply, domestic self-supply and industrial self-supply). Metrics describing the spatial patterns of development had the highest measure of relative importance (accounting for 53% of model's explanatory power), explaining significantly more variance in water use compared to socio-economic or environmental variables commonly used to estimate water use. Integrating metrics characterizing the spatial pattern of development into water use models is likely to increase their utility and could facilitate water-efficient land use planning.*

Sánchez, M. E., Chimner, R. A., Hribljan, J. A., Lilleskov, E. A., & Suárez, E. (2017). Carbon dioxide and methane fluxes in grazed and undisturbed mountain peatlands in the ecuadorian Andes. *Mires and Peat, 19*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042228527&doi=10.19189%2fMaP.2017.OMB.277&partnerID=40&md5=9ac26064850587fe7b748d816429d576. doi:10.19189/MaP.2017.OMB.277
Research Tags: Soil, Emissions, Livestock
Abstract: *Peatlands are widespread throughout the tropical Andean páramo. Despite the large carbon stocks in these ecosystems, carbon dioxide (CO2) and methane (CH4) flux data are lacking. In addition, cattle grazing is widespread in the páramo and could alter gas fluxes. Therefore, our objectives were to measure CO2 and CH4 fluxes with the static chamber technique in an undisturbed and in an intensively cattle grazed peatland in the mountains of Ecuador. We found that hummocks in the undisturbed site had higher net ecosystem exchange (NEE), gross primary production (GPP), ecosystem respiration (ER), and CH4 fluxes, compared to lawns. In contrast, microtopography at the grazed site did not predict CO2 fluxes, whereas vegetation cover was correlated for all three metrics (NEE, ER, and GPP). At low vegetation cover, NEE was positive (losing carbon). CH4 emissions in the undisturbed site were low (8.1 mg CH4 m-2 d-1). In contrast, CH4 emissions at the grazed site were much greater (132.3 mg CH4 m-2 d-1). This is probably attributable to trampling and nutrient inputs from cattle. In summary, the two peatlands differed greatly in CO2 and CH4 exchange rates, which could be due to the variation in climate and hydrology, or alternatively to intensive grazing by cattle.*

Sánchez-Cañete, E. P., Scott, R. L., van Haren, J., & Barron-Gafford, G. A. (2017). Improving the accuracy of the gradient method for determining soil carbon dioxide efflux. *Journal of Geophysical Research: Biogeosciences, 122*(1), 50-64. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008471568&doi=10.1002%2f2016JG003530&partnerID=40&md5=c2186106a50d314964769c0e1d6832e0. doi:10.1002/2016JG003530
Research Tags: Soil, Research
Abstract: *Soil CO2 efflux (Fsoil) represents a significant source of ecosystem CO2 emissions that is rarely quantified with high-temporal-resolution data in carbon flux studies. Fsoil estimates can be obtained by the low-cost gradient method (GM), but the utility of the method is hindered by uncertainties in the application of published models for the diffusion coefficient. Therefore, to address and resolve these uncertainties, we compared Fsoil measured by 2 soil CO2 efflux chambers and Fsoil estimated by 16 gas transport models using the GM across 1 year. We used 14 published empirical gas diffusion models and 2 in situ models: (1) a gas transfer model called "Chamber model" obtained using a calibration between the chamber and the gradient method and (2) a diffusion model called "SF6 model" obtained through an interwell conservative tracer experiment. Most of the published models using the GM underestimated cumulative annual Fsoil by 55% to 361%, while the Chamber model closely approximated cumulative Fsoil (0.6% error). Surprisingly, the SF6 model combined with the GM underestimated Fsoil by 32%. Differences between in situ models could stem from the Chamber model implicitly accounting for production of soil CO2, while the conservative tracer model does not. Therefore, we recommend using the GM only after calibration with chamber measurements to*

generate reliable long-term ecosystem Fsoil measurements. Accurate estimates of Fsoil will improve our understanding of soil respiration's contribution to ecosystem fluxes.

SanClements, M. D., Fernandez, I. J., Lee, R. H., Roberti, J. A., Adams, M. B., Rue, G. A., & McKnight, D. M. (2018). Long-Term Experimental Acidification Drives Watershed Scale Shift in Dissolved Organic Matter Composition and Flux. *Environmental Science and Technology, 52*(5), 2649-2657. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043270345&doi=10.1021%2facs.est.7b04499&partnerID=40&md5=2a28bb564bbc0907ba1f0ce3a2dad506. doi:10.1021/acs.est.7b04499
Research Tags: Water
Abstract: *Over the last several decades dissolved organic carbon concentrations (DOC) in surface waters have increased throughout much of the northern hemisphere. Several hypotheses have been proposed regarding the drivers of this phenomenon including decreased sulfur (S) deposition working via an acidity- change mechanism. Using fluorescence spectroscopy and data from two long-term (24+ years at completion of this study) whole watershed acidification experiments, that is, the Bear Brook Watershed in Maine (BBWM) and Fernow Experimental Forest in West Virginia (FEF) allowed us to control for factors other than the acidity-change mechanism (e.g., differing vegetation, shifting climate), resulting in the first study we are aware of where the acidity change mechanism could be experimentally isolated at the whole ecosystem and decadal scales as the driver of shifts in DOM dynamics. The multidecadal record of stream chemistry at BBWM demonstrates a significantly lower DOC concentration in the treated compared to the reference watershed. Additionally, at both BBWM and FEF we found significant and sustained differences in stream fluorescence index (FI) between the treated and reference watersheds, with the reference watersheds demonstrating a stronger terrestrial DOM signature. These data, coupled with evidence of pH shifts in upper soil horizons support the hypotheses that declines in S deposition are driving changes in the solubility of soil organic matter and increased flux of terrestrial DOC to water bodies.*

Sándor, R., Ehrhardt, F., Brilli, L., Carozzi, M., Recous, S., Smith, P., . . . Bellocchi, G. (2018). The use of biogeochemical models to evaluate mitigation of greenhouse gas emissions from managed grasslands. *Science of the Total Environment, 642*, 292-306. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048721429&doi=10.1016%2fj.scitotenv.2018.06.020&partnerID=40&md5=89526bfbbf64168e558d20c725ec1e16. doi:10.1016/j.scitotenv.2018.06.020
Research Tags: Grassland
Abstract: *Simulation models quantify the impacts on carbon (C) and nitrogen (N) cycling in grassland systems caused by changes in management practices. To support agricultural policies, it is however important to contrast the responses of alternative models, which can differ greatly in their treatment of key processes and in their response to management. We applied eight biogeochemical models at five grassland sites (in France, New Zealand, Switzerland, United Kingdom and United States) to compare the sensitivity of modelled C and N fluxes to changes in the density of grazing animals (from 100% to 50% of the original livestock densities), also in combination with decreasing N fertilization levels (reduced to zero from the initial levels). Simulated multi-model median values indicated that input reduction would lead to an increase in the C sink strength (negative net ecosystem C exchange) in intensive grazing systems: −64 ± 74 g C m−2 yr−1 (animal density reduction) and −81 ± 74 g C m−2 yr−1 (N and animal density reduction), against the baseline of −30.5 ± 69.5 g C m−2 yr−1 (LSU [livestock units] ≥ 0.76 ha−1 yr−1). Simulations also indicated a strong effect of N fertilizer reduction on N fluxes, e.g. N2O-N emissions decreased from 0.34 ± 0.22 (baseline) to 0.1 ± 0.05 g N m−2 yr−1 (no N fertilization). Simulated decline in grazing intensity had only limited impact on the N balance. The simulated pattern of enteric methane emissions was dominated by high model-to-model variability. The reduction in simulated offtake (animal intake + cut biomass) led to a doubling in net primary production per animal (increased by 11.6 ± 8.1 t C LSU−1 yr−1 across sites). The highest N2O-N intensities (N2O-N/offtake) were simulated at mown and extensively grazed arid sites. We show the possibility of using grassland models to determine sound mitigation practices while quantifying the uncertainties associated with the simulated outputs.*

Sands, R. D. (2018). U.S. CARBON TAX SCENARIOS and BIOENERGY. *Climate Change Economics, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044264430&doi=10.1142%2fS2010007818400109

&partnerID=40&md5=571bf1d1c8b50485844318e2d5fffcc6. doi:10.1142/S2010007818400109
Research Tags: Economics
Abstract: *This paper documents application of the Future Agricultural Resources Model (FARM) to stylized carbon tax scenarios specified by the Stanford Energy Modeling Forum (EMF). Model results show that the method of tax revenue recycling makes a difference. Either labor-tax, or capital-tax, recycling can reduce the welfare cost of a carbon tax policy relative to lump sum recycling. Of the two tax recycling options, reducing capital taxes provides the greater reduction in welfare costs. However, carbon tax revenues decline with stringent carbon dioxide (CO2) emission targets and the availability of a negative-emissions technology such as bio-electricity with CO2 capture and storage (BECCS). As BECCS expands, net carbon tax revenues peak and decline due to an offsetting subsidy for carbon sequestration, limiting the potential for labor- or capital-tax recycling to reduce welfare costs of a climate policy.*

Sankey, J. B., Kreitler, J., Hawbaker, T. J., McVay, J. L., Miller, M. E., Mueller, E. R., . . . Sankey, T. T. (2017). Climate, wildfire, and erosion ensemble foretells more sediment in western USA watersheds. *Geophysical Research Letters, 44*(17), 8884-8892. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029055258&doi=10.1002%2f2017GL073979&partnerID=40&md5=9bee6224558fd75f3cb3f769d0b568b6. doi:10.1002/2017GL073979
Research Tags: Weather, Soil, Water
Abstract: *The area burned annually by wildfires is expected to increase worldwide due to climate change. Burned areas increase soil erosion rates within watersheds, which can increase sedimentation in downstream rivers and reservoirs. However, which watersheds will be impacted by future wildfires is largely unknown. Using an ensemble of climate, fire, and erosion models, we show that postfire sedimentation is projected to increase for nearly nine tenths of watersheds by >10% and for more than one third of watersheds by >100% by the 2041 to 2050 decade in the western USA. The projected increases are statistically significant for more than eight tenths of the watersheds. In the western USA, many human communities rely on water from rivers and reservoirs that originates in watersheds where sedimentation is projected to increase. Increased sedimentation could negatively impact water supply and quality for some communities, in addition to affecting stream channel stability and aquatic ecosystems.*

Sapkota, A., Murtugudde, R., Curriero, F. C., Upperman, C. R., Ziska, L., & Jiang, C. (2019). Associations between alteration in plant phenology and hay fever prevalence among US adults: Implication for changing climate. *PLoS ONE, 14*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063659529&doi=10.1371%2fjournal.pone.0212010&partnerID=40&md5=4763ae6ca92cc6d88edf9a4b99f68fb5. doi:10.1371/journal.pone.0212010
Research Tags: Weather
Abstract: *Plant phenology (e.g. timing of spring green-up, flowering) is among the most sensitive indicator of ecological response to ongoing climate variability and change. While previous studies have documented changes in the timing of spring green-up and flowering across different parts of the world, empirical evidence regarding how such ongoing ecological changes impact allergic disease burden at population level is lacking. Because earlier spring green-up may increase season length for tree pollen, we hypothesized that early onset of spring (negative anomaly in start of season (SOS)) will be associated with increased hay fever burden. To test this, we first calculated a median cardinal date for SOS for each county within the contiguous US for the years 2001–2013 using phenology data from the National Aeronautics and Space Administration's Moderate Resolution Imaging Spectroradiometer (MODIS). We categorized yearly deviations in SOS for each county from their respective long-term averages as: very early (>3 wks early), early (1–3 wks early), average (within 1 wk), late (1–3 wks late) and very late (> 3 wks late). We linked these data to 2002–2013 National Health Interview Survey data, and investigated the association between changes in SOS and hay fever prevalence using logistic regression. We observed that adults living in counties with a very early onset of SOS had a 14% higher odds of hay fever compared to the reference group, i.e. those living in counties where onset of spring was within the normal range (Odds Ratios (OR): 1.14. 95% Confidence Interval (CI): 1.03–1.27). Likewise, adults living in counties with very late onset of SOS had a 18% higher odds hay fever compared to the reference group (OR: 1.18, CI: 1.05–1.32). Our data provides the first-ever national scale assessment of the impact of changing plant phenology–linked to ongoing climate variability and change–on hay fever prevalence. Our findings are likely*

tied to changes in pollen dynamics, i.e early onset of spring increases the duration of exposure to tree pollen, while very late onset of spring increases the propensity of exposure because of simultaneous blooming.

Sarauer, J. L., Page-Dumroese, D. S., & Coleman, M. D. (2019). Soil greenhouse gas, carbon content, and tree growth response to biochar amendment in western United States forests. *GCB Bioenergy, 11*(5), 660-671. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061077123&doi=10.1111%2fgcbb.12595&partnerID=40&md5=23879986927b76934c1475c4a6dc5995. doi:10.1111/gcbb.12595
Research Tags: Emissions, Soil, Forestry
Abstract: *Restoring overstocked forests by thinning and pyrolyzing residual biomass produces biochar and other value-added products. Forest soils amended with biochar have potential to sequester carbon (C), improve soil quality, and alter greenhouse gas (GHG) emissions without depleting nutrient stocks. Yet, few studies have examined the effects of biochar on GHG emissions and tree growth in temperate forest soils. We measured GHG emissions, soil C content, and tree growth at managed forest sites in Idaho, Montana, and Oregon. We applied biochar amendments of 0, 2.5, or 25 Mg/ha to the forest soil surface. Flux of carbon dioxide and methane varied by season; however, neither were affected by biochar amendment. Flux of nitrous oxide was not detected at these nitrogen-limited and unfertilized forest sites. Biochar amendment increased soil C content by 41% but did not affect tree growth. Overall, biochar had no detrimental effects on forest trees or soils. We conclude that biochar can be used harmlessly for climate change mitigation in forests by sequestering C in the soil.*

Savage, S. L., Lawrence, R. L., & Squires, J. R. (2017). Mapping post-disturbance forest landscape composition with Landsat satellite imagery. *Forest Ecology and Management, 399*, 9-23. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019904440&doi=10.1016%2fj.foreco.2017.05.017&partnerID=40&md5=124c1df8fbbf37043aad09b493a4d070. doi:10.1016/j.foreco.2017.05.017
Research Tags: Forestry
Abstract: *Forests worldwide are impacted by a wide variety of disturbances that are happening more frequently with more intensity than in the past due to global climate change. Forest managers, therefore, need to identify new ways to quickly and accurately predict post-disturbance forest landscape composition. We suggest the use of Landsat satellite imagery and an image processing tool to map percent canopy cover (PCC) by species and sub-canopy species counts to be used in adaptive forest management strategies. We used zero-inflated models to successfully predict PCC and sub-canopy counts (number of regenerating trees per pixel, also called biotic legacies) for 4 tree species, along with overall PCC and percent mortality, for a large portion of the Rio Grande National Forest (RGNF) in 2013. The RGNF had recently been disturbed by spruce beetle (Dendroctonus rufipennis) infestation since the early 2000s and the West Fork Fire Complex in 2013. Our PCC models resulted in pseudo median differences between observed and predicted values of 0.2–6.5%, RMSE of 10.9–17.0%, and 95% confidence interval widths of 4.4–24.9%, depending on the species. The percent mortality model resulted in pseudo median differences between observed and predicted values of 1.1%, RMSE of 12.4%, and 95% confidence interval width of 4.6%. The sub-canopy PCC model resulted in a pseudo median differences between observed and predicted values of 1.3%, RMSE of 9.4%, and 95% confidence interval of 3.0%. The sub-canopy count models resulted in mean differences of 0.1–1.4 trees, RMSE of 3.0–13.4 trees, and 95% confidence interval widths of 1.1–5.0 trees, depending on species. By mapping PCC and sub-canopy counts, we have provided forest managers with knowledge of the current surviving forest (PCC) as well as the biotic legacies (sub-canopy counts) that can aid in forming hypotheses as to what the forest might become in the future, adding to the forest manager toolbox for forest management strategies. The methods described can be applied to a variety of issues within the field of disturbance ecology and, combined with change analyses, will provide forest managers with empirical evidence of current and future forest composition along with biological legacies that will impact forest regeneration.*

Savage, S. L., Lawrence, R. L., Squires, J. R., Holbrook, J. D., Olson, L. E., Braaten, J. D., & Cohen, W. B. (2018). Shifts in forest structure in northwest Montana from 1972 to 2015 using the landsat archive from multispectral scanner to operational land imager. *Forests, 9*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044403364&doi=10.3390%2ff9040157&partnerID

=40&md5=488311825ee6adc43459bc20fdedd745. doi:10.3390/f9040157
Research Tags: Forestry
Abstract: *There is a pressing need to map changes in forest structure from the earliest time period possible given forest management policies and accelerated disturbances from climate change. The availability of Landsat data from over four decades helps researchers study an ecologically meaningful length of time. Forest structure is most often mapped utilizing lidar data, however these data are prohibitively expensive and cover a narrow temporal window relative to the Landsat archive. Here we describe a technique to use the entire length of the Landsat archive from Multispectral Scanner to Operational Land Imager (M2O) to produce three novel outcomes: (1) we used the M2O dataset and standard change vector analysis methods to classify annual forest structure in northwestern Montana from 1972 to 2015, (2) we improved the accuracy of each yearly forest structure classification by applying temporal continuity rules to the whole time series, with final accuracies ranging from 97% to 68% respectively for two and six-category classifications, and (3) we demonstrated the importance of pre-1984 Landsat data for long-term change studies. As the Landsat program continues to acquire Earth imagery into the foreseeable future, time series analyses that aid in classifying forest structure accurately will be key to the success of any land management changes in the future.*

Sawaya, M. A., Clevenger, A. P., & Schwartz, M. K. (2019). Demographic fragmentation of a protected wolverine population bisected by a major transportation corridor. *Biological Conservation, 236*, 616-625. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069809543&doi=10.1016%2fj.biocon.2019.06.030&partnerID=40&md5=c40e7f0702ba46bf3adb12bb201c6ef1. doi:10.1016/j.biocon.2019.06.030
Research Tags: Wildlfie
Abstract: *Roads fragment ecosystems around the globe, but the effects of this fragmentation on biodiversity remain poorly understood. Wolverines (Gulo gulo) are snow-dependent carnivores that occur at low densities and they exhibit low genetic diversity at the southern extent of their range where they are snow-limited and fragmented by human development. Therefore, understanding the effect of roads and transportation infrastructure on population connectivity in protected strongholds such as national parks is crucial to effective wolverine management in a changing climate. We assessed whether the Trans-Canada Highway, Canada's largest east-west transportation corridor, affects wolverine gene flow in the Rocky Mountains. We used noninvasive genetic sampling methods (i.e., hair traps, backtracking) to collect DNA samples (i.e. hair, scat) from an 8000 km2 area of Banff, Kootenay, and Yoho National Parks and provincial lands and then used population and individual-based genetic analyses (e.g., assignment tests, principal coordinates analysis) to examine genetic structure across the highway in the national parks complex. We collected 2586 DNA samples between 2010 and 2013 from which we identified 49 unique individuals (29 males, 20 females). We detected weak population structure in males and relatively strong genetic differentiation in females spanning the highway with complementary nuclear and mitochondrial DNA analyses. Our results demonstrate that sex-biased dispersal across a major highway can lead to genetic isolation and demographic fragmentation in a protected carnivore population, highlighting the urgent need to maintain connectivity for wildlife over an expanding global road network in the face of climate change, landscape degradation, and loss of biodiversity.*

Schaedel, M. S., Larson, A. J., Affleck, D. L. R., Belote, R. T., Goodburn, J. M., & Page-Dumroese, D. S. (2017). Early forest thinning changes aboveground carbon distribution among pools, but not total amount. *Forest Ecology and Management, 389*, 187-198. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008873185&doi=10.1016%2fj.foreco.2016.12.018&partnerID=40&md5=0d515d305cdd6606ab7d17cc3eba462a. doi:10.1016/j.foreco.2016.12.018
Research Tags: Forestry
Abstract: *Mounting concerns about global climate change have increased interest in the potential to use common forest management practices, such as forest density management with thinning, in climate change mitigation and adaptation efforts. Long-term effects of forest density management on total aboveground C are not well understood, especially for precommercial thinning (PCT) implemented very early in stand development. To assess the climate change mitigation potential of PCT, as well as tradeoffs with climate change adaptation, we examined total aboveground C stores in a 54-year-old western larch (Larix occidentalis Nutt.) precommercial thinning experiment to determine how different PCT treatments affect long-term aboveground C storage and distribution among pools. Four aboveground C pools (live overstory, live*

understory/mid-story, woody detritus, and forest floor) were measured and separated into C accumulated prior to initiation of the current stand (legacy C) and C accumulated by the current stand (non-legacy C). PCT had no influence on the total non-legacy aboveground C stores 54 years after treatment. Live tree C was nearly identical across densities due to much larger trees in low density treatments. Low density stands had more understory and mid-story C while unthinned plots had significantly more non-legacy woody detritus C than thinned stands. Legacy pools did not vary significantly with density, but made up a substantial proportion of aboveground C stores. We found that: (1) fifty-four years after PCT total aboveground C is similar across treatments, due primarily to the increase in mean tree C of trees grown at lower stand densities; (2) deadwood legacies from the pre-disturbance forest still play an important role in long-term C storage 62 years after current stand initiation, accounting for approximately 20–25% of aboveground C stores; and (3) given enough time since early thinning, there is no trade-off between managing stands to promote individual tree growth and development of understory vegetation, and maximizing stand level accumulation of aboveground C over the long term. We infer that early PCT can be used to simultaneously achieve climate change mitigation and adaptation objectives, provided treatments are implemented early in stand development before canopy closure and the onset of intense intertree competition.

Schantz, M., Sheley, R., & Hardegree, S. (2019). Restoring Perennial Grasses in Medusahead Habitat: Role of Tilling, Fire, Herbicides, and Seeding Rate. *Rangeland Ecology and Management, 72*(2), 249-259. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059105374&doi=10.1016%2fj.rama.2018.10.012&partnerID=40&md5=646545d604ab2f736e60fa3037aa56ba. doi:10.1016/j.rama.2018.10.012

Research Tags: Grassland, Weather

Abstract: *Restoring arid regions degraded by invasive annual grasses to native perennial grasses is a critical conservation goal. Targeting site availability, species availability, and species performance is a key strategy for reducing invasive annual grass cover while simultaneously increasing the abundance of seeded native perennial grasses. However, the potential for establishing successful seedings is still highly variable in rangeland ecosystems, likely because of variable year-to-year weather. In this study, we evaluated the independent and combined inputs of tilling, burning, applying imazapic herbicide, and varying seeding rates on existing species and seeded native perennial grass performance from 2008 to 2012 in a southwestern Idaho rangeland ecosystem. We found that combining tilling, fire, and herbicides produced the lowest annual grass cover. The combination of fire and herbicides yielded the highest seeded species density in the hydrologic year (HY) (October − September) 2010, especially at higher than minimum recommended seeding rates. Although the independent and combined effects of fire and herbicides directly affected the growth of resident species, they failed to affect seeded species cover except in HY 2010, when weather was favorable for seedling growth. Specifically, low winter temperature variability (few freeze-thaw cycles) followed by high growing season precipitation in HY 2010 yielded 14 × more seeded perennial grasses than any other seeding year, even though total annual precipitation amounts did not greatly vary between 2009 and 2012. Collectively, these findings suggest that tilling, applying prescribed fire, and herbicides before seeding at least 5 × the minimum recommended seeding rate should directly reduce resident annual grass abundance and likely yield high densities of seeded species in annual grass − dominated ecosystems, but only during years of stable winter conditions followed by wet springs.*

Schattman, R. E., Hurley, S., & Caswell, M. (2019). Now I See: Photovisualization to Support Agricultural Climate Adaptation. *Society and Natural Resources, 32*(2), 222-228. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059942651&doi=10.1080%2f08941920.2018.1530819&partnerID=40&md5=709daa83b88d44ca46c43310824f29af. doi:10.1080/08941920.2018.1530819

Research Tags: Economics

Abstract: *To remain viable, agricultural producers will need to adapt to changing climatic conditions in coming decades. Agricultural advisers play an important role in helping producers decide to adopt appropriate adaptation practices. Photovisualizations have the potential to complement currently utilized outreach and education strategies. This research uses a focus group approach to explore (1) whether photovisualizations can aid in decision-making about climate change adaptation, and (2) what characteristics of photovisualizations are most effective at conveying spatial aspects of adaptation practices. We found that photovisualizations generate rich discussions about ecological and economic effects as well as tradeoffs associated with climate* *adaptation practices. To have the greatest impact, photovisualizations should be used when producers are considering implementing high-cost or high-risk projects, when practices are likely to dramatically change the visual landscape, or when a practice is unfamiliar to a producer.*

Schattman, R. E., Kaplan, M., Aitken, H. M., & Helminski, J. (2019). Climate change curricula for adult audiences in agriculture and forestry: A review. *Journal of Adult and Continuing Education, 25*(1), 131-151. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065666052&doi=10.1177%2f1477971419840670&partnerID=40&md5=b9f80d8cb4fa86bdb4c1cc67f8864380. doi:10.1177/1477971419840670
Research Tags: Economics
Abstract: *Agricultural and forestry advisers and other technical service providers play an important role in supporting farmers and foresters to adapt to climate change. However, not all agricultural and forestry advisers are comfortable talking about climate change with land managers. While there is a demonstrated interest related to climate-related professional development, few examples of curricula developed with the express purpose of serving this audience and a systematic review of these curricula has not been conducted. To address this gap, we reviewed 12 curricula which were developed and implemented between 2001 and 2017. The goal of this review is to apply the lessons learned from a range of climate change-focused curricula to new, regionally or sector-specific educational programs targeting both agricultural advisers and innovative farmers. Our findings suggest that developers of future educational programs consider the following: (a) the specific needs of their audience, including topical interests and learning needs; (b) the use of interdisciplinary teams for curricula development; (c) trade-offs associated with inclusivity and depth of course content; and (d) the advantages of project-based education approaches suited for adult learning audiences. By applying these concepts to future curricula, these curricula are likely to have the greatest level of impact.*

Schattman, R. E., Méndez, V. E., Merrill, S. C., & Zia, A. (2018). Mixed methods approach to understanding farmer and agricultural advisor perceptions of climate change and adaptation in Vermont, United States. *Agroecology and Sustainable Food Systems, 42*(2), 121-148. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029894567&doi=10.1080%2f21683565.2017.1357667&partnerID=40&md5=77ce4a7a181236c849ce81e719561106. doi:10.1080/21683565.2017.1357667
Research Tags: Economics
Abstract: *The relationships among farmers' belief in climate change, perceptions of climate-related risk, and use of climate adaptation practices is a growing topic of interest in U.S. scholarship. The northeast region is not well represented in the literature, although it is highly agricultural and will likely face climate-related risks that differ from those faced in other regions. We used a mixed methods approach to examine northeast farmers' perceptions of climate change and climate-related risks over time, and perceived trade-offs associated with on-farm practices. Our investigation shows how northeastern farmers think about climate-risk, and what they are doing to address it.*

Schattman, R. E., Roesch-Mcnally, G., Wiener, S., Niles, M. T., & Hollinger, D. Y. (2018). Farm service agency employee intentions to use weather and climate data in professional services. *Renewable Agriculture and Food Systems, 33*(3), 212-221. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046159705&doi=10.1017%2fS1742170517000783&partnerID=40&md5=bacf03778b665e35b4c8bfa0444cf71f. doi:10.1017/S1742170517000783
Research Tags: Economics
Abstract: *Agricultural service providers often work closely with producers, and are well positioned to include weather and climate change information in the services they provide. By doing so, they can help producers reduce risks due to climate variability and change. A national survey of United States Department of Agriculture Farm Service Agency (FSA) field staff (n = 4621) was conducted in 2016. The survey was designed to assess FSA employees' use of climate and weather-related data and explore their perspectives on climate change, attitudes toward adaptation and concerns regarding climate- and weather-driven risks. Two structural equation models were developed to explore relationships between these factors, and to predict respondents' willingness to integrate climate and weather data into their professional services in the future. The two models were compared with assess the relative influence of respondents' current use of weather and climate information. Findings suggest that respondents' perceptions of weather-related risk in combination with their*

personal observations of weather variability help predict whether an individual intends to use weather and climate information in the future. Importantly, climate change belief is not a significant predictor of this intention; however, the belief that producers will have to adapt to climate change in order to remain viable is. Surprisingly, whether or not an individual currently uses weather and climate information is not a good predictor of whether they intend to in the future. This suggests that there are opportunities to increase employee exposure and proficiency with weather and climate information to meet the needs of American farmers by helping them to reduce risk.

Schebeck, M., Hansen, E. M., Schopf, A., Ragland, G. J., Stauffer, C., & Bentz, B. J. (2017). Diapause and overwintering of two spruce bark beetle species. *Physiological Entomology, 42*(3), 200-210. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022010130&doi=10.1111%2fphen.12200&partnerID=40&md5=4431138c2fcbb839bd2ee5090b9dd3d8. doi:10.1111/phen.12200

Research Tags: Weather, Wildlife

Abstract: *Diapause, a strategy to endure unfavourable conditions (e.g. cold winters) is commonly found in ectothermic organisms and is characterized by an arrest of development and reproduction, a reduction of metabolic rate, and an increased resistance to adversity. Diapause, in addition to adaptations for surviving low winter temperatures, significantly influences phenology, voltinism and ultimately population growth. We review the literature on diapause and overwintering behaviour of two bark beetle species that affect spruce-dominated forests in the northern hemisphere, and describe and compare how these strategies can influence population dynamics. The European spruce bark beetle Ips typographus (L.) (Coleoptera, Curculionidae) is the most important forest pest of Norway spruce in Europe. It enters an adult reproductive diapause that might be either facultative or obligate. Obligate diapausing beetles are considered strictly univoltine, entering this dormancy type regardless of environmental cues. Facultative diapausing individuals enter diapause induced by photoperiod, modified by temperature, thus being potentially multivoltine. The spruce beetle Dendroctonus rufipennis (Kirby) (Coleoptera: Curculionidae) infests all spruce species in its natural range in North America. A facultative prepupal diapause is averted by relatively warm temperatures, resulting in a univoltine life cycle, whereas cool temperatures induce prepupal diapause leading to a semivoltine cycle. An adult obligate diapause in D. rufipennis could limit bi- or multivoltinism. We discuss and compare the influence of diapause and overwinter survival on voltinism and population dynamics of these two species in a changing climate and provide an outlook on future research.*

Scheller, R. M., Kretchun, A. M., Loudermilk, E. L., Hurteau, M. D., Weisberg, P. J., & Skinner, C. (2018). Interactions Among Fuel Management, Species Composition, Bark Beetles, and Climate Change and the Potential Effects on Forests of the Lake Tahoe Basin. *Ecosystems, 21*(4), 643-656. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026898611&doi=10.1007%2fs10021-017-0175-3&partnerID=40&md5=a35b15ac8765d656c18b4ba2ab51fe68. doi:10.1007/s10021-017-0175-3

Research Tags: Forestry, Wildlife, Weather

Abstract: *Climate-driven increases in wildfires, drought conditions, and insect outbreaks are critical threats to forest carbon stores. In particular, bark beetles are important disturbance agents although their long-term interactions with future climate change are poorly understood. Droughts and the associated moisture deficit contribute to the onset of bark beetle outbreaks although outbreak extent and severity is dependent upon the density of host trees, wildfire, and forest management. Our objective was to estimate the effects of climate change and bark beetle outbreaks on ecosystem carbon dynamics over the next century in a western US forest. Specifically, we hypothesized that (a) bark beetle outbreaks under climate change would reduce net ecosystem carbon balance (NECB) and increase uncertainty and (b) these effects could be ameliorated by fuels management. We also examined the specific tree species dynamics—competition and release—that determined NECB response to bark beetle outbreaks. Our study area was the Lake Tahoe Basin (LTB), CA and NV, USA, an area of diverse forest types encompassing steep elevation and climatic gradients and representative of mixed-conifer forests throughout the western United States. We simulated climate change, bark beetles, wildfire, and fuels management using a landscape-scale stochastic model of disturbance and succession. We simulated the period 2010–2100 using downscaled climate projections. Recurring droughts generated conditions conducive to large-scale outbreaks; the resulting large and sustained outbreaks significantly increased the probability of LTB forests becoming C sources over decadal time scales, with* *slower-than-anticipated landscape-scale recovery. Tree species composition was substantially altered with a reduction in functional redundancy and productivity. Results indicate heightened uncertainty due to the synergistic influences of climate change and interacting disturbances. Our results further indicate that current fuel management practices will not be effective at reducing landscape-scale outbreak mortality. Our results provide critical insights into the interaction of drivers (bark beetles, wildfire, fuel management) that increase the risk of C loss and shifting community composition if bark beetle outbreaks become more frequent.*

Schmer, M. R., Stewart, C. E., & Jin, V. L. (2017). Empirical evidence of soil carbon changes in bioenergy cropping systems. In *Bioenergy and Land Use Change: Impact on Natural Capital and Ecosystem Services* (pp. 99-114).
Research Tags: Soil, Energy, Emissions
Abstract: *Biofuels are seen as a near-term solution to reduce greenhouse gas (GHG) emissions, reduce petroleum usage, and diversify rural economies. Accurate accounting of all GHG emissions is necessary to measure the overall carbon (C) intensity of new biofuel feedstocks. Changes in direct soil organic carbon (SOC) can have a major impact on estimating overall GHG emissions from biofuels. Even though SOC represents a small portion of a soil's mass, it plays an essential role in soil functioning and C cycling. Currently, there are limited long-term data sets that can be used to evaluate SOC changes of perennial energy crops. However, certain recommendations can be made. Conversion of native ecosystems to annual bioenergy crops will likely result in significant SOC stock loss. The expected use of agricultural residues for bioenergy and its effect on SOC use will largely be dependent on residue removal amounts, climate, management practices, previous land history, topography, and soil type. Perennial bioenergy crops have the ability to significantly increase SOC stocks while providing substantial biomass quantities on degraded cropland or idle land under proper management. A multifeedstock, landscape approach minimizes environmental risks in meeting feedstock demands for bioenergy production by providing sufficient feedstock production while maintaining or increasing SOC.*

Schoettle, A. W., Burns, K. S., Cleaver, C. M., & Connor, J. J. (2019). Proactive limber pine conservation strategy for the Greater Rocky Mountain National Park Area. *USDA Forest Service - General Technical Report RMRS-GTR, 2019*(379), 1-81. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069661776&partnerID=40&md5=03b49e01d092e17dff2e86d0f54f8fc2.
Research Tags: Forestry
Abstract: *This proactive conservation strategy addresses the unique situation of limber pine in the Greater Rocky Mountain National Park Area (GRMNPA). The target area includes Rocky Mountain National Park and surrounding areas of northern Colorado and southern Wyoming. The GRMNPA is at the infection front for white pine blister rust (WPBR) where populations were also impacted by the recent mountain pine beetle epidemic and are threatened by climate change. This is the first proactive conservation strategy for a five-needle pine species in North America. It focuses on timing specific monitoring efforts and interventions to sustain healthy limber pine populations and ecosystems during invasion and naturalization of WPBR, thereby putting limber pine on a trajectory that reduces the probability of ecosystem impairment in the future. The high frequency of complete resistance to WPBR in limber pine populations in the GRMNPA is a distinctive feature of this area's ecology. Having this information and other site-based genetic and disturbance ecology information before WPBR affects the populations is also unique and warranted the development of this proactive conservation strategy. The strategy outlines recommendations to promote (1) ex situ and in situ limber pine conservation and protection, (2) increased limber pine population size and sustained genetic diversity, (3) treatments to maintain durability of genetic resistance to WPBR, (4) monitoring forest health conditions for early detection of WPBR and changes in pathogen virulence, and (5) coordinated management actions within and among agencies. The recommendations apply to the GRMNPA and possibly to all of the southern Rockies; the approach used can be applied further. The recommendations herein are expected to be relevant for at least 20 years.*

Schoettle, A. W., & Coop, J. D. (2017). Range-wide conservation of Pinus aristata: a genetic collection with ecological context for proactive management today and resources for tomorrow. *New Forests, 48*(2), 181-199. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012241723&doi=10.1007%2fs11056-017-9570-z&partnerID=40&md5=e659576a8962f6dcf95f564d728f7917. doi:10.1007/s11056-017-9570-z
Research Tags: Forestry
Abstract: *Tree species are highly vulnerable to anthropogenic environmental change, and are increasingly being challenged by non-native pests and climate change. Rocky Mountain bristlecone pines are long-lived, exhibit delayed maturation, have low genetic diversity, and inhabit cold, high-elevation environments. They are threatened by the non-native disease white pine blister rust, warming temperatures, changing precipitation patterns, and altered disturbance regimes. The goal of this work was to (1) sample the range-wide genetic diversity of bristlecone pine for ex situ seed and tissue collections and research before the populations are impacted, (2) assess the health and ecological conditions of the species across its geographic range (61 stands) to provide a baseline by which to evaluate future changes, and (3) assess relationships between stand and regeneration characteristics and topographic, geographic, and climatic factors to identify vulnerabilities and proactive management interventions to increase population resilience. Local variation in topoclimate was strongly related to stand structure, composition, health, and regeneration. Bristlecone pine currently showed only minor impacts from insects and pathogens, but relationships between cone production and regeneration with climate variables suggest vulnerabilities to projected climate change. Both cone production and seedling regeneration were also linked to stand structure and ground cover that provide opportunities for proactive in situ management to increase population size to mitigate potential future climate- and pathogen-driven declines. These efforts represent the first proactive coordinated range-wide genetic collection design and forest health assessment for a threatened, but not yet impacted, tree species and offers a model for other species at risk.*

Schooley, R. L., Bestelmeyer, B. T., & Campanella, A. (2018). Shrub encroachment, productivity pulses, and core-transient dynamics of Chihuahuan Desert rodents. *Ecosphere*, *9*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052597534&doi=10.1002%2fecs2.2330&partnerID=40&md5=1142f90f4391c05bbef1aed6ddc48440. doi:10.1002/ecs2.2330
Research Tags: Grassland, Wildlife
Abstract: *Drylands worldwide are experiencing shrub encroachment into grasslands with potential consequences for biodiversity and ecosystem services. Climate change could increase the rate of shrub encroachment, amplify precipitation variability, and thus alter bottom-up processes for animal communities. Desert rodents are important biodiversity elements of arid grasslands and shrublands that exert strong effects on soil, vegetation, and other animal species. We used long-term data from the Jornada Basin Long Term Ecological Research site in the Chihuahuan Desert of southern New Mexico to ask whether bottom-up control of desert rodents changes across shrub encroachment gradients. Our design included spatial blocks with replicated ecological states representing transitions from black grama (Bouteloua eriopoda) to honey mesquite (Prosopis glandulosa). Grassland-to-shrubland transitions did not produce degraded ecosystems, on average, with reduced net primary production or decreased rodent biomass. However, more rodent biomass was supported on unencroached grasslands following droughts whose frequency and severity may increase in southwestern United States. Hence, the observed evenness in rodent biomass across ecological states should be sensitive to climate change. The best predictors of rodent biomass also differed markedly for two trophic groups. This outcome was explained by considering core-transient dynamics. Granivores were mostly core species that regularly occurred on sites and responded to lagged net primary production at local scales, whereas folivores included transient species (especially Sigmodon hispidus) that responded to lagged precipitation at broader scales via spillover dynamics. Bottom-up processes for desert rodents across shrub invasion gradients were understood by integrating lagged responses to productivity pulses with core-transient structuring of communities.*

Schroeder, T. A., Schleeweis, K. G., Moisen, G. G., Toney, C., Cohen, W. B., Freeman, E. A., . . . Huang, C. (2017). Testing a Landsat-based approach for mapping disturbance causality in U.S. forests. *Remote Sensing of Environment, 195*, 230-243. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018260615&doi=10.1016%2fj.rse.2017.03.033&partnerID=40&md5=9de1026ece529ece65b8a96a7f153b53. doi:10.1016/j.rse.2017.03.033
Research Tags: Research

Abstract: *In light of Earth's changing climate and growing human population, there is an urgent need to improve monitoring of natural and anthropogenic disturbances which effect forests' ability to sequester carbon and provide other ecosystem services. In this study, a two-step modeling approach was used to map the type and timing of forest disturbances occurring between 1984 and 2010 in ten Landsat scenes located in diverse forest systems of the conterminous U.S. In step one, Random Forest (RF) models were developed to predict the presence of five forest disturbance agents (conversion, fire, harvest, stress and wind) and stable (i.e. undisturbed) forest. Models were developed using a suite of predictors including spectral change metrics derived from a nonparametric shape-restricted spline fitting algorithm, as well as several topographic and biophysical variables which potentially influence the initiation and/or spread of forest disturbance agents. Step two involved applying a rule-based model to the spectrally-based shape parameters (e.g. shape type, year and duration) to assign a year to the disturbance types and locations predicted in step one. Out of bag (OOB) predictions from RF showed that across the ten scenes, overall agreement was highest when only causal agent was considered (avg = 80%, min = 69%, max = 86%), and was lowest when both agent and year (within ± 1 of the reference date) were required to be correct (avg = 71%, min = 56%, max = 80%). Across scene omission and commission errors for fire and stable forest classes were mostly around 10% to 20%, respectively. Harvests were also modeled well, as five of nine test scenes had error rates < 26%. Accuracy of the wind and stress classes were much more variable with model errors ranging from 24% to 88%. The years assigned by the rule-based model were reasonably accurate, as 88% of all disturbances were assigned a year that fell within ± 2 years of the reference date. Fire disturbances were assigned the correct year 78% of the time, followed by harvest (69%) and conversion (54%). Although 17% and 63% of wind and stress disturbances were under-estimated by 5 or more years, the impact on overall accuracy was nominal given these two classes only accounted for roughly 5% of all disturbances. Our results also revealed that causal agent models summarized to broader disturbed/not disturbed classes were as accurate as models specifically constructed to predict binary disturbance, thus there appears to be no advantage to modeling disturbance prior to assigning causality. A relative evaluation of mean decrease in accuracy from RF showed that although a wide range of predictor variables contributed to the successful modeling of causal agents and stable forest (e.g. patch metrics, forest occurrence, and topography), disturbance variables (e.g. MTBS) and spectral change metrics (e.g. absolute and relative magnitude) were by far the most important. Modeled causality maps and annual disturbance rates were examined and found to be in good agreement with existing literature and other published data sets. Lastly, results are used to make recommendations for mapping forest disturbance agents nationally across the U.S.*

Schultze-Kraft, R., Rao, I. M., Peters, M., Clements, R. J., Bai, C., & Liu, G. (2018). Tropical forage legumes for environmental benefits: An overview. *Tropical Grasslands-Forrajes Tropicales, 6*(1), 1-14. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041345242&doi=10.17138%2fTGFT%286%291-14&partnerID=40&md5=2d6ae8db6cd9e056baafc5def1475583. doi:10.17138/TGFT(6)1-14
Research Tags: Grassland, Livestock
Abstract: *Ruminant livestock production in the tropics, particularly when based on pastures, is frequently blamed for being detrimental to the environment, allegedly contributing to: (1) degradation and destruction of ecosystems, including degradation and loss of soil, water and biodiversity; and (2) climate change (global warming). In this paper we argue that, rather than being detrimental, tropical forage legumes can have a positive impact on the environment, mainly due to key attributes that characterize the Leguminosae (Fabaceae) family: (1) symbiotic nitrogen fixation; (2) high nutritive value; (3) deep-reaching tap-root system; (4) wide taxonomic and genetic diversity; and (5) presence of particular secondary metabolites. Although there are also potential negative aspects, such as soil acidification and the risks of introduced legumes becoming invasive weeds, we submit that legumes have potential to contribute significantly to sustainable intensification of livestock production in the tropics, along with the provision of ecosystem services. To further assess, document and realize this potential, research for development needs in a range of areas are indicated.*

Schwalm, C. R., Anderegg, W. R. L., Michalak, A. M., Fisher, J. B., Biondi, F., Koch, G., . . . Tian, H. (2017). Global patterns of drought recovery. *Nature, 548*(7666), 202-205. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027349887&doi=10.1038%2fnature23021&partnerID=40&md5=298f2876da07d6693c865b117abaab59. doi:10.1038/nature23021

Research Tags: Weather
Abstract: *Drought, a recurring phenomenon with major impacts on both human and natural systems1,2,3, is the most widespread climatic extreme that negatively affects the land carbon sink2,4. Although twentieth-century trends in drought regimes are ambiguous5,6,7, across many regions more frequent and severe droughts are expected in the twenty-first century3,7,8,9. Recovery time—how long an ecosystem requires to revert to its pre-drought functional state—is a critical metric of drought impact. Yet the factors influencing drought recovery and its spatiotemporal patterns at the global scale are largely unknown. Here we analyse three independent datasets of gross primary productivity and show that, across diverse ecosystems, drought recovery times are strongly associated with climate and carbon cycle dynamics, with biodiversity and CO2 fertilization as secondary factors. Our analysis also provides two key insights into the spatiotemporal patterns of drought recovery time: first, that recovery is longest in the tropics and high northern latitudes (both vulnerable areas of Earth's climate system10) and second, that drought impacts11 (assessed using the area of ecosystems actively recovering and time to recovery) have increased over the twentieth century. If droughts become more frequent, as expected, the time between droughts may become shorter than drought recovery time, leading to permanently damaged ecosystems and widespread degradation of the land carbon sink.*

Scudiero, E., Corwin, D. L., Anderson, R. G., Yemoto, K., Clary, W., Wang, Z., & Skaggs, T. H. (2017). Remote sensing is a viable tool for mapping soil salinity in agricultural lands. *California Agriculture, 71*(4), 231-238. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034823433&doi=10.3733%2fca.2017a0009&partnerID=40&md5=8df83ab85c8db27a4071e22c6ff930c6. doi:10.3733/ca.2017a0009
Research Tags: Research
Abstract: *Soil salinity negatively impacts the productivity and profitability of western San Joaquin Valley (WSJV) farmland. Many factors, including drought, climate change, reduced water allocations, and land-use changes could worsen salinity conditions there, and in other agricultural lands in the state. Mapping soil salinity at regional and state levels is essential for identifying drivers and trends in agricultural soil salinity, and for developing mitigation strategies, but traditional soil sampling for salinity does not allow for accurate large-scale mapping. We tested remote-sensing modeling to map root zone soil salinity for farmland in the WSJV. According to our map, 0.78 million acres are salt affected (i.e., ECe > 4 dS/m), which represents 45% of the mapped farmland; 30% of that acreage is strongly or extremely saline. Independent validations of the remote-sensing estimations indicated acceptable to excellent correspondences, except in areas of low salinity and high soil heterogeneity. Remote sensing is a viable tool for helping landowners make decisions about land use and also for helping water districts and state agencies develop salinity mitigation strategies.*

Sebastián-González, E., Barbosa, J. M., Pérez-García, J. M., Morales-Reyes, Z., Botella, F., Olea, P. P., . . . Sánchez-Zapata, J. A. (2019). Scavenging in the Anthropocene: Human impact drives vertebrate scavenger species richness at a global scale. *Global Change Biology, 25*(9), 3005-3017. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068029527&doi=10.1111%2fgcb.14708&partnerID=40&md5=a18568cb8f52fe27ff26fc0ea939ff7b. doi:10.1111/gcb.14708
Research Tags: Wildlife
Abstract: *Understanding the distribution of biodiversity across the Earth is one of the most challenging questions in biology. Much research has been directed at explaining the species latitudinal pattern showing that communities are richer in tropical areas; however, despite decades of research, a general consensus has not yet emerged. In addition, global biodiversity patterns are being rapidly altered by human activities. Here, we aim to describe large-scale patterns of species richness and diversity in terrestrial vertebrate scavenger (carrion-consuming) assemblages, which provide key ecosystem functions and services. We used a worldwide dataset comprising 43 sites, where vertebrate scavenger assemblages were identified using 2,485 carcasses monitored between 1991 and 2018. First, we evaluated how scavenger richness (number of species) and diversity (Shannon diversity index) varied among seasons (cold vs. warm, wet vs. dry). Then, we studied the potential effects of human impact and a set of macroecological variables related to climatic conditions on the scavenger assemblages. Vertebrate scavenger richness ranged from species-poor to species rich assemblages (4–30 species). Both scavenger richness and diversity also showed some seasonal variation. However, in general, climatic variables did not drive latitudinal patterns, as scavenger richness and diversity were not*

affected by temperature or rainfall. Rainfall seasonality slightly increased the number of species in the community, but its effect was weak. Instead, the human impact index included in our study was the main predictor of scavenger richness. Scavenger assemblages in highly human-impacted areas sustained the smallest number of scavenger species, suggesting human activity may be overriding other macroecological processes in shaping scavenger communities. Our results highlight the effect of human impact at a global scale. As species-rich assemblages tend to be more functional, we warn about possible reductions in ecosystem functions and the services provided by scavengers in human-dominated landscapes in the Anthropocene.

Sergeant, C. J., Bellmore, J. R., McConnell, C., & Moore, J. W. (2017). High salmon density and low discharge create periodic hypoxia in coastal rivers. *Ecosphere, 8*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021209845&doi=10.1002%2fecs2.1846&partnerID=40&md5=bed82e649c6d95b654c7ce6795cd14e8. doi:10.1002/ecs2.1846
Research Tags: Water, Wildlife
Abstract: *Dissolved oxygen (DO) is essential to the survival of almost all aquatic organisms. Here, we examine the possibility that abundant Pacific salmon (Oncorhynchus spp.) and low streamflow combine to create hypoxic events in coastal rivers. Using high-frequency DO time series from two similar watersheds in southeastern Alaska, we summarize DO regimes and the frequency of hypoxia in relationship to salmon density and stream discharge. We also employ a simulation model that links salmon oxygen respiration to DO dynamics and predicts combinations of salmon abundance, discharge, and water temperature that may result in hypoxia. In the Indian River, where DO was monitored hourly during the ice-free season from 2010 to 2015, DO levels decreased when salmon were present. In 2013, a year with extremely high spawning salmon densities, DO dropped to 1.7 mg/L and 16% saturation, well below lethal limits. In Sawmill Creek, where DO was monitored every six minutes across an upstream–downstream gradient during the 2015 spawning season, DO remained fully saturated upstream of spawning reaches, but declined markedly downstream to 2.9 mg/L and 26% saturation during spawning. Modeled DO dynamics in the Indian River closely tracked field observations. Model sensitivity analysis illustrates that low summertime river discharge is a precursor to salmon-induced oxygen depletion in our study systems. Our results provide compelling evidence that dense salmon populations and low discharge can trigger hypoxia, even in rivers with relatively cold thermal regimes. Although climate change modeling for southeastern Alaska predicts an increase in annual precipitation, snowfall in the winter and rainfall in the summer are likely to decrease, which would in turn decrease summertime discharge in rain- and snow-fed streams and potentially increase the frequency of hypoxia. Our model template can be adapted by resource managers and watershed stakeholders to create real-time predictive models of DO trends for individual streams. While preserving thermally suitable stream habitat for cold-water taxa facing climate change has become a land management priority, managers should also consider that some protected watersheds may still be at risk of increasingly frequent hypoxia due to human impacts such as water diversion and artificially abundant salmon populations caused by hatchery straying.*

Seybold, S. J., Bentz, B. J., Fettig, C. J., Lundquist, J. E., Progar, R. A., & Gillette, N. E. (2018) Management of Western North American Bark Beetles with Semiochemicals. In*: Vol. 63. Annual Review of Entomology* (pp. 407-432).
Research Tags: Wildlife
Abstract: *We summarize the status of semiochemical-based management of the major bark beetle species in western North America. The conifer forests of this region have a long history of profound impacts by phloem-feeding bark beetles, and species such as the mountain pine beetle (Dendroctonus ponderosae) and the spruce beetle (D. rufipennis) have recently undergone epic outbreaks linked to changing climate. At the same time, great strides are being made in the application of semiochemicals to the integrated pest management of bark beetles. In this review, we synthesize and interpret these recent advances in applied chemical ecology of bark beetles for scientists and land managers.*

Seyfried, M., Lohse, K., Marks, D., Flerchinger, G., Pierson, F., & Holbrook, W. S. (2018). Reynolds creek experimental watershed and critical zone observatory. *Vadose Zone Journal, 17*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058799139&doi=10.2136%2fvzj2018.07.0129&partnerID=40&md5=925069dc23fa69a5be5511d9c09f0676. doi:10.2136/vzj2018.07.0129
Research Tags: Water

Abstract: *The Reynolds Creek Experimental Watershed (RCEW) was established in 1960 as an "outdoor hydrological laboratory" to investigate hydrological processes of interest in the interior northwestern part of the United States. Initial emphasis was on installing and testing instrumentation and data collection and dissemination. The initial instrumentation network sampled the climatic gradient within the 239-km2 watershed and focused on specific subwatersheds for intensive instrumentation. This network has expanded and supported ad hoc research and provides a stable platform for the development of long-term programs supporting research and model development in snow hydrology, climate change, water and energy balance, land management, carbon cycling, and critical zone hydrology. Recently, the challenge taken up at the RCEW is to integrate different processes over space for applications to larger areas outside the watershed. The presence of steep local environmental gradients associated with topography in addition to more gradual, elevational gradients requires high-resolution modeling. The snow hydrology program has demonstrated the potential for high-resolution, process-based modeling across large landscapes. The direct linkage of biogeochemical processes with hydrological processes ultimately requires a multidisciplinary approach that has been adopted at the RCEW since inclusion in the Critical Zone Observatory program. We think that coupling of these processes will lead to a better understanding and management of natural resources on the landscape*

Shah, R., Yueh, S., Xu, X., Elder, K., & Baldi, C. (2017). *Remote sensing of terrestrial snow using signals of opportunity*. Paper presented at the International Geoscience and Remote Sensing Symposium (IGARSS).
Research Tags: Water
Abstract: *Snow water equivalent (SWE) storage is critical parameters of the water cycle and may be important indicators of climate change. Despite their importance in the seasonal and regional terrestrial water cycle, SWE is currently poorly characterized in space and time. We develop a method for observations of these parameters using P-band signals of opportunity (SoOp) concept to measure the SWE. Effect of wet snow on the measurement is analyzed through modeling and it is found that for wet snow, the phase of the SoOp measurement becomes correlated to snow depth while for dry snow, phase is correlated to the Snow Water Equivalent (SWE). In addition, qualitative data analysis from two different site for a proof-of-concept experiment is shown in this paper.*

Shankar, U., Prestemon, J. P., McKenzie, D., Talgo, K., Xiu, A., Mohammad, O., . . . Vizuete, W. (2018). Projecting wildfire emissions over the south-eastern United States to mid-century. *International Journal of Wildland Fire, 27*(5), 313-328. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047819225&doi=10.1071%2fWF17116&partnerID=40&md5=3e6a3de214064a0e8853f01e4328b99b. doi:10.1071/WF17116
Research Tags: Weather
Abstract: *Wildfires can impair human health because of the toxicity of emitted pollutants, and threaten communities, structures and the integrity of ecosystems sensitive to disturbance. Climate and socioeconomic factors (e.g. population and income growth) are known regional drivers of wildfires. Reflecting changes in these factors in wildfire emissions estimates is thus a critical need in air quality and health risk assessments in the south-eastern United States. We developed such a methodology leveraging published statistical models of annual area burned (AAB) over the US Southeast for 2011–2060, based on county-level socioeconomic and climate projections, to estimate daily wildfire emissions in selected historical and future years. Projected AABs were 7 to 150% lower on average than the historical mean AABs for 1992–2010; projected wildfire fine-particulate emissions were 13 to 62% lower than those based on historical AABs, with a temporal variability driven by the climate system. The greatest differences were in areas of large wildfire impacts from socioeconomic factors, suggesting that historically based (static) wildfire inventories cannot properly represent future air quality responses to changes in these factors. The results also underscore the need to correct biases in the dynamical downscaling of wildfire climate drivers to project the health risks of wildfire emissions more reliably.*

Shannon, P. D., Swanston, C. W., Janowiak, M. K., Handler, S. D., Schmitt, K. M., Brandt, L. A., . . . Ontl, T. (2019). Adaptation strategies and approaches for forested watersheds. *Climate Services, 13*, 51-64. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061089305&doi=10.1016%2fj.cliser.2019.01.005&partnerID=40&md5=af48cc27a8b32b7a7a524360510a17ce. doi:10.1016/j.cliser.2019.01.005

Research Tags: Forestry, Water
Abstract: *Intentional climate adaptation planning for ecosystems has become a necessary part of the job for natural resource managers and natural resource professionals in this era of non-stationarity. One of the major challenges in adapting ecosystems to climate change is in the translation of broad adaptation concepts to specific, tangible actions. Addressing management goals and values while considering the long-term risks associated with local climate change can make forested watershed management plans more robust to uncertainty and changing conditions. We provide a menu of tiered adaptation strategies, which we developed with a focus on forests of the Midwest and Northeastern U.S., as part of a flexible framework to support the integration of climate change considerations into forested watershed management and conservation activities. This menu encapsulates ideas from the literature into statements that signify climate adaptation intention and provide examples of associated tactics to help ground the concepts in specific actions. Finally, we describe two demonstration projects, shared through the Northern Institute of Applied Climate Science's Climate Change Response Framework, that have used this Forested Watershed Adaptation Menu and Adaptation Workbook in project-level planning.*

Shappell, N. W., Feifarek, D. J., Rearick, D. C., Bartell, S. E., & Schoenfuss, H. L. (2018). Do environmental factors affect male fathead minnow (Pimephales promelas) response to estrone? Part 2. Temperature and food availability. *Science of the Total Environment, 610-611*, 32-43. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026899621&doi=10.1016%2fj.scitotenv.2017.08.021&partnerID=40&md5=2dae5d6d8d69a919a38947249590852c. doi:10.1016/j.scitotenv.2017.08.021
Research Tags: Water, Wildlife
Abstract: *Fish are subject to constantly changing environmental conditions and food availability, factors that may impact their response to endocrine disruptors (EDs). This may, in part, explain outcome discrepancies between field studies and laboratory exposures to EDs. This study assessed whether standard laboratory conditions for fish exposures adequately represent effects of ED exposure at two environmentally realistic temperatures. The impact of temperature and food availability on male fathead minnow response to estrone (E1) exposure was studied in two experiments (3 × 2 × 2 factorial design) with three E1 concentrations (range 0–135 ng/L); two temperatures (18 °C and 26 °C, the latter the prescribed laboratory temperature), and two feeding treatments (full fed vs. 25% of full fed) in a 21-day flow-through system. Morphometric endpoints [including body condition factor, somatic index of gonad (GSI) and liver (HSI), and secondary sex characteristics (SSC)], blood parameters [hematocrit (HCT), blood glucose, cortisol, and vitellogenin (VTG) concentrations], and histology of liver and testis were determined on day 22. High E1 consistently increased VTG, though interactions among E1, temperature and/or food on liver weight, HSI, and HCT were inconsistent between experiments. High temperature impacted the greatest number of parameters, independent of E1 treatment. Three sex-linked parameters were lower at high temperature (testis weight, GSI and VTG), and in Exp. 2SSC and gonad maturity rating were lower. At 26 °C, in Exp. 1 HSI and HCT decreased, and in Exp. 2 length, body and liver weight, and body condition factor were lower. Food restriction decreased GSI in Exp. 1, and blood glucose and liver weight in Exp. 2. At 26 °C several parameters were altered independent of E1 exposure, including three out of four measurements of sperm differentiation. Concordance between laboratory and field investigations of the biological effects of EDs may improve if environmentally-relevant exposure conditions, especially temperature, are employed.*

Sharda, V., Gowda, P. H., Marek, G., Kisekka, I., Ray, C., & Adhikari, P. (2019). Simulating the Impacts of Irrigation Levels on Soybean Production in Texas High Plains to Manage Diminishing Groundwater Levels. *Journal of the American Water Resources Association, 55*(1), 56-69. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059869369&doi=10.1111%2f1752-1688.12720&partnerID=40&md5=6d63ae0e93489f74d8a83f7e3222eb86. doi:10.1111/1752-1688.12720
Research Tags: Crops, Water
Abstract: *There is an increasing need to strategize and plan irrigation systems under varied climatic conditions to support efficient irrigation practices while maintaining and improving the sustainability of groundwater systems. This study was undertaken to simulate the growth and production of soybean [Glycine max (L.)] under different irrigation scenarios. The objectives of this study were to calibrate and validate the CROPGRO-Soybean model under Texas High Plains' (THP) climatic conditions and to apply the calibrated model to simulate the*

impacts of different irrigation levels and triggers on soybean production. The methodology involved combining short-term experimental data with long-term historical weather data (1951–2012), and use of mechanistic crop growth simulation algorithms to determine optimum irrigation management strategies. Irrigation was scheduled based on five different plant extractable water levels (irrigation threshold [ITHR]) set at 20%, 35%, 50%, 65%, and 80%. The calibrated model was able to satisfactorily reproduce measured leaf area index, biomass, and evapotranspiration for soybean, indicating it can be used for investigating different strategies for irrigating soybean in the THP. Calculations of crop water productivity for biomass and yield along with irrigation water use efficiency indicated soybean can be irrigated at ITHR set at 50% or 65% with minimal yield loss as compared to 80% ITHR, thus conserving water and contributing toward lower groundwater withdrawals. Editor's note: This paper is part of the featured series on Optimizing Ogallala Aquifer Water Use to Sustain Food Systems. See the February 2019 issue for the introduction and background to the series.

Sharifi, A., Kalin, L., Hantush, M. M., Dahlgren, R. A., O'Geen, A. T., & Maynard, J. J. (2017). Capturing spatial variability of biogeochemical mass exchanges and reaction rates in wetland water and soil through model compartmentalization. *Journal of Hydrologic Engineering, 22*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009343361&doi=10.1061%2f%28ASCE%29HE.1943-5584.0001196&partnerID=40&md5=a40df7ca6b40c30f038c6b5b189bdc92. doi:10.1061/(ASCE)HE.1943-5584.0001196

Research Tags: Water, Soil

Abstract: *A common phenomenon observed in natural and constructed wetlands is short-circuiting of flow and formation of stagnant zones that are only indirectly connected with the incoming water. Biogeochemistry of passive areas is potentially much different than that of active zones. In the research reported in this paper, the spatial resolution of a previously developed wetland nutrient cycling model was improved in order to capture the spatial variability of concentrations and reaction rates regarding nitrogen and carbon cycles throughout active and passive zones of wetlands. The upgraded model allows for several compartments in the horizontal domain, with all neighboring compartments connected through advective and dispersive/diffusive mass transport. The model was applied to data collected from a restored wetland in California that was characterized by the formation of a large stagnant zone at the southern end of the wetland due to close vicinity of the inlet and outlet structures in the northern end. Mass balance analysis revealed that over the course of the research period, about 23.4±3.9% of the incoming total nitrogen load was removed or retained by the wetland. It was observed that mass of all exchanges (physical and biogeochemical) regarding nitrogen cycling decreased along the activity gradient from active to passive zones. Model results also revealed that anaerobic processes become more significant along the activity gradient towards passive areas.*

Sharma, S., Nadaoka, K., Nakaoka, M., Uy, W. H., MacKenzie, R. A., Friess, D. A., & Fortes, M. D. (2017). Growth performance and structure of a mangrove afforestation project on a former seagrass bed, Mindanao Island, Philippines. *Hydrobiologia, 803*(1), 359-371. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020234627&doi=10.1007%2fs10750-017-3252-x&partnerID=40&md5=5c2ec3da3b691e1685415af3851f45b7. doi:10.1007/s10750-017-3252-x

Research Tags: Forestry, Water

Abstract: *The Philippines has lost nearly 70% of its natural mangrove cover since the early 1900s. As a result, large investments have been made to restore mangrove forests and the many ecosystem services that they provide. Most of these restoration efforts have been through outplanting of Rhizophora sp. seedlings, many of which have failed because the proper hydrological and ecological conditions were not properly assessed. Other afforestation projects involved planting seedlings in inappropriate places (e.g., seagrass beds, mudflats) that resulted in replacing one valuable ecosystem with another. The aim of this research was to investigate the growth of 3-, 9-, and 21-year-old afforested stands of Rhizophora spp. mangrove forest. We also investigated the impact of these plantations on local seagrass beds. The total aboveground biomass was 42.6, 74.4, and 111.7 Mg ha−1 for the 3-, 9-, and 21-year-old mangrove stands, respectively. Seagrass bed cover decreased under the closed canopy of the mangrove due to reduced photosynthetically active radiation and competition for growing space. This study shows that mangroves can grow to some extent on seagrass beds, though mangrove planting in these areas could eventually lead to seagrass loss. Thus, mangroves should not be planted in areas that are naturally occupied by other ecologically important ecosystems. The purpose of* *mangrove restoration should be clear and efforts should be focused on formerly deforested or degraded areas. Additional studies are needed from different locations to understand how mangrove planting in seagrass beds impacts growth performance and ecological functions of the latter ecosystem.*

Shellie, K., Kovaleski, A. P., & Londo, J. P. (2018). Water deficit severity during berry development alters timing of dormancy transitions in wine grape cultivar Malbec. *Scientia Horticulturae, 232*, 226-230. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044351905&doi=10.1016%2fj.scienta.2018.01.014&partnerID=40&md5=3a1fa544ffc2b644a741f68ed8f674af. doi:10.1016/j.scienta.2018.01.014
Research Tags: Crops, Weather
Abstract: *The objective of this study was to test the hypothesis that vine water stress during the growing season can lengthen the dormancy cycle by inducing earlier transition into endodormancy. A bud forcing assay was used to compare the dormancy transitions of field-grown 'Malbec' grapevines that had been deficit-irrigated for seven consecutive growing seasons to supply 35 or 70% of estimated water demand to that of fully-watered vines. Canes were field-sampled from deficit-irrigated and fully-watered plots at multiple time points over a span of 100 days, beginning 30 days prior to harvest. Buds at nodes two through eight were cut into single-node segments, held under bud-forcing conditions for 60 days, and evaluated daily for the occurrence of bud break. Contrary to our initial hypothesis, water stress shortened the dormancy cycle by delaying the onset of endodormancy, decreasing the amount of chilling required for release from endodormancy and increasing the readiness to resume growth during ecodormancy. Results support the idea that drought stress-induced regulatory networks 'cross-talk' with environmental and hormonal regulatory signals that modulate the activity-dormancy cycle. Understanding the underlying mechanisms by which drought stress alters the activity-dormancy cycle may be critical for sustaining vine productivity in a changing climate.*

Sherrod, L. A., McMaster, G. S., Delgado, J. A., Schipanski, M. E., Fonte, S. J., Montenieri, R. L., & Larson, K. (2018). Soil carbon pools in dryland agroecosystems as affected by several years of drought. *Journal of Environmental Quality, 47*(4), 766-773. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049439710&doi=10.2134%2fjeq2017.09.0371&partnerID=40&md5=57bab53875cde1358b91816e9bf03b32. doi:10.2134/jeq2017.09.0371
Research Tags: Weather, Soil, Crops
Abstract: *No-till and increased cropping intensity (CI) can increase yield and soil organic C (SOC) in the US Great Plains compared with traditional wheat (Triticum aestivum L.)–fallow management. However, gains in SOC and other C pools may not be permanent. Increasing frequency of drought may reduce C inputs and potentially reverse gains accrued during wetter periods. This study examined the effect of drought on the persistence of SOC with two objectives: (i) to determine soil C pools (0–20 cm) after 24 yr in no-till as influenced by potential evapotranspiration (PET), landscape position (slope), and CI; and (ii) to compare the size of the C pools after the first 12 yr (wet) versus the subsequent 12 yr, notable for frequent droughts. Rotations were wheat–corn (Zea mays L.)–fallow (WCF), continuous cropping (CC), and a grass Conservation Reserve Program mixture planted across slopes at three sites in Colorado with similar precipitation but increasing PET. After 24 yr, water-soluble organic C increased with CI from WCF to CC to grass with 250, 340, and 440 kg C ha−1, respectively. Soil microbial biomass C also increased with CI–1500, 1660, and 2135 kg C ha−1 for WCF, CC, and grass, respectively. The particulate organic matter C pool had a three-way interaction with PET, slope, and CI. Overall, between Years 12 and 24, SOC increased in grass by 16.9%, with a rate of 425 kg C ha−1 yr−1 sequestration compared with 10.5 and 1.4% for the WCF and CC systems, respectively.*

Shetty, N. J., Pandey, A., Baker, S., Hao, W. M., & Chakrabarty, R. K. (2019). Measuring light absorption by freshly emitted organic aerosols: Optical artifacts in traditional solvent-extraction-based methods. *Atmospheric Chemistry and Physics, 19*(13), 8817-8830. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069042606&doi=10.5194%2facp-19-8817-2019&partnerID=40&md5=29c3fe0379beb7ba2e9abbb97e437620. doi:10.5194/acp-19-8817-2019
Research Tags: Research
Abstract: *Recent studies have shown that organic aerosol (OA) could have a nontrivial role in atmospheric light absorption at shorter visible wavelengths. Good estimates of OA light absorption are therefore necessary*

to better estimate radiative forcing due to these aerosols in climate models. One of the common techniques used to measure OA light absorption is the solvent extraction technique from filter samples which involves the use of a spectrophotometer to measure bulk absorbance by the solvent-soluble organic fraction of particulate matter. Measured solvent-phase absorbance is subsequently converted to particle-phase absorption coefficient using scaling factors. The conventional view is to apply a correction factor of 2 to absorption coefficients obtained from solvent-extracted OA based on Mie calculations. The appropriate scaling factors are a function of biases due to incomplete extraction of organic carbon (OC) by solvents and size-dependent absorption properties of OA. The range for these biases along with their potential dependence on burn conditions is an unexplored area of research.
Here, we performed a comprehensive laboratory study involving three solvents (water, methanol, and acetone) to investigate the bias in absorption coefficients obtained from solvent-extraction-based photometry techniques as compared to in situ particle-phase absorption for freshly emitted OA from biomass burning. We correlated the bias with OC/TC (total carbon) mass ratio and single scattering albedo (SSA) and observed that the conventionally used correction factor of 2 for water and methanol-extracted OA might not be extensible to all systems, and we suggest caution while using such correction factors to estimate particle-phase OA absorption coefficients. Furthermore, a linear correlation between SSA and the OC/TC ratio was also established. Finally, from the spectroscopic data, we analyzed the differences in absorption Ångström exponents (AÅE) obtained from solution- and particulate-phase measurements. We noted that AÅE from solvent-phase measurements could deviate significantly from their OA counterparts.

Shi, R., Ukaew, S., Archer, D. W., Lee, J. H., Pearlson, M. N., Lewis, K. C., & Shonnard, D. R. (2017). Life Cycle Water Footprint Analysis for Rapeseed Derived Jet Fuel in North Dakota. *ACS Sustainable Chemistry and Engineering, 5*(5), 3845-3854. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018401465&doi=10.1021%2facssuschemeng.6b02956&partnerID=40&md5=a3b0ff1ad5e6a5e1792c41d2eeab9719. doi:10.1021/acssuschemeng.6b02956
Research Tags: Energy, Water
Abstract: *Rapeseed is considered to be a promising sources for hydroprocessed ester and fatty acid (HEFA) jet fuel production as a means to address energy security and climate change mitigation. However, concerns have been raised about its impact on water, as large-scale biofuel production may place pressure on fresh water supplies and water quality. Water footprint (WF) analysis, when combined with water-focused life cycle assessment (LCA), can be an effective system analysis tool for water sustainability. This study developed a life cycle water footprint analysis informed by inputs from multiple models for rapeseed HEFA jet fuel production in North Dakota and evaluated the environmental impacts on water utilization and water quality due to large scale HEFA jet production. The biogeochemical-based EPIC model was incorporated to simulate crop growth that influences the hydrological cycle. Systematic LCA models were built in SimaPro to conduct life cycle blue WF analysis. Results using energy allocation indicate that rapeseed derived HEFA jet fuel has a WF of 131–143 m3 per GJ fuel over a rapeseed price range of $470–600, including all green, blue, and gray WF components. Discussions also indicate the importance of incorporating allocation within a life cycle approach when conducting biofuel WF analysis.*

Shirk, A. J., Cushman, S. A., Waring, K. M., Wehenkel, C. A., Leal-Sáenz, A., Toney, C., & Lopez-Sanchez, C. A. (2018). Southwestern white pine (Pinus strobiformis) species distribution models project a large range shift and contraction due to regional climatic changes. *Forest Ecology and Management, 411*, 176-186. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041453232&doi=10.1016%2fj.foreco.2018.01.025&partnerID=40&md5=bd5c4806751f725f2afaab7f6704f063. doi:10.1016/j.foreco.2018.01.025
Research Tags: Forestry
Abstract: *Southwestern white pine (Pinus strobiformis; SWWP) is a conifer species that occurs at mid to high elevations in the mountains of Arizona, New Mexico, and northern Mexico. A key component of mixed conifer forests in the region, SWWP is an important species for wildlife and biodiversity. The dual threats of the non-native fungal pathogen that causes white pine blister rust (WPBR) and a warmer, drier projected future climate have created an uncertain future for SWWP. In this study, we used a novel multi-scale optimization approach including an ensemble of four species distribution modeling methods to explore the relationship between SWWP occurrence and environmental variables based on climate, soil, and topography. Spatial*

projections of these models reflecting the present climate provide an improved range map for this species that can be used to guide field data collection and monitoring of WPBR outbreaks. Future projections based on two emissions scenarios and an ensemble of 15 general circulation models project a large range shift and range contraction by 2080. Changes in the future distribution were particularly extreme under the higher emissions scenario, with a more than 1000 km northerly shift in the mean latitude and 500 m increase in the mean elevation of the species' suitable habitat. This coincided with a range contraction of over 60% and a significant increase in habitat fragmentation. The ability of SWWP to realize its projected future range will depend on colonization at the leading edge of the range shift, including dispersal dynamics, resistance to WPBR, competition with other species, and genetic adaptations to local climate. Our results provide information that can be used to guide monitoring efforts and inform conservation planning for this keystone species.

Shirk, A. J., Landguth, E. L., & Cushman, S. A. (2018). A comparison of regression methods for model selection in individual-based landscape genetic analysis. *Molecular Ecology Resources, 18*(1), 55-67. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041343127&doi=10.1111%2f1755-0998.12709&partnerID=40&md5=03b4b9ba1d0d1ab88ed178f9b17e607b. doi:10.1111/1755-0998.12709
Research Tags: Research
Abstract: *Anthropogenic migration barriers fragment many populations and limit the ability of species to respond to climate-induced biome shifts. Conservation actions designed to conserve habitat connectivity and mitigate barriers are needed to unite fragmented populations into larger, more viable metapopulations, and to allow species to track their climate envelope over time. Landscape genetic analysis provides an empirical means to infer landscape factors influencing gene flow and thereby inform such conservation actions. However, there are currently many methods available for model selection in landscape genetics, and considerable uncertainty as to which provide the greatest accuracy in identifying the true landscape model influencing gene flow among competing alternative hypotheses. In this study, we used population genetic simulations to evaluate the performance of seven regression-based model selection methods on a broad array of landscapes that varied by the number and type of variables contributing to resistance, the magnitude and cohesion of resistance, as well as the functional relationship between variables and resistance. We also assessed the effect of transformations designed to linearize the relationship between genetic and landscape distances. We found that linear mixed effects models had the highest accuracy in every way we evaluated model performance; however, other methods also performed well in many circumstances, particularly when landscape resistance was high and the correlation among competing hypotheses was limited. Our results provide guidance for which regression-based model selection methods provide the most accurate inferences in landscape genetic analysis and thereby best inform connectivity conservation actions.*

Shirk, A. J., Schroeder, M. A., Robb, L. A., & Cushman, S. A. (2017). Persistence of greater sage-grouse in agricultural landscapes. *Journal of Wildlife Management, 81*(5), 905-918. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017457776&doi=10.1002%2fjwmg.21268&partnerID=40&md5=30e20c68049fe7578e7be6b9acb9a222. doi:10.1002/jwmg.21268
Research Tags: Grassland, Wildlife
Abstract: *Local extirpations influence species' range contractions and are often precursors of range-wide extinction. Understanding extinction dynamics is important for devising effective management strategies to protect threatened and endangered species. The greater sage-grouse (Centrocercus urophasianus) is an example of a species undergoing range contraction, and has been extirpated from nearly half its historically occupied habitat. We used species distribution modeling to quantify environmental variables constraining a threatened sage-grouse population inhabiting an agricultural landscape in Washington, USA. Fields planted to perennial vegetation as part of the Conservation Reserve Program (CRP) were important in providing year-round habitat for sage-grouse but only when intermixed with native sagebrush-steppe vegetation. Without the CRP, we estimate 66% of sage-grouse habitat in the study area would become unsuitable. Conversely, if CRP allotments were concentrated near occupied native sagebrush-steppe, we estimate the area of sage-grouse habitat could be increased by up to 63%. In addition to the area of native sagebrush-steppe and CRP lands, we also found that climate variability, the patch configuration of sagebrush-steppe, and proximity to major roads and transmission lines constrain the distribution of occupied habitat within the study area. Our study demonstrates how conservation programs such as CRP may be used as a management tool to reduce the*

risk of extirpation in agricultural areas, and to facilitate species range shifts in response to climatic changes in the sagebrush biome.

Shive, K. L., Preisler, H. K., Welch, K. R., Safford, H. D., Butz, R. J., O'Hara, K., & Stephens, S. L. (2018). From the stand scale to the landscape scale: predicting the spatial patterns of forest regeneration after disturbance. *Ecological Applications, 28*(6), 1626-1639. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052746976&doi=10.1002%2feap.1756&partnerID=40&md5=eacad0b5965bd8f97d160ca5ea44c268. doi:10.1002/eap.1756
Research Tags: Forestry
Abstract: *Shifting disturbance regimes can have cascading effects on many ecosystems processes. This is particularly true when the scale of the disturbance no longer matches the regeneration strategy of the dominant vegetation. In the yellow pine and mixed conifer forests of California, over a century of fire exclusion and the warming climate are increasing the incidence and extent of stand-replacing wildfire; such changes in severity patterns are altering regeneration dynamics by dramatically increasing the distance from live tree seed sources. This has raised concerns about limitations to natural reforestation and the potential for conversion to non-forested vegetation types, which in turn has implications for shifts in many ecological processes and ecosystem services. We used a California region-wide data set with 1,848 plots across 24 wildfires in yellow pine and mixed conifer forests to build a spatially explicit habitat suitability model for forecasting postfire forest regeneration. To model the effect of seed availability, the critical initial biological filter for regeneration, we used a novel approach to predicting spatial patterns of seed availability by estimating annual seed production from existing basal area and burn severity maps. The probability of observing any conifer seedling in a 60-m2 area (the field plot scale) was highly dependent on 30-yr average annual precipitation, burn severity, and seed availability. We then used this model to predict regeneration probabilities across the entire extent of a "new" fire (the 2014 King Fire), which highlights the spatial variability inherent in postfire regeneration patterns. Such forecasts of postfire regeneration patterns are of importance to land managers and conservationists interested in maintaining forest cover on the landscape. Our tool can also help anticipate shifts in ecosystem properties, supporting researchers interested in investigating questions surrounding alternative stable states, and the interaction of altered disturbance regimes and the changing climate.*

Siebers, M. H., Slattery, R. A., Yendrek, C. R., Locke, A. M., Drag, D., Ainsworth, E. A., . . . Ort, D. R. (2017). Simulated heat waves during maize reproductive stages alter reproductive growth but have no lasting effect when applied during vegetative stages. *Agriculture, Ecosystems and Environment, 240*, 162-170. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013806611&doi=10.1016%2fj.agee.2016.11.008&partnerID=40&md5=c54a6de86aee7c571f0036231651cca6. doi:10.1016/j.agee.2016.11.008
Research Tags: Weather, Crops
Abstract: *Due to climate change, heat waves are predicted to become more frequent and severe. While long-term studies on temperature stress have been conducted on important crops such as maize (Zea mays), the immediate or long-term effects of short duration but extreme high temperature events during key developmental periods on physiological and yield parameters are unknown. Therefore, heat waves were applied to field-grown maize in east central Illinois using infrared heating technology. The heat waves warmed the canopy approximately 6 °C above ambient canopy temperatures for three consecutive days during vegetative development (Wv1) and during an early reproductive stage (silking; Wv2). Neither treatment affected aboveground vegetative biomass, and Wv1 did not significantly reduce reproductive biomass. However, Wv2 significantly reduced total reproductive biomass by 16% ($p < 0.1$) due to significant reductions in cob length ($p < 0.1$), cob mass ($p < 0.05$), and husk mass ($p < 0.05$). Although not statistically significant, seed yield was also reduced by 13% ($p = 0.15$) and kernel number by 10% ($p = 0.16$) in the Wv2 treatment. Soil water status was unaffected in both treatments, and leaf water potential and midday photosynthesis were only transiently reduced by heating with complete recovery after the treatment period. Therefore, the reduction in Wv2 reproductive biomass was most likely due to greater sensitivity of reproductive structures to direct effects of high temperature stress.*

Sihi, D., Davidson, E. A., Chen, M., Savage, K. E., Richardson, A. D., Keenan, T. F., & Hollinger, D. Y. (2018). Merging a mechanistic enzymatic model of soil heterotrophic respiration into an ecosystem model in two AmeriFlux

sites of northeastern USA. *Agricultural and Forest Meteorology, 252*, 155-166. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041471015&doi=10.1016%2fj.agrformet.2018.01.026&partnerID=40&md5=5ddc0a3de41b36a4e3884a013e1e83e8. doi:10.1016/j.agrformet.2018.01.026
Research Tags: Research, Soil
Abstract: *Heterotrophic respiration (Rh), microbial processing of soil organic matter to carbon dioxide (CO2), is a major, yet highly uncertain, carbon (C) flux from terrestrial systems to the atmosphere. Temperature sensitivity of Rh is often represented with a simple Q10 function in ecosystem models and earth system models (ESMs), sometimes accompanied by an empirical soil moisture modifier. More explicit representation of the effects of soil moisture, substrate supply, and their interactions with temperature has been proposed as a way to disentangle the confounding factors of apparent temperature sensitivity of Rh and improve the performance of ecosystem models and ESMs. The objective of this work was to insert into an ecosystem model a more mechanistic, but still parsimonious, model of environmental factors controlling Rh and evaluate the model performance in terms of soil and ecosystem respiration. The Dual Arrhenius and Michaelis-Menten (DAMM) model simulates Rh using Michaelis-Menten, Arrhenius, and diffusion functions. Soil moisture affects Rh and its apparent temperature sensitivity in DAMM by regulating the diffusion of oxygen, soluble C substrates, and extracellular enzymes to the enzymatic reaction site. Here, we merged the DAMM soil flux model with a parsimonious ecosystem flux model, FöBAAR (Forest Biomass, Assimilation, Allocation and Respiration). We used high-frequency soil flux data from automated soil chambers and landscape-scale ecosystem fluxes from eddy covariance towers at two AmeriFlux sites (Harvard Forest, MA and Howland Forest, ME) in the northeastern USA to estimate parameters, validate the merged model, and to quantify the uncertainties in a multiple constraints approach. The optimized DAMM-FöBAAR model better captured the seasonal and inter-annual dynamics of soil respiration (Soil R) compared to the FöBAAR-only model for the Harvard Forest, where higher frequency and duration of drying events significantly regulate substrate supply to heterotrophs. However, DAMM-FöBAAR showed improvement over FöBAAR-only at the boreal transition Howland Forest only in unusually dry years. The frequency of synoptic-scale dry periods is lower at Howland, resulting in only brief water limitation of Rh in some years. At both sites, the declining trend of soil R during drying events was captured by the DAMM-FöBAAR model; however, model performance was also contingent on site conditions, climate, and the temporal scale of interest. While the DAMM functions require a few more parameters than a simple Q10 function, we have demonstrated that they can be included in an ecosystem model and reduce the model-data mismatch. Moreover, the mechanistic structure of the soil moisture effects using DAMM functions should be more generalizable than the wide variety of empirical functions that are commonly used, and these DAMM functions could be readily incorporated into other ecosystem models and ESMs.*

Sikkink, P. G., Jain, T. B., Reardon, J., Heinsch, F. A., Keane, R. E., Butler, B., & Baggett, L. S. (2017). Effect of particle aging on chemical characteristics, smoldering, and fire behavior in mixed-conifer masticated fuel. *Forest Ecology and Management, 405*, 150-165. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029603161&doi=10.1016%2fj.foreco.2017.09.008&partnerID=40&md5=d0cbd4ab6a43a7ba8cae19adb77989d8. doi:10.1016/j.foreco.2017.09.008
Research Tags: Weather, Forestry
Abstract: *Mastication is a silvicultural technique that grinds, shreds, or chops trees or shrubs into pieces and redistributes the biomass onto the forest floor to form a layer of woody debris. Unlike other fuel treatments that remove this biomass, masticated biomass often remains on site, which increases total fuel loading and causes concern over how the masticated particles may burn if exposed to prescribed fire or wildfire. Central to the question of how these particles may burn is how the time since mastication affects the decomposition of the wood particles comprising the fuels. We conducted controlled laboratory experiments to investigate how the particles changed chemically over the time since they were masticated and how those chemical changes affected fire behavior characteristics. The objectives were (1) to quantify the chemical differences of masticated materials from different climates and different decomposition stages, (2) determine whether chemical changes occurred similarly in all fuel particles, and (3) describe the fire behavior characteristics exhibited by these fuels. Masticated materials came from mixed-conifer forests at fifteen different sites throughout the Rocky Mountains. Paired stands from these sites were of similar vegetation and forest stage. They represented wet and dry climates, different stages of wood decomposition, and variable piece sizes based on the type of machine used to masticate the biomass.*

Time since mastication and piece size affected the rate of chemical changes in the masticated particles. Fragmented particles had less heat value, N, and C than intact particles from the same site. C decreased and N increased with time since treatment. In most cases, cellulose decreased as decomposition occurred. Age of the particles, tree species, climate, and quantity of fuel load were all important factors influencing chemical change and burn characteristics. In the smoldering experiments, age was not a significant factor but soil substrate was. Soil surface temperatures in the smoldering tests differed significantly between dry sand and dry duff, and most of the smoldering burns in dry duff easily reached temperatures and durations at the surface between the fuel and the soil that would kill soil plants, microbes, and fauna and severely affect soil ecology. When planning prescribed burns in these treatments, managers need to consider not only the moisture of the fuels, air temperature, and wind, but also the dryness and type of soil, the amount of decomposition (time since mastication) of the fuel particles, fuel depths, fuel loads, and the spatial distribution of the fuel loads left by the masticator.

Sima, N. Q., Andales, A. A., Harmel, R. D., Ma, L., & Trout, T. J. (2019). Evaluating RZWQM2-CERES-Maize and water production functions for predicting irrigated maize yield and biomass in eastern Colorado. *Transactions of the ASABE, 62*(1), 213-223. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069527105&doi=10.13031%2ftrans.13045&partnerID=40&md5=855f15afbe5ea0fa11f680c0ee3264fb. doi:10.13031/trans.13045

Research Tags: Crops

Abstract: *Complex crop models have been developed to simulate the interactions among biophysical processes and to extend experimental results beyond the local soil and climate conditions. However, in-depth studies on a model's capability to predict crop growth under different conditions are sparse, and the question of whether a crop model outperforms a simple water production function (WPF) has not been answered. The objective of this study was to compare the predictive ability of a complex crop model with simple WPFs for yield and biomass estimation at three sites (Greeley, Fort Collins, and Akron) in eastern Colorado. Specifically, the CERES-Maize crop model in the Root Zone Water Quality Model (RZWQM2), which has been applied extensively in eastern Colorado for simulating maize growth, was compared to crop WPFs based on irrigation and rainfall amounts during growing seasons. Results showed that the predictive ability of CERES-Maize depended on which datasets were used for model parameterization, and that WPFs in general performed as good as or better than CERES-Maize based on a modified F-test after considering experimental uncertainties. The ability of CERES-Maize and the WPF derived from Greeley (2008-2011) to predict maize yield in Greeley (2012-2013), Fort Collins (2006-2010), and Akron (1984-1986) depended on year and site. WPFs outperformed CERES-Maize for Greeley (2012-2013) and Fort Collins (2006-2010) but performed similarly for Akron (1984-1986). This study also identified the need to improve crop model responses to water stress, especially at different growth stages, for cropping systems models to be adequate for estimating the impacts of irrigation management on yield. Ultimately, the choice between the use of a complex crop model and a simpler WPF depends on the purpose of the user and the required accuracy.*

Singh, B., Singh, S. K., Matcha, S. K., Kakani, V. G., Wijewardana, C., Chastain, D., . . . Reddy, K. R. (2019). Parental environmental effects on seed quality and germination response to temperature of andropogon gerardii. *Agronomy, 9*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068462584&doi=10.3390%2fagronomy9060304&partnerID=40&md5=44a29a584603f6077a0819b5f188fc9c. doi:10.3390/agronomy9060304

Research Tags: Grassland

Abstract: *Parental environments (PEs) affect seed quality and might alter the re-establishment of big bluestem grass due to impacts on seed germination. An in vitro study was conducted to quantify the temperature response of seed germination and its interaction with the PE in big bluestem. Seeds developed under eight PEs consisting of a combination of four day/night growth temperatures (GTs) (20/12, 25/17, 30/22, and 35/27 °C) and two CO2 levels (360 and 720 µL L−1) were germinated at eight temperatures (germination temperatures (GRTs)) ranging from 10 to 42.5 °C. Quadratic and modified bilinear regressions best described the cardinal temperatures for the estimated maximum seed germination (MSG) and seed germination rate (SGR), respectively. The average MSG and SGR showed differential responses to the PEs and significantly declined above a 35 °C GRT across the PEs. For the SGR, the minimum and optimum temperatures showed significant* *differences from other treatments but the opposite response to elevated CO2, while maximum temperatures significantly declined at high (35/27 °C) and low GTs (20/12 °C). Seed quality parameters, individual seed weight, and C and N contents showed a high correlation (R2 > 60) with the average percentage of seed germination and the SGR. Thus, high temperatures for both the PEs (>30/22 °C) and GRTs (>30 °C) could significantly reduce germination, affecting the re-establishment of big bluestem.*

Singh, I., Dominguez, F., Demaria, E., & Walter, J. (2018). Extreme Landfalling Atmospheric River Events in Arizona: Possible Future Changes. *Journal of Geophysical Research: Atmospheres, 123*(14), 7076-7097. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050490579&doi=10.1029%2f2017JD027866&partnerID=40&md5=cadeeea228e63830931f5229e8fe56d2. doi:10.1029/2017JD027866
Research Tags: Water
Abstract: *The semiarid Salt and Verde River Basins in Arizona are susceptible to atmospheric river (AR)-related flooding. To understand the precipitation-related impacts of climate change on extreme ARs affecting Arizona, a pseudo-global warming method was used. High-resolution control and future simulations of five intense historical AR events that affected the Salt and Verde River Basins in Central Arizona were carried out using the Weather Research and Forecasting regional climate model. The pseudo-global warming approach for future simulations involved adding a temperature delta at different vertical levels to the historical initial and lateral boundary conditions of the input data while keeping constant relative humidity. The deltas were calculated using projected changes toward end of the 21st century from an ensemble of nine Global Climate Models for the Representative Concentration Pathway (RCP) 8.5. Future simulations showed an overall increase in vertically integrated transport of vapor and upward moisture flux at cloud base over the region for all events. The changes in precipitation at both domain and basin levels were highly spatially heterogeneous. Precipitation increased in all future simulations; but in general, this increase remained less than the increase in column-integrated water vapor. It was found that in most cases, cloud ice content decreased while cloud water content increased, indicating the increased role of warm-rain processes in producing precipitation in the future simulations. Freezing levels rose by more than 600 m, and this along with increased temperature and greater role of warm-rain processes led to a decrease of more than 80% in the amount of frozen precipitation during the events.*

Singh, S., Dash, P., Silwal, S., Feng, G., Adeli, A., & Moorhead, R. J. (2017). Influence of land use and land cover on the spatial variability of dissolved organic matter in multiple aquatic environments. *Environmental Science and Pollution Research, 24*(16), 14124-14141. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017507140&doi=10.1007%2fs11356-017-8917-5&partnerID=40&md5=eef8146ed5f758b22ebd38a35d59d01c. doi:10.1007/s11356-017-8917-5
Research Tags: Water
Abstract: *Water quality of lakes, estuaries, and coastal areas serves as an indicator of the overall health of aquatic ecosystems as well as the health of the terrestrial ecosystem that drains to the water body. Land use and land cover plays not only a significant role in controlling the quantity of the exported dissolved organic matter (DOM) but also influences the quality of DOM via various biogeochemical and biodegradation processes. We examined the characteristics and spatial distribution of DOM in five major lakes, in an estuary, and in the coastal waters of the Mississippi, USA, and investigated the influence of the land use and land cover of their watersheds on the DOM composition. We employed absorption and fluorescence spectroscopy including excitation-emission matrix (EEM) combined with parallel factor (PARAFAC) analysis modeling techniques to determine optical properties of DOM and its characteristics in this study. We developed a site-specific PARAFAC model to evaluate DOM characteristics resulting in five diverse DOM compositions that included two terrestrial humic-like (C1 and C3), two microbial humic-like (C2 and C5), and one protein-like (C4) DOM. Our results showed elevated fluorescence levels of microbial humic-like or protein-like DOM in the lakes and coastal waters, while the estuarine waters showed relatively high fluorescence levels of terrestrial humic-like DOM. The results also showed that percent forest and wetland coverage explained 68 and 82% variability, respectively, in terrestrial humic-like DOM exports, while 87% variability in microbially derived humiclike DOM was explained by percent agricultural lands. Strong correlations between microbial humic-like DOM and fluorescence-derived DOM indices such as biological index (BIX) and fluorescence index (FI) indicated autochthonous characteristics in the lakes, while the estuary showed largely allochthonous DOM of terrestrial origin. We also observed higher*

concentrations of total dissolved phosphorous (TDP) and ammonium nitrogen (NH4-N) in coastal waters potentially due to photodegradation of refractory DOM derived from the sediment-bound organic matter in the coastal wetlands. This study highlights the relationships between the DOM compositions in the water and the land use and land cover in the watershed. The spatial variability of DOM in three different types of aquatic environments enhances the understanding of the role of land use and land cover in carbon cycling through export of organic matter to the aquatic ecosystems..

Singleton, M. P., Thode, A. E., Sánchez Meador, A. J., & Iniguez, J. M. (2019). Increasing trends in high-severity fire in the southwestern USA from 1984 to 2015. *Forest Ecology and Management, 433*, 709-719. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057891250&doi=10.1016%2fj.foreco.2018.11.039&partnerID=40&md5=6f89ee0dc6b3b03abc6853feb0affee0. doi:10.1016/j.foreco.2018.11.039
Research Tags: Forestry, Weather
Abstract: *In the last three decades, over 4.1 million hectares have burned in Arizona and New Mexico and the largest fires in documented history have occurred in the past two decades. Changes in burn severity over time, however, have not been well documented in forest and woodland ecosystems in the southwestern US. Using remotely sensed burn severity data from 1621 fires (>404 ha), we assessed trends from 1984 to 2015 in Arizona and New Mexico in (1) number of fires and total area burned in all vegetation types; (2) area burned, area of high-severity, and percent of high-severity fire in all forest and woodland areas; and (3) area burned, area of high-severity, and percent of high-severity in seven different grouped forest and woodland vegetation types (Ecological Response Unit [ERU] Fire Regime Types). Number of fires and area burned increased across the Southwest regardless of vegetation type. The significant increasing trends held for area burned, area of high-severity, and percent of high-severity fire in all forest and woodland ecosystems. Area burned and area burned severely increased in all seven ERU Fire Regime Types while percent of high-severity fire increased in two ERUs: Mixed Conifer Frequent Fire and Mixed Conifer with Aspen/Spruce Fir. Managers must face the implications of increasing, uncharacteristic high-severity fire in many ecosystems as climate change and human pressures continue to affect fire regimes.*

Siry, J. P., Cubbage, F. W., Potter, K. M., & McGinley, K. (2018). Current Perspectives on Sustainable Forest Management: North America. *Current Forestry Reports, 4*(3), 138-149. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051529685&doi=10.1007%2fs40725-018-0079-2&partnerID=40&md5=26ed8c45448fdaa13d75906a58597c8e. doi:10.1007/s40725-018-0079-2
Research Tags: Forestry
Abstract: *Purpose of Review*
Increased availability of current forest resource information provides an opportunity to evaluate the continued concerns about forest sustainability in North America. The purpose of this study is to assess and discuss the current state and trends of North American forest resources, sustainable forest management, and their implications for forest sustainability.
Recent Findings
Recent information indicates that forest sustainability in North America is not under threat. Forest area, inventory, and carbon stocks have been increasing while wood harvest has been declining. Large expanses of forest resources are covered by management plans, and many forests are certified. The areas of concern include forest fires and bark beetle infestations in primarily public forests in the western USA and Canada, and continued loss of forest cover in Mexico.
Summary
Despite progress made in gathering information on forest resources, evaluating forest sustainability remains challenging. Practicing sustainable forest management is made difficult by unfavorable market conditions and the ensuing lack of funding, challenges in developing and implementing forest management plans, and uncertainties including potential impacts of climate change, population growth, and changing markets.

Skidmore, E. L., Hagen, L. J., Armbrust, D. V., Durar, A. A., Fryrear, D. W., Potter, K. N., . . . Zobeck, T. M. (2017). Methods for investigating basic processes and conditions affecting wind erosion. In *Soil Erosion Research Methods* (pp. 295-330).
Research Tags: Soil, Weather

Abstract: *This chapter reviews some of the methods used for investigating basic processes and conditions affecting wind erosion. E. L. Skidmore and J. Tatarko developed a wind data base suitable for use in the stochastic approaches in the wind erosion modeling effort. Dry soil-aggregate stability and aggregate-size distribution are primary factors affecting soil susceptibility to wind erosion. Various methods based on different principles have been used to evaluate dry aggregate stability. Detachment and transport of particles during wind erosion are controlled by a number of static and dynamic forces interacting with a wide range of particle sizes in a turbulent flow. The various processes that compose wind erosion are difficult to study at a point in space and time, so measurements usually represent either quasi-steady state or time integrations of detachment and transport processes over some finite space. Environmental wind tunnels are often used to study detachment and transport.*

Slack, A. W., Kane, J. M., Knapp, E. E., & Sherriff, R. L. (2017). Contrasting impacts of climate and competition on large sugar pine growth and defense in a fire-excluded forest of the central Sierra Nevada. *Forests, 8*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026193484&doi=10.3390%2ff8070244&partnerID=40&md5=8463b223677a842af67f5008af6f9aa6. doi:10.3390/f8070244
Research Tags: Forestry, Weather
Abstract: *Many forest ecosystems with a large pine component in the western United States have experienced environmental stress associated with climate change and increased competition with forest densification in the absence of fire. Information on how changes in climate and competition affect carbon allocation to tree growth and defense is needed to anticipate changes to tree vigor and, ultimately, stand structure. This study retrospectively examined the influence of annual climate and competition measures on the growth and defense of 113 large sugar pines (Pinus lambertiana) in a mixed-conifer forest of the central Sierra Nevada of California. We found that growth in large sugar pine was positively associated with higher January temperatures and lower intraspecific competition. Resin duct size was negatively associated with climatic water deficit and total competition, while resin duct area contrastingly showed a positive relationship with total competition. From 1979 to 2012, the rates of growth increased, while resin duct size decreased. Our results suggest that tree vigor measures can respond differently to climate and competition factors that may lead to separate growth and defense trends over time. Stress associated with warmer temperatures and higher competition may distinctly influence individual tree and stand-level vigor with potential implications for future forest dynamics.*

Slaughter, L. C., Nelson, J. A., Carlisle, E., Bourguignon, M., Dinkins, R. D., Phillips, T. D., & McCulley, R. L. (2018). Climate change and Epichloë coenophiala association modify belowground fungal symbioses of tall fescue host. *Fungal Ecology, 31*, 37-46. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034668761&doi=10.1016%2fj.funeco.2017.10.002&partnerID=40&md5=d03f789e1595d2089cc9d04e59b42283. doi:10.1016/j.funeco.2017.10.002
Research Tags: Grassland
Abstract: *Human alteration of symbiont genetics among aboveground endophytic Epichloë coenophiala strains within tall fescue (Schedonorus arundinaceus) has led to widespread deployment of novel grass-endophyte combinations, yet little is known about their ecological consequences. In this study, clone pairs (endophyte-infected, endophyte-free) of two tall fescue genotypes received factorial combinations of increased temperature (+3 °C) and precipitation (+30% long-term annual mean) for 2 yr. We measured root arbuscular mycorrhizal fungi (AMF), dark septate endophyte (DSE) colonization, and soil AMF extraradical hyphae (ERH) length. We hypothesized that genetically distinct grass-E. coenophiala associations would differentially affect belowground fungi, and that these relationships would be climate-sensitive. Tall fescue genotype, endophyte presence, and climate treatment interactions affected AMF arbuscules, vesicles, and ERH. DSE decreased with E. coenophiala presence but increased with warming. Genetically distinct tall fescue-E. coenophiala associations may have divergent long-term impacts on other host-symbiont interactions, potentially impacting ecosystem function and response to climate change.*

Sloat, M. R., Reeves, G. H., & Christiansen, K. R. (2017). Stream network geomorphology mediates predicted vulnerability of anadromous fish habitat to hydrologic change in southeast Alaska. *Global Change Biology,* *23*(2), 604-620. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84987678298&doi=10.1111%2fgcb.13466&partnerID=40&md5=c7c4b6bdd15452b6b003f51c83248485. doi:10.1111/gcb.13466

Research Tags: Water, Wildlife

Abstract: *In rivers supporting Pacific salmon in southeast Alaska, USA, regional trends toward a warmer, wetter climate are predicted to increase mid- and late-21st-century mean annual flood size by 17% and 28%, respectively. Increased flood size could alter stream habitats used by Pacific salmon for reproduction, with negative consequences for the substantial economic, cultural, and ecosystem services these fish provide. We combined field measurements and model simulations to estimate the potential influence of future flood disturbance on geomorphic processes controlling the quality and extent of coho, chum, and pink salmon spawning habitat in over 800 southeast Alaska watersheds. Spawning habitat responses varied widely across watersheds and among salmon species. Little variation among watersheds in potential spawning habitat change was explained by predicted increases in mean annual flood size. Watershed response diversity was mediated primarily by topographic controls on stream channel confinement, reach-scale geomorphic associations with spawning habitat preferences, and complexity in the pace and mode of geomorphic channel responses to altered flood size. Potential spawning habitat loss was highest for coho salmon, which spawn over a wide range of geomorphic settings, including steeper, confined stream reaches that are more susceptible to streambed scour during high flows. We estimated that 9–10% and 13–16% of the spawning habitat for coho salmon could be lost by the 2040s and 2080s, respectively, with losses occurring primarily in confined, higher-gradient streams that provide only moderate-quality habitat. Estimated effects were lower for pink and chum salmon, which primarily spawn in unconfined floodplain streams. Our results illustrate the importance of accounting for valley and reach-scale geomorphic features in watershed assessments of climate vulnerability, especially in topographically complex regions. Failure to consider the geomorphic context of stream networks will hamper efforts to understand and mitigate the vulnerability of anadromous fish habitat to climate-induced hydrologic change.*

Smart, M. D., Cornman, R. S., Iwanowicz, D. D., McDermott-Kubeczko, M., Pettis, J. S., Spivak, M. S., & Otto, C. R. V. (2017). A comparison of honey bee-collected pollen from working agricultural lands using light microscopy and its metabarcoding. *Environmental Entomology*, *46*(1), 38-49. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015813504&doi=10.1093%2fee%2fnvw159&partnerID=40&md5=d028ab81d0cdbd88b330b07b0aa143a9. doi:10.1093/ee/nvw159

Research Tags: Wildlife, Crops

Abstract: *Taxonomic identification of pollen has historically been accomplished via light microscopy but requires specialized knowledge and reference collections, particularly when identification to lower taxonomic levels is necessary. Recently, next-generation sequencing technology has been used as a cost-effective alternative for identifying bee-collected pollen; however, this novel approach has not been tested on a spatially or temporally robust number of pollen samples. Here, we compare pollen identification results derived from light microscopy and DNA sequencing techniques with samples collected from honey bee colonies embedded within a gradient of intensive agricultural landscapes in the Northern Great Plains throughout the 2010–2011 growing seasons. We demonstrate that at all taxonomic levels, DNA sequencing was able to discern a greater number of taxa, and was particularly useful for the identification of infrequently detected species. Importantly, substantial phenological overlap did occur for commonly detected taxa using either technique, suggesting that DNA sequencing is an appropriate, and enhancing, substitutive technique for accurately capturing the breadth of bee-collected species of pollen present across agricultural landscapes. We also show that honey bees located in high and low intensity agricultural settings forage on dissimilar plants, though with overlap of the most abundantly collected pollen taxa. We highlight practical applications of utilizing sequencing technology, including addressing ecological issues surrounding land use, climate change, importance of taxa relative to abundance, and evaluating the impact of conservation program habitat enhancement efforts.*

Smith, A. T., & Millar, C. I. (2018). American Pika (Ochotona princeps) Population Survival in Winters with Low or No Snowpack. *Western North American Naturalist, 78*(2), 126-132. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052592020&doi=10.3398%2f064.078.0203&partnerID=40&md5=5b80bb5579da4db0c4ff9775563195da. doi:10.3398/064.078.0203

Research Tags: Wildlife, Weather
Abstract: *A prediction that has gained considerable traction in the American pika (Ochotona princeps) literature is that because of climate change, high mortality is likely to occur in winters of low or early snowmelt and cause extirpation of local populations. The basis for this prediction is the perception that the absence of an insulative layer of snow to protect pikas from severe winter cold temperatures may cause animals to utilize metabolic reserves through excessive thermoregulation before the spring emergence of fresh vegetation, or die directly from exposure to extreme winter temperatures. The Sierra Nevada of east central California experienced its lowest snowfall in recorded history during the winter of 2014/2015. We observed patch occupancy as a proxy for overwinter survivorship of American pikas in the Sierra Nevada during summer 2015 in comparison to baseline populations at the same sites during summer 2014. In summer 2015, pika presence was documented at 36 of 37 sites where pikas had been observed in summer 2014. Contrary to the low snowfall-high mortality prediction, there was no evidence that the nearly total lack of snow caused unusual overwinter mortality in Sierra Nevada pikas.*

Smith, D. M., & Finch, D. M. (2017). Climate change and wildfire effects in aridland riparian ecosystems: An examination of current and future conditions. *USDA Forest Service - General Technical Report RMRS-GTR, 2017*(364). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022190734&partnerID=40&md5=2aacaec33d168aa19c1503fb3c673516.
Research Tags: Water, Weather, Grassland
Abstract: *Aridland riparian ecosystems are limited, the climate is changing, and further hydrological change is likely in the American Southwest. To protect riparian ecosystems and organisms, we need to understand how they are affected by disturbance processes and stressors such as fire, drought, and non-native plant invasions. Riparian vegetation is critically important as foraging, resting, migrating, and breeding habitat to birds and other animal species in the southwestern United States. Fremont cottonwood (Populus fremontii), Arizona sycamore (Platanus wrightii), and other woody species provide birds with nesting sites and foraging opportunities, some of which are absent or rare in adjacent plant communities. The structurally diverse, species-rich vegetation along many southwestern streams supports high densities of territories and nest sites for a variety of birds including several species of high conservation priority. Survival and reproduction of woody riparian plants is largely determined by periodic floods and droughts. As in other regions, rivers and streams of the American Southwest have been heavily altered by human activity, resulting in significant changes to disturbance regimes. Hydrological models, incorporating greenhouse gas emission scenarios, project that these changes will be exacerbated by climate change. In this report, we review the ecohydrology of southwestern streams and share results from our study sites along the Middle Rio Grande to describe effects of hydrological changes, wildfire, and invasions on plant communities and riparian-nesting birds. We also examine climate change projections and output from population models to gauge the future of aridland riparian ecosystems in an increasingly arid Southwest.*

Smith, J. L., & Fratamico, P. M. (2018). Emerging and Re-Emerging Foodborne Pathogens. *Foodborne Pathogens and Disease, 15*(12), 737-757. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058779489&doi=10.1089%2ffpd.2018.2493&partnerID=40&md5=16e3e89c853a0a6b6233e03659e90e06. doi:10.1089/fpd.2018.2493
Research Tags: Crops
Abstract: *Emergence and re-emergence of foodborne pathogens is a continuing concern for public health agencies and organizations, the food industry, and consumers. Several factors that contribute to the emergence include changes in the behavior of microorganisms and consumers, changes in agricultural practices and animal husbandry, increase in foreign travel, food distribution through a global marketplace, and climate changes. Furthermore, advances in molecular technologies and pathogen detection methods are allowing increased recognition of the presence of new pathogens. Emerging foodborne pathogens are often zoonotic in origin and may include Gram-negative and Gram-positive bacteria, parasites, and viruses. Previously established foodborne pathogens may re-emerge as more virulent pathogens after the acquisition of new virulence factors, including antibiotic resistance determinants. In this review, various important emerging foodborne pathogens, including non-O157 Shiga toxin–producing Escherichia coli serogroups, pathogenic*

hybrid E. coli, extraintestinal pathogenic E. coli, drug-resistant foodborne bacteria, Clostridium difficile, hepatitis E virus, and others, are discussed, as well as factors that may be involved in their emergence. Reducing the number of foodborne illnesses and the emergence/re-emergence of pathogens require global partnerships among government agencies, the food industry, and other groups involved in food safety.

Smith, R. J., Jovan, S., Gray, A. N., & McCune, B. (2017). Sensitivity of carbon stores in boreal forest moss mats - effects of vegetation, topography and climate. *Plant and Soil, 421*(1-2), 31-42. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029901935&doi=10.1007%2fs11104-017-3411-x&partnerID=40&md5=49393b61e0b0d8bc08576976f4634ea4. doi:10.1007/s11104-017-3411-x

Research Tags: Forestry, Soil

Abstract: *Background and aims*

In northern regions, moss and lichen mats are the major carbon-cycling interface between soils and the atmosphere. We aimed to quantify sensitivity of ground layer nutrient stores to environmental predictors, to better understand interactions with vegetation, topography and climatic conditions.

Methods

With non-destructive forest inventory techniques, we estimated distributions of biomass, carbon and nitrogen among moss/lichen ground layers in a 1.1 million-ha watershed within Alaska's boreal forest region. Using nonparametric multiplicative regression, we fit response surfaces and quantified sensitivity to environmental predictors.

Results

Across 96 sites, half the ground layer biomass values were in the range 4750–18,900 kg ha−1 (25th to 75th percentiles). Carbon and nitrogen stores peaked in older stands and those with little forb cover (suggesting low disturbance) and low incident radiation. Among functional groups, the most abundant were nitrogen-fixing feather mosses, which formed extensive carpets. Nutrient stores were most sensitive to local vegetation and topography predictors, but less sensitive to regional climate.

Conclusions

Moss and lichen mats in boreal forests are substantial carbon and nitrogen stores, with consequences for carbon sequestration and ecosystem productivity. Their environmental sensitivity suggests that ground layer nutrient stores could decrease if global changes promote vascular vegetation expansions and intensifying wildfire regimes.

Smith, R. J., Nelson, P. R., Jovan, S., Hanson, P. J., & McCune, B. (2018). Novel climates reverse carbon uptake of atmospherically dependent epiphytes: Climatic constraints on the iconic boreal forest lichen Evernia mesomorpha. *American Journal of Botany, 105*(2), 266-274. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042510121&doi=10.1002%2fajb2.1022&partnerID=40&md5=f417a49bc816d0ba60fa86052c9dad50. doi:10.1002/ajb2.1022

Research Tags: Forestry

Abstract: *Premise of the Study*

Changing climates are expected to affect the abundance and distribution of global vegetation, especially plants and lichens with an epiphytic lifestyle and direct exposure to atmospheric variation. The study of epiphytes could improve understanding of biological responses to climatic changes, but only if the conditions that elicit physiological performance changes are clearly defined.

Methods

We evaluated individual growth performance of the epiphytic lichen Evernia mesomorpha, an iconic boreal forest indicator species, in the first year of a decade-long experiment featuring whole-ecosystem warming and drying. Field experimental enclosures were located near the southern edge of the species' range.

Key Results

Mean annual biomass growth of Evernia significantly declined 6 percentage points for every +1°C of experimental warming after accounting for interactions with atmospheric drying. Mean annual biomass growth was 14% in ambient treatments, 2% in unheated control treatments, and −9% to −19% (decreases) in energy-added treatments ranging from +2.25 to +9.00°C above ambient temperatures. Warming-induced biomass losses among persistent individuals were suggestive evidence of an extinction debt that could precede further local mortality events.

Conclusions
Changing patterns of warming and drying would decrease or reverse Evernia growth at its southern range margins, with potential consequences for the maintenance of local and regional populations. Negative carbon balances among persisting individuals could physiologically commit these epiphytes to local extinction. Our findings illuminate the processes underlying local extinctions of epiphytes and suggest broader consequences for range shrinkage if dispersal and recruitment rates cannot keep pace.

Smithers, B. V., North, M. P., Millar, C. I., & Latimer, A. M. (2018). Leap frog in slow motion: Divergent responses of tree species and life stages to climatic warming in Great Basin subalpine forests. *Global Change Biology, 24*(2), e442-e457. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041292184&doi=10.1111%2fgcb.13881&partnerID=40&md5=b6f94d7abb78ee6bd47326883a85f3c8. doi:10.1111/gcb.13881

Research Tags: Forestry

Abstract: *In response to climate warming, subalpine treelines are expected to move up in elevation since treelines are generally controlled by growing season temperature. Where treeline is advancing, dispersal differences and early life stage environmental tolerances are likely to affect how species expand their ranges. Species with an establishment advantage will colonize newly available habitat first, potentially excluding species that have slower establishment rates. Using a network of plots across five mountain ranges, we described patterns of upslope elevational range shift for the two dominant Great Basin subalpine species, limber pine and Great Basin bristlecone pine. We found that the Great Basin treeline for these species is expanding upslope with a mean vertical elevation shift of 19.1 m since 1950, which is lower than what we might expect based on temperature increases alone. The largest advances were on limber pine-dominated granitic soils, on west aspects, and at lower latitudes. Bristlecone pine juveniles establishing above treeline share some environmental associations with bristlecone adults. Limber pine above-treeline juveniles, in contrast, are prevalent across environmental conditions and share few environmental associations with limber pine adults. Strikingly, limber pine is establishing above treeline throughout the region without regard to site characteristic such as soil type, slope, aspect, or soil texture. Although limber pine is often rare at treeline where it coexists with bristlecone pine, limber pine juveniles dominate above treeline even on calcareous soils that are core bristlecone pine habitat. Limber pine is successfully "leap-frogging" over bristlecone pine, probably because of its strong dispersal advantage and broader tolerances for establishment. This early-stage dominance indicates the potential for the species composition of treeline to change in response to climate change. More broadly, it shows how species differences in dispersal and establishment may result in future communities with very different specific composition.*

Smýkal, P., Hradilová, I., Trněný, O., Brus, J., Rathore, A., Bariotakis, M., . . . Pirintsos, S. (2017). Genomic diversity and macroecology of the crop wild relatives of domesticated pea. *Scientific Reports, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037733806&doi=10.1038%2fs41598-017-17623-4&partnerID=40&md5=c15c982ffac78625bb5f9e7c1065ebd8. doi:10.1038/s41598-017-17623-4

Research Tags: Crops

Abstract: *There is growing interest in the conservation and utilization of crop wild relatives (CWR) in international food security policy and research. Legumes play an important role in human health, sustainable food production, global food security, and the resilience of current agricultural systems. Pea belongs to the ancient set of cultivated plants of the Near East domestication center and remains an important crop today. Based on genome-wide analysis, P. fulvum was identified as a well-supported species, while the diversity of wild P. sativum subsp. elatius was structured into 5 partly geographically positioned clusters. We explored the spatial and environmental patterns of two progenitor species of domesticated pea in the Mediterranean Basin and in the Fertile Crescent in relation to the past and current climate. This study revealed that isolation by distance does not explain the genetic structure of P. sativum subsp. elatius in its westward expansion from its center of origin. The genetic diversity of wild pea may be driven by Miocene-Pliocene events, while the phylogenetic diversity centers may reflect Pleisto-Holocene climatic changes. These findings help set research and discussion priorities and provide geographical and ecological information for germplasm-collecting missions, as well as for the preservation of extant diversity in ex-situ collections.*

Smyth, C. E., Smiley, B. P., Magnan, M., Birdsey, R., Dugan, A. J., Olguin, M., . . . Kurz, W. A. (2018). Climate change mitigation in Canada's forest sector: A spatially explicit case study for two regions. *Carbon Balance and Management, 13*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053164335&doi=10.1186%2fs13021-018-0099-z&partnerID=40&md5=5d970b734c846ae0c75e82865f7a3c00. doi:10.1186/s13021-018-0099-z

Research Tags: Forestry

Abstract: *Background*

We determine the potential of forests and the forest sector to mitigate greenhouse gas (GHG) emissions by changes in management practices and wood use for two regions within Canada's managed forest from 2018 to 2050. Our modeling frameworks include the Carbon Budget Model of the Canadian Forest Sector, a framework for harvested wood products that estimates emissions based on product half-life decay times, and an account of marginal emission substitution benefits from the changes in use of wood products and bioenergy. Using a spatially explicit forest inventory with 16 ha pixels, we examine mitigation scenarios relating to forest management and wood use: increased harvesting efficiency; residue management for bioenergy; reduced harvest; reduced slashburning, and more longer-lived wood products. The primary reason for the spatially explicit approach at this coarse resolution was to estimate transportation distances associated with delivering harvest residues for heat and/or electricity production for local communities.

Results

Results demonstrated large differences among alternative scenarios, and from alternative assumptions about substitution benefits for fossil fuel-based energy and products which changed scenario rankings. Combining forest management activities with a wood-use scenario that generated more longer-lived products had the highest mitigation potential.

Conclusions

The use of harvest residues to meet local energy demands in place of burning fossil fuels was found to be an effective scenario to reduce GHG emissions, along with scenarios that increased the utilization level for harvest, and increased the longevity of wood products. Substitution benefits from avoiding fossil fuels or emissions-intensive products were dependent on local circumstances for energy demand and fuel mix, and the assumed wood use for products. As projected future demand for biomass use in national GHG mitigation strategies could exceed sustainable biomass supply, analyses such as this can help identify biomass sources that achieve the greatest mitigation benefits.

Sniezko, R. A., Kegley, A., & Savin, D. P. (2017). Ex situ genetic conservation potential of seeds of two high elevation white pines. *New Forests, 48*(2), 245-261. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014572979&doi=10.1007%2fs11056-017-9579-3&partnerID=40&md5=8928512d4af4f5911a1d9f054673cdbc. doi:10.1007/s11056-017-9579-3

Research Tags: Forestry

Abstract: *Genetic variation in a plant species is a key to its ability to survive and evolve in the face of changing environmental pressures. Due to insect and disease impacts, changes in fire regimes, and a changing climate, many populations of high elevation white pine species continue to experience high mortality levels and potentially worrisome decreases in genetic variation. In recent years, some trees rated highly for resistance to the non-native white pine blister rust have been killed by fire or mountain pine beetle. Ex situ genetic conservation offers the possibility to conserve the genetic variation within a species before much of it is lost. For many conifer species, freezer storage of seed offers a relatively inexpensive, long-term method of storing germplasm for future use. However, there is uncertainty concerning how long seed of some conifers can be stored and retain viability. We report here on results of germination testing of the oldest known seedlots of whitebark pine (Pinus albicaulis Engelm.) and foxtail pine (P. balfouriana Grev. & Balf.), some of which had been in storage for several decades. The 52 whitebark pine seedlots averaged 47.7% germination (average seed age of 19.2 years), while the four foxtail pine seedlots had an average germination of 71.3% (average seed age of 15.3 years). Some seedlots of both species had greater than 90% germination. Refinements to the stratification procedure have since been developed which should enhance germination further. A follow-up study examining seedling vigor of long-stored whitebark pine seed is planned.*

Snow, N. P., Jarzyna, M. A., & VerCauteren, K. C. (2017). Interpreting and predicting the spread of invasive wild pigs.

Journal of Applied Ecology, 54(6), 2022-2032. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011035339&doi=10.1111%2f1365-2664.12866&partnerID=40&md5=2b6a0058b43b7b9e8e4ac5fca3e4a6f2. doi:10.1111/1365-2664.12866
Research Tags: Wildlife
Abstract: *The eruption of invasive wild pigs (IWPs) Sus scrofa throughout the world exemplifies the need to understand the influences of exotic and nonnative species expansions. In particular, the continental USA is precariously threatened by a rapid expansion of IWPs, and a better understanding of the rate and process of spread can inform strategies that will limit the expansion.*
We developed a spatially and temporally dynamic model to examine three decades (1982–2012) of IWP expansion, and predict the spread of IWPs throughout the continental USA, relative to where IWPs previously inhabited. We used the model to predict where IWPs are likely to invade next.
The average rate of northward expansion increased from 6·5 to 12·6 km per year, suggesting most counties in the continental USA could be inhabited within the next 3–5 decades. The spread of IWPs was primarily associated with expansion into areas with similar environmental characteristics as their previous range, with the exception of spreading into colder regions. We identified that climate change may assist spread into northern regions by generating milder winters with less snow. Otherwise, the spread of IWPs was not dependent on agriculture, precipitation or biodiversity at the county level. The model correctly predicted 86% of counties that were invaded during 2012, and those predictions indicate that large portions of the USA are in immediate danger of invasion.
Synthesis and applications. Anti-invasion efforts should focus along the boundaries of current occupied range to stop natural expansion, and anti-invasion policies should focus on stopping anthropogenic transport and release of invasive wild pigs. Our results demonstrate the utility of a spatio-temporal examination to inform strategies for limiting the spread of invasive wild pigs.

Snyder, K. A., Evers, L., Chambers, J. C., Dunham, J., Bradford, J. B., & Loik, M. E. (2019). Effects of Changing Climate on the Hydrological Cycle in Cold Desert Ecosystems of the Great Basin and Columbia Plateau. *Rangeland Ecology and Management, 72*(1), 1-12. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051973688&doi=10.1016%2fj.rama.2018.07.007&partnerID=40&md5=a9ff61a76fc81ca0a0a7dfea3ee51e65. doi:10.1016/j.rama.2018.07.007
Research Tags: Water, Grassland
Abstract: *Climate change is already resulting in changes in cold desert ecosystems, lending urgency to the need to understand climate change effects and develop effective adaptation strategies. In this review, we synthesize information on changes in climate and hydrologic processes during the past century for the Great Basin and Columbia Plateau and discuss future projections for the 21st century. We develop midcentury projections of temperature and climate for the Great Basin and Columbia Plateau at timescales relevant to managers (2020 − 2050) and discuss concepts and strategies for adapting to the projected changes. For the instrumented record in the Great Basin and Columbia Plateau (1985 − 2011), a temperature increase of 0.7 − 1.4°C has been documented, but changes in precipitation have been relatively minor with no clear trends. Climate projections for 2020 − 2050 indicate that temperatures will continue to increase, especially in winter and during the night. Precipitation is more difficult to project, and estimates range from an 11% decrease to 25% increase depending on location. Recent records indicate that the Great Basin and Columbia Plateau are becoming more arid, a trend that is projected to continue. Droughts are likely to become more frequent and last longer, invasive annual grasses are likely to continue to expand, and the duration and severity of wildfire seasons are likely to increase. Climate projections can help in developing adaptive management strategies for actual or expected changes in climate. Strategies include reducing the risks of nonnative invasive plant spread and wildfires that result in undesirable transitions, planning for drought, and where necessary, facilitating the transition of populations, communities, and ecosystems to new climatic conditions. A proactive approach to planning for and adapting to climate change is needed, and publicly available Internet-based resources on climate data and planning strategies are available to help meet that need.*

Snyder, S. A., Kilgore, M. A., Emery, M. R., & Schmitz, M. (2019). Maple Syrup Producers of the Lake States, USA: Attitudes Towards and Adaptation to Social, Ecological, and Climate Conditions. *Environmental Management, 63*(2), 185-199. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060783758&doi=10.1007%2fs00267-018-1121-7&partnerID=40&md5=048830f3470ab69833dc7edbbb43ccdc. doi:10.1007/s00267-018-1121-7
Research Tags: Crops, Forestry
Abstract: *Maple syrup is an important non-timber forest product derived from the sap of the sugar maple (Acer saccharum Marshall). However, maple syrup producers are facing a diversity of challenges, including: potential range shifts in the maple resource; increasing variability in the timing, duration and yield of sap flow and syrup operations; invasive species, pests and diseases; and intergenerational land and business transfer challenges. Members of Maple Syrup Producer Associations in Minnesota, Wisconsin, and Michigan were surveyed to learn about their operations, adaptation strategies, concerns, and information needs. While many respondents indicated they have undertaken or plan to undertake adaptation activities, only 11% had done so out of specific concern over changing climate conditions. Climate-motivated activities included: being prepared to tap earlier and utilizing newer technology such as vacuum tubing or reverse osmosis to enhance sap collection and processing efficiency. Respondents were generally unlikely to consider planting climate-resilient maple cultivars or tapping trees other than sugar maple. They expressed the greatest concerns over tree health and forest pests, as well as their physical ability and family member interest to continue their operations. Boil season variability and weather issues were viewed with less concern. Respondents were generally optimistic that they can adapt to future conditions, likely in large measure through the adoption of new technologies, and they expect their syrup production levels to slightly increase in the future. If future climate scenarios play out, however, additional planning and adaptation strategies may be called for, particularly as they relate to forest health and productivity issues.*

Sofaer, H. R., Jarnevich, C. S., & Flather, C. H. (2018). Misleading prioritizations from modelling range shifts under climate change. *Global Ecology and Biogeography, 27*(6), 658-666. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043400024&doi=10.1111%2fgeb.12726&partnerID=40&md5=c1fd6fcacd4793b30052d599c94c7d7c. doi:10.1111/geb.12726
Research Tags: Wildlife, Research
Abstract: *Aim*
Conservation planning requires the prioritization of a subset of taxa and geographical locations to focus monitoring and management efforts. Integration of the threats and opportunities posed by climate change often relies on predictions from species distribution models, particularly for assessments of vulnerability or invasion risk for multiple taxa. We evaluated whether species distribution models could reliably rank changes in species range size under climate and land use change.
Location
Conterminous U.S.A.
Time period
1977–2014.
Major taxa studied
Passerine birds.
Methods
We estimated ensembles of species distribution models based on historical North American Breeding Bird Survey occurrences for 190 songbirds, and generated predictions to recent years given c. 35 years of observed land use and climate change. We evaluated model predictions using standard metrics of discrimination performance and a more detailed assessment of the ability of models to rank species vulnerability to climate change based on predicted range loss, range gain, and overall change in range size.
Results
Species distribution models yielded unreliable and misleading assessments of relative vulnerability to climate and land use change. Models could not accurately predict range expansion or contraction, and therefore failed to anticipate patterns of range change among species. These failures occurred despite excellent overall discrimination ability and transferability to the validation time period, which reflected strong performance at the majority of locations that were either always or never occupied by each species.
Main conclusions
Models failed for the questions and at the locations of greatest interest to conservation and management. This highlights potential pitfalls of multi-taxa impact assessments under global change; in our case, models

provided misleading rankings of the most impacted species, and spatial information about range changes was not credible. As modelling methods and frameworks continue to be refined, performance assessments and validation efforts should focus on the measures of risk and vulnerability useful for decision-making.

Sohoulande Djebou, D. C. (2018). Toward an integrated watershed zoning framework based on the spatio-temporal variability of land-cover and climate: Application in the Volta river basin. *Environmental Development, 28*, 55-66. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054098673&doi=10.1016%2fj.envdev.2018.09.006&partnerID=40&md5=a797f28251889767116db25ff16e851f. doi:10.1016/j.envdev.2018.09.006
Research Tags: Water, Research
Abstract: *This article details a watershed regionalization approach which uses the concept of entropy in combination with the k-means clusters analysis. The regionalization approach aims to subdivide a watershed into relatively uniform zones based on the spatial variability of the local climate and land-covers. A case study is presented to illustrate the approach and outline the environmental implications of the outcomes. Especially, the study reports an application in the Volta river basin which is a transnational watershed, shared by six different countries in West Africa. Over years, the transboundary status of the Volta watershed seems to have exacerbated its environmental challenges, because the environmental policies in the six countries do not necessarily complement. Subsequently, it is desirable to envision unified scientific tools to support the management platform of the Volta basin. To date, the literature on the Volta has virtually neglected this aspect. Hence, this case study is timely as it intends to create a unified zoning system for the Volta river basin. In the study, formulations of entropy theory and k-means clustering were jointly applied to 16-years gridded time-series of monthly leaf area index, precipitation, and temperature across the Volta basin. Based on a clustering optimization criterion, a total of five zones were identified then the related land-cover and climatic patterns were comparatively analyzed. Significant environmental contrasts were diagnosed then specificities were pinpointed for each zone. A comparison of the new zones with an existing macro-scale ecoregion shows similarities which sustain the capacity of the regionalization approach to capturing meaningful biophysical signals. Hence, the zoning technique may be valued for further applications in environmental management.*

Sohrabi, M. M., Benjankar, R., Tonina, D., Wenger, S. J., & Isaak, D. J. (2017). Estimation of daily stream water temperatures with a Bayesian regression approach. *Hydrological Processes, 31*(9), 1719-1733. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014764025&doi=10.1002%2fhyp.11139&partnerID=40&md5=d7797ae0cce67159f5bf28f807db09c4. doi:10.1002/hyp.11139
Research Tags: Water, Weather
Abstract: *Stream water temperature plays a significant role in aquatic ecosystems where it controls many important biological and physical processes. Reliable estimates of water temperature at the daily time step are critical in managing water resources. We developed a parsimonious piecewise Bayesian model for estimating daily stream water temperatures that account for temporal autocorrelation and both linear and nonlinear relationships with air temperature and discharge. The model was tested at 8 climatically different basins of the USA and at 34 sites within the mountainous Boise River Basin (Idaho, USA). The results show that the proposed model is robust with an average root mean square error of 1.25 °C and Nash–Sutcliffe coefficient of 0.92 over a 2-year period. Our approach can be used to predict historic daily stream water temperatures in any location using observed daily stream temperature and regional air temperature data.*

Sohrabi, M. M., Tonina, D., Benjankar, R., Kumar, M., Kormos, P., & Marks, D. (2018). Role of temporal resolution of meteorological inputs for process-based snow modelling. *Hydrological Processes, 32*(19), 2976-2989. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052376570&doi=10.1002%2fhyp.13242&partnerID=40&md5=11bbb441f08a627e9eff6d4ae484f8a5. doi:10.1002/hyp.13242
Research Tags: Weather, Research
Abstract: *Accurate snow accumulation and melt simulations are crucial for understanding and predicting hydrological dynamics in mountainous settings. As snow models require temporally varying meteorological inputs, time resolution of these inputs is likely to play an important role on the model accuracy. Because meteorological data at a fine temporal resolution (~1 hr) are generally not available in many snow-dominated*

settings, it is important to evaluate the role of meteorological inputs temporal resolution on the performance of process-based snow models. The objective of this work is to assess the loss in model accuracy with temporal resolution of meteorological inputs, for a range of climatic conditions and topographic elevations. To this end, a process-based snow model was run using 1-, 3-, and 6-hourly inputs for wet, average, and dry years over Boise River Basin (6,963 km2), which spans rain dominated (≤1,400 m), rain–snow transition (>1,400 and ≤1,900 m), snow dominated below tree line (>1,900 and ≤2,400 m), and above tree line (>2,400 m) elevations. The results show that sensitivity of the model accuracy to the inputs time step generally decreases with increasing elevation from rain dominated to snow dominated above tree line. Using longer than hourly inputs causes substantial underestimation of snow cover area (SCA) and snow water equivalent (SWE) in rain-dominated and rain–snow transition elevations, due to the precipitation phase mischaracterization. In snow-dominated elevations, the melt rate is underestimated due to errors in estimation of net snow cover energy input. In addition, the errors in SCA and SWE estimates generally decrease toward years with low snow mass, that is, dry years. The results indicate significant increases in errors in estimates of SCA and SWE as the temporal resolution of meteorological inputs becomes coarser than an hour. However, use of 3-hourly inputs can provide accurate estimates at snow-dominated elevations. The study underscores the need to record meteorological variables at an hourly time step for accurate process-based snow modelling.

Sorokin, Y., Zelikova, T. J., Blumenthal, D., Williams, D. G., & Pendall, E. (2017). Seasonally contrasting responses of evapotranspiration to warming and elevated CO<inf>2</inf> in a semiarid grassland. *Ecohydrology, 10*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030467423&doi=10.1002%2feco.1880&partnerID=40&md5=ccf73a104977de4cfc7bcfbb794cf64b. doi:10.1002/eco.1880

Research Tags: Weather, Grassland

Abstract: *Global climate change is expected to alter seasonal patterns and rates of evapotranspiration in dry regions. Although climate change will involve elevated CO_2 and increased temperatures, independently, these factors may have different impacts on actual evapotranspiration (AET) due to their opposing effects on transpiration. We used canopy gas exchange chambers to quantify AET in a semiarid grassland experimentally altered by elevated CO_2 and warming over 3 years with contrasting ambient precipitation. Seasonal and interannual variations in AET due to background climate variability were larger than the effects of climate manipulation treatments. However, in a year with average precipitation, cumulative growing season AET was suppressed by warming by 23%. Across years, warming increased AET early in the growing season and suppressed it later in the growing season. By contrast, elevated CO_2 suppressed AET early in the growing season and enhanced it later, but only in years with average or above-average precipitation. Vegetation greenness (a proxy for photosynthetically active leaf area) was consistently the strongest predictor of AET, whereas soil moisture and vapor pressure deficit were secondary drivers. Our research demonstrates that effects of increased atmospheric CO_2 and temperature on AET will be mediated by plant phenological development and seasonal climatic conditions.*

Sorunmu, Y. E., Billen, P., Elkasabi, Y., Mullen, C. A., Macken, N. A., Boateng, A. A., & Spatari, S. (2017). Fuels and Chemicals from Equine-Waste-Derived Tail Gas Reactive Pyrolysis Oil: Technoeconomic Analysis, Environmental and Exergetic Life Cycle Assessment. *ACS Sustainable Chemistry and Engineering, 5*(10), 8804-8814. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030483674&doi=10.1021%2facssuschemeng.7b01609&partnerID=40&md5=e4e1664fc13cf6183764d57069a5fb6c. doi:10.1021/acssuschemeng.7b01609

Research Tags: Emissions, Livestock, Energy

Abstract: *Horse manure, the improper disposal of which, imposes considerable environmental costs, constitutes an apt feedstock for conversion to renewable fuels and chemicals when tail gas reactive pyrolysis (TGRP) is employed. TGRP is a modification of fast pyrolysis that recycles its noncondensable gases and produces a bio-oil low in oxygen concentration and rich in naphthalene. Herein, we evaluate the coproduction of phenol as a value-added renewable chemical, alongside jet-range fuels within distributed TGRP systems using techno-economic analysis and life cycle assessment. We investigate the metrics global warming potential (GWP), cumulative exergy demand (CExD), and cost for the conversion of 200 dry metric tons per day of horse manure to bio-oil and its subsequent upgrade to hydrocarbon fuel and phenolic chemicals. Assigning credits for*

the offset of the coproducts, the net GWP and CExD of TGRP jet fuel are 10 g of CO2 eq and 0.4 MJ per passenger kilometer distance traveled, respectively. These values are considerably lower than the GWP and CExD of petroleum-based aviation fuel. The minimum fuel selling price of the TGRP jet fuel ($1.35–$1.80 L–1) is estimated to be much greater than that of petroleum-based aviation fuel ($0.42 L–1), except under optimized fuel conversion and coproduct market conditions ($0.53–$0.79 L–1) when including a market price for carbon.

Sparrow, E. B., & Cochran, V. L. (2018). Effect of soil depth and temperature on CH <inf>4</inf> consumption in subarctic agricultural soils. In *Soil Management and Greenhouse Effect* (pp. 197-204).
Research Tags: Soil, Emissions
No Abstract (Book):

Srock, A. F., Charney, J. J., Potter, B. E., & Goodrick, S. L. (2018). The Hot-Dry-Windy Index: A new fireweather index. *Atmosphere, 9*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050486880&doi=10.3390%2fatmos9070279&partnerID=40&md5=b77630467fa8f8466b4f0ea608e5ccab. doi:10.3390/atmos9070279
Research Tags: Weather, Research
Abstract: *Fire weather indices are commonly used by fire weather forecasters to predict when weather conditions will make a wildland fire difficult to manage. Complex interactions at multiple scales between fire, fuels, topography, and weather make these predictions extremely difficult. We define a new fire weather index called the Hot-Dry-Windy Index (HDW). HDW uses the basic science of how the atmosphere can affect a fire to define the meteorological variables that can be predicted at synoptic-and meso-alpha-scales that govern the potential for the atmosphere to affect a fire. The new index is formulated to account for meteorological conditions both at the Earth's surface and in a 500-m layer just above the surface. HDW is defined and then compared with the Haines Index (HI) for four historical fires. The Climate Forecast System Reanalysis (CFSR) is used to provide the meteorological data for calculating the indices. Our results indicate that HDW can identify days on which synoptic-and meso-alpha-scale weather processes can contribute to especially dangerous fire behavior. HDW is shown to perform better than the HI for each of the four historical fires. Additionally, since HDW is based on the meteorological variables that govern the potential for the atmosphere to affect a fire, it is possible to speculate on why HDW would be more or less effective based on the conditions that prevail in a given fire case. The HI, in contrast, does not have a physical basis, which makes speculation on why it works or does not work difficult because the mechanisms are not clear.*

Stagge, J. H., & Moglen, G. E. (2017). Water resources adaptation to climate and demand change in the potomac river. *Journal of Hydrologic Engineering, 22*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029534120&doi=10.1061%2f%28ASCE%29HE.1943-5584.0001579&partnerID=40&md5=7c0cfd61c469f6639a98b5a67791840b. doi:10.1061/(ASCE)HE.1943-5584.0001579
Research Tags: Water
Abstract: *The effects of climate change are increasingly considered in conjunction with changes in water demand and reservoir sedimentation in forecasts of water supply vulnerability. Here, the relative effects of these factors are evaluated for the Washington, DC metropolitan area water supply for the near (2010–2039), intermediate (2040–2069), and distant (2070–2099) future by repeated water resources model simulations. This system poses water management challenges because of long water-delivery travel times that increase uncertainty, multiple water jurisdictions that constrain potential decisions, and future scenarios that simultaneously increase demand and decrease water supply during the critical summer period. Adaptation strategies were developed for the system using a multiobjective evolutionary algorithm. Optimized reservoir management policies were compared using six distinct objectives ranging from reservoir storage to environmental and recreational benefits. Simulations of future conditions show water stress increasing with time. Reservoir sedimentation is projected to more than double (114% increase) the severity of reservoir storage failures by 2040. Increases in water demand and climate change are projected to further stress the system, causing longer periods of low flow and a loss of recreational reservoir storage. The adoption of optimized rules mitigates some of these effects, most notably returning simulations of 2070–2099 climate to near historical levels. Modifying the balance between upstream and downstream reservoirs improved storage penalties by*

20.7% and flowby penalties by 50%. Changing triggers for shifting load to off-line reservoirs improved flowby (8.3%) and environmental (4.1%) penalties slightly, whereas changing demand restriction triggers provided only moderate improvements, but with few adverse effects.

Stagge, J. H., Rosenberg, D. E., DeRose, R. J., & Rittenour, T. M. (2018). Monthly paleostreamflow reconstruction from annual tree-ring chronologies. *Journal of Hydrology, 557*, 791-804. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040030382&doi=10.1016%2fj.jhydrol.2017.12.057&partnerID=40&md5=00410a8deb7a811f544e97f48046965e. doi:10.1016/j.jhydrol.2017.12.057
Research Tags: Water, Forestry
Abstract: *Paleoclimate reconstructions are increasingly used to characterize annual climate variability prior to the instrumental record, to improve estimates of climate extremes, and to provide a baseline for climate-change projections. To date, paleoclimate records have seen limited engineering use to estimate hydrologic risks because water systems models and managers usually require streamflow input at the monthly scale. This study explores the hypothesis that monthly streamflows can be adequately modeled by statistically decomposing annual flow reconstructions. To test this hypothesis, a multiple linear regression model for monthly streamflow reconstruction is presented that expands the set of predictors to include annual streamflow reconstructions, reconstructions of global circulation, and potential differences among regional tree-ring chronologies related to tree species and geographic location. This approach is used to reconstruct 600 years of monthly streamflows at two sites on the Bear and Logan rivers in northern Utah. Nash-Sutcliffe Efficiencies remain above zero (0.26–0.60) for all months except April and Pearson's correlation coefficients (R) are 0.94 and 0.88 for the Bear and Logan rivers, respectively, confirming that the model can adequately reproduce monthly flows during the reference period (10/1942 to 9/2015). Incorporating a flexible transition between the previous and concurrent annual reconstructed flows was the most important factor for model skill. Expanding the model to include global climate indices and regional tree-ring chronologies produced smaller, but still significant improvements in model fit. The model presented here is the only approach currently available to reconstruct monthly streamflows directly from tree-ring chronologies and climate reconstructions, rather than using resampling of the observed record. With reasonable estimates of monthly flow that extend back in time many centuries, water managers can challenge systems models with a larger range of natural variability in drought and pluvial events and better evaluate extreme events with recurrence intervals longer than the observed record. Establishing this natural baseline is critical when estimating future hydrologic risks under conditions of a non-stationary climate.*

Stanturf, J. A., Perdue, J. H., Young, T. M., Huang, X., Guo, Z., Dougherty, D., & Pigott, M. (2019). A spatially explicit approach to modeling biological productivity and economic attractiveness of short-rotation woody crops in the eastern USA. *Energy, Sustainability and Society, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069769212&doi=10.1186%2fs13705-019-0211-6&partnerID=40&md5=47b1b213c97960e22135288ae8c64ae5. doi:10.1186/s13705-019-0211-6
Research Tags: Research, Forestry, Energy
Abstract: *Over the past two decades, the United States government conducted detailed analyses of the potential of a biobased national energy strategy that produced four unified studies, namely the 2005–2016 US Billion-Ton Study and updates. With each effort, better perspective was gained on the biophysical potential of biomass and the economic availability of these resources on a national scale. It was also apparent that many questions remained, including crop yields, logistical operations, and systems integration across production and harvest. These reports accentuated the need for improving geospatial performance metrics for biomass supply chains. This study begins to address these problems by developing spatially specific data layers that incorporate data on soils, climatology, growth, and economics for short-rotation woody biomass plantations. Methods were developed to spatially assess the potential productivity and profitability of four candidate species Pinus taeda L., Populus deltoides W. Bartram ex Marshall and Populus hybrids, Eucalyptus grandis Hill ex Maiden, and Eucalyptus benthamii Maiden et Cambage for biomass plantations in the eastern United States. Productivity was estimated using the process-based growth model 3PG (Physiological Processes Predicting Growth) parameterized at the resolution of the United States 5-digit zip code tabulation area (ZCTA). Each ZCTA is unique in terms of species suitability, cost, and productive potential. These data layers make available dedicated energy crop analyses for practitioners interested in facility siting scenarios in conjunction with a*

species growth potential at a particular location. Production systems for SRWC are extremely regionalized given key biophysical and economic factors that determine the potential for acceptable growth and profitability. This analysis points to the return on invested capital being dependent on the site location of a species within its operable range. Large-scale biomass plantation systems are feasible in regions with higher potential internal rate of return. The higher the potential return, the more desirable it is to plant the specific species on the site. Increasing the available feedstock by lowering cost, increasing productivity, and stabilizing logistics would have a similar effect as higher feedstock prices. The modeled growth can be used for further economic evaluation, carbon sequestration studies, and sustainability research.

Steel, Z. L., Koontz, M. J., & Safford, H. D. (2018). The changing landscape of wildfire: burn pattern trends and implications for California's yellow pine and mixed conifer forests. *Landscape Ecology*, *33*(7), 1159-1176. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048083090&doi=10.1007%2fs10980-018-0665-5&partnerID=40&md5=48613f91bd9c18b161453e3c0681e52e. doi:10.1007/s10980-018-0665-5

Research Tags: Forestry, Weather

Abstract: *Purpose*

Wildfire spatial patterns drive ecological processes including vegetation succession and wildlife community dynamics. Such patterns may be changing due to fire suppression policies and climate change, making characterization of trends in post-fire mosaics important for understanding and managing fire-prone ecosystems.

Methods

For wildfires in California's yellow pine and mixed-conifer forests, spatial pattern trends of two components of the post-fire severity matrix were assessed for 1984–2015: (1) unchanged or very low-severity and (2) high-severity, which represent remnant forest and stand-replacing fire, respectively. Trends were evaluated for metrics of total and proportional burned area, shape complexity, aggregation, and core area. Additionally, comparisons were made between management units where fire suppression is commonly practiced and those with a history of managing wildfire for ecological/resource benefits.

Results

Unchanged or very low-severity area per fire decreased proportionally through time, and became increasingly fragmented. High-severity area and core area increased on average across most of California, with the high-severity component also becoming simpler in shape in the Sierra Nevada. Compared to suppression units, managed wildfire units lack an increase in high-severity area, have less aggregated post-fire mosaics, and more high-severity spatial complexity.

Conclusions

Documented changes in severity patterns have cascading ecological effects including increased vegetation type conversion risk, habitat availability shifts, and remnant forest fragmentation. These changes likely benefit early-seral-associated species at the expense of mature closed-canopy forest-associated species. Managed wildfire appears to moderate some effects of fire suppression, and may help buy time for ecosystems and managers to respond to a changing climate.

Steele, C., Reyes, J., Elias, E., Aney, S., & Rango, A. (2018). Cascading impacts of climate change on southwestern US cropland agriculture. *Climatic Change, 148*(3), 437-450. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047913417&doi=10.1007%2fs10584-018-2220-4&partnerID=40&md5=00181a2bdfebae7c58862ba6900877ce. doi:10.1007/s10584-018-2220-4

Research Tags: Crops

Abstract: *The interior southwest United States is one of the hottest, driest regions on the planet, yet irrigated cropland agriculture is successfully practiced where there is access to surface water and/or groundwater. Through climate change, the southwest is projected to become even hotter and drier, increasing the challenges faced by farmers across the region. We can assess the vulnerability of cropland agriculture, to assist in developing potential solutions to these challenges of warming temperatures and water scarcity. However, these types of biophysical vulnerability assessment usually generate technological or policy-level solutions that do not necessarily account for farmers' ability to respond to climate change impacts. Further, there are non-climatic factors that also threaten the future of agriculture in the region, such as population increase, loss* *of agricultural land, and increasing competition for depleting water resources. In this paper, we assert that to fully address how southwestern farmers may respond to climate change impacts, we must consider both biophysical outcome and contextual vulnerabilities. Future research on individual localities and/or specific commodities and including cross-disciplinary analysis of socio-economic, institutional, cultural, and political factors alongside biophysical factors will help to develop more substantive understanding of system vulnerabilities and feasible adaptive solutions.*

Steele, R., & Hatfield, J. L. (2018). Navigating climate-related challenges on working lands: a special issue by the USDA Climate Hubs and their partners. *Climatic Change, 146*(1-2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041321018&doi=10.1007%2fs10584-017-2129-3&partnerID=40&md5=9e9329cdde5db5250fe3950652afcf32. doi:10.1007/s10584-017-2129-3
Research Tags: Crops, Forestry, Livestock
No Abstract:

Steidinger, B. S., Crowther, T. W., Liang, J., Van Nuland, M. E., Werner, G. D. A., Reich, P. B., . . . Zo-Bi, I. C. (2019). Climatic controls of decomposition drive the global biogeography of forest-tree symbioses. *Nature, 569*(7756), 404-408. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065790614&doi=10.1038%2fs41586-019-1128-0&partnerID=40&md5=416cf3480d062ff4a1f78b6ccd7cf1c3. doi:10.1038/s41586-019-1128-0
Research Tags: Forestry
Abstract: *The identity of the dominant root-associated microbial symbionts in a forest determines the ability of trees to access limiting nutrients from atmospheric or soil pools1,2, sequester carbon3,4 and withstand the effects of climate change5,6. Characterizing the global distribution of these symbioses and identifying the factors that control this distribution are thus integral to understanding the present and future functioning of forest ecosystems. Here we generate a spatially explicit global map of the symbiotic status of forests, using a database of over 1.1 million forest inventory plots that collectively contain over 28,000 tree species. Our analyses indicate that climate variables—in particular, climatically controlled variation in the rate of decomposition—are the primary drivers of the global distribution of major symbioses. We estimate that ectomycorrhizal trees, which represent only 2% of all plant species7, constitute approximately 60% of tree stems on Earth. Ectomycorrhizal symbiosis dominates forests in which seasonally cold and dry climates inhibit decomposition, and is the predominant form of symbiosis at high latitudes and elevation. By contrast, arbuscular mycorrhizal trees dominate in aseasonal, warm tropical forests, and occur with ectomycorrhizal trees in temperate biomes in which seasonally warm-and-wet climates enhance decomposition. Continental transitions between forests dominated by ectomycorrhizal or arbuscular mycorrhizal trees occur relatively abruptly along climate-driven decomposition gradients; these transitions are probably caused by positive feedback effects between plants and microorganisms. Symbiotic nitrogen fixers—which are insensitive to climatic controls on decomposition (compared with mycorrhizal fungi)—are most abundant in arid biomes with alkaline soils and high maximum temperatures. The climatically driven global symbiosis gradient that we document provides a spatially explicit quantitative understanding of microbial symbioses at the global scale, and demonstrates the critical role of microbial mutualisms in shaping the distribution of plant species.*

Steiner, J. L., Briske, D. D., Brown, D. P., & Rottler, C. M. (2018). Vulnerability of Southern Plains agriculture to climate change. *Climatic Change, 146*(1-2), 201-218. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017407703&doi=10.1007%2fs10584-017-1965-5&partnerID=40&md5=9a5ef46bec7b0f311f5344e89e7599b3. doi:10.1007/s10584-017-1965-5
Research Tags: Crops
Abstract: *Projections of greater interannual and intrannual climate variability, including increasing temperatures, longer and more intense drought periods, and more extreme precipitation events, present growing challenges for agricultural production in the Southern Plains of the USA. We assess agricultural vulnerabilities within this region to support identification and development of adaptation strategies at regional to local scales, where many management decisions are made. Exposure to the synergistic effects of warming, such as fewer and more intense precipitation events and greater overall weather variability, will uniquely affect rain-fed and irrigated cropping, high-value specialty crops, extensive and intensive livestock production, and*

forestry. Although the sensitivities of various agricultural sectors to climatic stressors can be difficult to identify at regional scales, we summarize that crops irrigated from the Ogallala aquifer possess a high sensitivity; rangeland beef cattle production a low sensitivity; and rain-fed crops, forestry, and specialty crops intermediate sensitivities. Numerous adaptation strategies have been identified, including drought contingency planning, increased soil health, improved forecasts and associated decision support tools, and implementation of policies and financial instruments for risk management. However, the extent to which these strategies are adopted is variable and influenced by both biophysical and socioeconomic considerations. Inadequate local- and regional-scale climate risk and resilience information suggests that climate vulnerability research and climate adaptation approaches need to include bottom-up approaches such as learning networks and peer-to-peer communication.

Stephens, S. L., Collins, B. M., Fettig, C. J., Finney, M. A., Hoffman, C. M., Knapp, E. E., . . . Wayman, R. B. (2018). Drought, Tree Mortality, and Wildfire in Forests Adapted to Frequent Fire. *BioScience, 68*(2), 77-88. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042276527&doi=10.1093%2fbiosci%2fbix146&partnerID=40&md5=add7a6a1ad07b38752bebf0bc06794aa. doi:10.1093/biosci/bix146

Research Tags: Weather, Forestry

Abstract: *Massive tree mortality has occurred rapidly in frequent-fire-adapted forests of the Sierra Nevada, California. This mortality is a product of acute drought compounded by the long-established removal of a key ecosystem process: frequent, low- to moderate-intensity fire. The recent tree mortality has many implications for the future of these forests and the ecological goods and services they provide to society. Future wildfire hazard following this mortality can be generally characterized by decreased crown fire potential and increased surface fire intensity in the short to intermediate term. The scale of present tree mortality is so large that greater potential for "mass fire" exists in the coming decades, driven by the amount and continuity of dry, combustible, large woody material that could produce large, severe fires. For long-term adaptation to climate change, we highlight the importance of moving beyond triage of dead and dying trees to making "green" (live) forests more resilient.*

Stewart, C. E., Halvorson, A. D., & Delgado, J. A. (2017). Long-term N fertilization and conservation tillage practices conserve surface but not profile SOC stocks under semi-arid irrigated corn. *Soil and Tillage Research, 171*, 9-18. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018610282&doi=10.1016%2fj.still.2017.04.003&partnerID=40&md5=b340f5fe1ebad50771c668d271f1cec2. doi:10.1016/j.still.2017.04.003

Research Tags: Crops, Soil

Abstract: *No tillage (NT) and N fertilization can increase surface soil organic C (SOC) stocks, but these gains are frequently not observed through the soil profile and could be subject to loss through subsequent tillage events. We evaluated a long-term irrigated continuous corn no-tillage (NT) and N rate study near Fort Collins, CO that was split into continuous NT or strip till (ST) treatments after five years. We measured grain and residue yields yearly, and SOC and particulate organic matter C (POM-C) at baseline, 5 yrs and 11 yrs later. Continuous NT depressed grain yields (10%) but not stover yields compared to ST. Continuous NT and increasing N fertilization rate increased surface (0–7.5 cm) SOC stocks 10 and 13%, respectively, compared to baseline. Seven years of ST completely negated initial surface (0–7.5 cm) SOC gain under NT and was only partially explained by POM-C loss (8–25%). All treatments lost between 14 and 19 Mg C ha−1 in the soil profile (0–120 cm) compared to baseline with no N or tillage effects. Soil C cycling appears to be rapid in this irrigated system, requiring greater C inputs to maintain SOC stocks. Effective conservation practices will need to balance crop yield, surface erosion protection, and profile-wide SOC stock losses.*

Stewart, C. E., Roosendaal, D., Denef, K., Pruessner, E., Comas, L. H., Sarath, G., . . . Soundararajan, M. (2017). Seasonal switchgrass ecotype contributions to soil organic carbon, deep soil microbial community composition and rhizodeposit uptake during an extreme drought. *Soil Biology and Biochemistry, 112*, 191-203. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019963601&doi=10.1016%2fj.soilbio.2017.04.021&partnerID=40&md5=dfbd6306f024526d51db22b62c404dac. doi:10.1016/j.soilbio.2017.04.021

Research Tags: Soil, Weather

Abstract: *The importance of rhizodeposit C and associated microbial communities in deep soil C stabilization* *is relatively unknown. Phenotypic variability in plant root biomass could impact C cycling through belowground plant allocation, rooting architecture, and microbial community abundance and composition. We used a pulse-chase 13C labeling experiment with compound-specific stable-isotope probing to investigate the importance of rhizodeposit C to deep soil microbial biomass under two switchgrass ecotypes (Panicum virgatum L., Kanlow and Summer) with contrasting root morphology. We quantified root phenology, soil microbial biomass (phospholipid fatty acids, PLFA), and microbial rhizodeposit uptake (13C-PLFAs) to 150 cm over one year during a severe drought. The lowland ecotype, Kanlow, had two times more root biomass with a coarser root system compared to the upland ecotype, Summer. Over the drought, Kanlow lost 78% of its root biomass, while Summer lost only 60%. Rhizosphere microbial communities associated with both ecotypes were similar. However, rhizodeposit uptake under Kanlow had a higher relative abundance of gram-negative bacteria (44.1%), and Summer rhizodeposit uptake was primarily in saprotrophic fungi (48.5%). Both microbial community composition and rhizodeposit uptake shifted over the drought into gram-positive communities. Rhizosphere soil C was greater one year later under Kanlow due to turnover of unlabeled structural root C. Despite a much greater root biomass under Kanlow, rhizosphere δ13C was not significantly different between the two ecotypes, suggesting greater microbial C input under the finer rooted species, Summer, whose microbial associations were predominately saprotrophic fungi. Ecotype specific microbial communities can direct rhizodeposit C flow and C accrual deep in the soil profile and illustrate the importance of the microbial community in plant strategies to survive environmental stress such as drought.*

Stewart, J. A. E., Wright, D. H., & Heckman, K. A. (2017). Apparent climate-mediated loss and fragmentation of core habitat of the American pika in the Northern Sierra Nevada, California, USA. *PLoS ONE, 12*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029029075&doi=10.1371%2fjournal.pone.0181834&partnerID=40&md5=bd3c0d98d79077a71e4d136534a06274. doi:10.1371/journal.pone.0181834

Research Tags: Wildlife

Abstract: *Contemporary climate change has been widely documented as the apparent cause of range contraction at the edge of many species distributions but documentation of climate change as a cause of extirpation and fragmentation of the interior of a species' core habitat has been lacking. Here, we report the extirpation of the American pika (Ochotona princeps), a temperature-sensitive small mammal, from a 165-km2 area located within its core habitat in California's Sierra Nevada mountains. While sites surrounding the area still maintain pikas, radiocarbon analyses of pika fecal pellets recovered within this area indicate that former patch occupancy ranges from before 1955, the beginning of the atmospheric spike in radiocarbon associated with above ground atomic bomb testing, to c. 1991. Despite an abundance of suitable rocky habitat climate warming appears to have precipitated their demise. Weather station data reveal a 1.9°C rise in local temperature and a significant decline in snowpack over the period of record, 1910–2015, pushing pika habitat into increasingly tenuous climate conditions during the period of extirpation. This is among the first accounts of an apparently climate-mediated, modern extirpation of a species from an interior portion of its geographic distribution, resulting in habitat fragmentation, and is the largest area yet reported for a modern-era pika extirpation. Our finding provides empirical support to model projections, indicating that even core areas of species habitat are vulnerable to climate change within a timeframe of decades.*

Stewart, J. F., Will, R., Crane, B. S., & Nelson, C. D. (2017). Occurrence of shortleaf × loblolly pine hybrids in shortleaf pine orchards: Implications for ecosystem restoration. *Forest Science, 63*(2), 225-231. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020245172&doi=10.5849%2fforsci.15-167&partnerID=40&md5=106b1c53dd152d2226187b2a0abb908c. doi:10.5849/forsci.15-167

Research Tags: Forestry

Abstract: *Shortleaf pine (Pinus echinata Mill.) is an important conifer in much of the southeastern United States. However, the species and its associated ecosystems are in decline, and recent evidence about hybridization with loblolly pine (Pinus taeda L.) raises concerns that the species may be at risk of further losses due to introgression. Although shortleaf pine is not widely planted for timber production, the US Department of Agriculture (USDA) Forest Service, state forestry agencies, some conservation organizations, and private landowners use artificial regeneration to regenerate shortleaf pine for various purposes including restoration of shortleaf pine-dominated ecosystems. Given the threat of introgression with loblolly pine, we tested federal and state shortleaf pine seed orchard trees (i.e., grafted clones) and wind-pollinated seedlings (from various* *nurseries sourced from several of the tested orchards) for hybrid character, using a previously developed microsatellite DNA test. We found that 8 to 10% of the USDA Forest Service orchard clones and 0 to 10% of state agency clones genetically resembled F1 hybrids or first-generation backcrosses to shortleaf pine (SLBC1). Frequencies of hybrid classifications in seedlings were generally similar to those of their seed orchard parent trees (0–10%), although seedlings from the Oklahoma Forestry Services nursery contained an unusually high proportion of apparent F1 hybrids (4%), possibly due to the proximity of a loblolly pine seed orchard and loblolly pine plantations to the shortleaf pine seed orchard of origin. Based on these results, we recommend that shortleaf pine seed orchard managers consider steps to mitigate the genetic impact of trees classified as either F1 or SLBC1 hybrids to maintain the genetic integrity and desired phenotypic traits (i.e., fire, drought, and ice tolerance) of their shortleaf pine seeds, ensuring survival and adaptation of the species and its ecosystem to future climate variation.*

Stöckle, C. O., Higgins, S., Nelson, R., Abatzoglou, J., Huggins, D., Pan, W., . . . Brooks, E. (2018). Evaluating opportunities for an increased role of winter crops as adaptation to climate change in dryland cropping systems of the U.S. Inland Pacific Northwest. *Climatic Change, 146*(1-2), 247-261. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017241843&doi=10.1007%2fs10584-017-1950-z&partnerID=40&md5=00ecb0fbf2fa0c3fcabaab74d14b33f1. doi:10.1007/s10584-017-1950-z

Research Tags: Crops

Abstract: *The long-term sustainability of wheat-based dryland cropping systems in the Inland Pacific Northwest (IPNW) of the United States depends on how these systems adapt to climate change. Climate models project warming with slight increases in winter precipitation but drier summers for the IPNW. These conditions combined with elevated atmospheric CO2, which promote crop growth and improve transpiration-use efficiency, may be beneficial for cropping systems in the IPNW and may provide regional opportunities for agricultural diversification and intensification. Crop modeling simulation under future climatic conditions showed increased wheat productivity for the IPNW for most of the century. Water use by winter wheat was projected to decrease significantly in higher and intermediate precipitation zones and increase slightly in drier locations, but with winter crops utilizing significantly more water overall than spring crops. Crop diversification with inclusion of winter crops other than wheat is a possibility depending on agronomic and economic considerations, while substitution of winter for spring crops appeared feasible only in high precipitation areas. Increased weed pressure, higher pest populations, expanded ranges of biotic stressors, and agronomic, plant breeding, economic, technology, and other factors will influence what production systems eventually prevail under future climatic conditions in the region.*

Stockton, D., Wallingford, A., Rendon, D., Fanning, P., Green, C. K., Diepenbrock, L., . . . Loeb, G. M. (2019). Interactions between biotic and abiotic factors affect survival in overwintering drosophila suzukii (Diptera: Drosophilidae). *Environmental Entomology, 48*(2), 454-464. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064139300&doi=10.1093%2fee%2fnvy192&partnerID=40&md5=0762db51c62d6665779fb9217e93fb76. doi:10.1093/ee/nvy192

Research Tags: Wildlife, Crops, Weather

Abstract: *Drosophila suzukii Matsumura is an invasive species affecting berry crops and cherries throughout North America, South America, and Europe. Previous research suggests that in temperate climates, the overwintering success of D. suzukii is likely dependent on access to food, shelter, and adequate cold hardening. We performed a multi-state study under field conditions for two winters to determine whether D. suzukii sex, phenotype (summer-morphotype, winter-morphotype), and life stage (adults, pupae) affected survival over time while recording naturally-occurring spatial and temporal variation in temperature. Access to food was provided and the flies were buried under leaf litter. Baited traps were deployed to determine whether local populations of D. suzukii were active throughout the winter season. The duration of exposure, mean daily temperature, and cumulative time below freezing significantly affected survival. Below freezing, D. suzukii survival was significantly reduced, particularly in northern locations. In contrast, we observed sustained survival up to 10 wk in southern locations among adults and pupae. Biotic factors also significantly affected survival outcomes: female survival was greater than male survival, winter-morphotype survival was greater than summer-morphotype survival, and adult survival was greater than pupal survival. In the north, wild D. suzukii were captured only in early winter, while in the south they were found throughout the winter. These data* *suggest that although adult D. suzukii may overwinter in sheltered microclimates, this ability may be limited in regions where the ground temperature, or site of overwintering, falls below freezing for extended durations.*

Stockton, D. G., Wallingford, A. K., & Loeb, G. M. (2018). Phenotypic plasticity promotes overwintering survival in a globally invasive crop pest, drosophila suzukii. *Insects, 9*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055574080&doi=10.3390%2finsects9030105&partnerID=40&md5=1d4c2e40c484008440336f64dc7e68b5. doi:10.3390/insects9030105

Research Tags: Crops, Wildlife, Weather

Abstract: *Spotted wing drosophila, Drosophila suzukii Matsumura, is a major pest of small fruit worldwide in temperate and subtropical growing regions. In Northern climates, D. suzukii likely overwinters locally under leaf litter and snow pack, but our understanding of the factors affecting thermal susceptibility is limited. While previous investigations of thermal susceptibility in this species have employed conventional static acclimation protocols, we aimed to determine whether gradual cooling, or dynamic acclimation, may extend the limits of known thermal tolerance by more closely approximating naturally occurring shifts in temperature. First, we assessed survival among adult and pupal D. suzukii using static acclimation. Then, we re-assessed survival using a novel dynamic acclimation method. We found that while static acclimation was sufficient to induce cold tolerance, dynamic acclimation significantly improved survival at temperatures as low as −7.5 °C. Following static acclimation, the lower lethal limit of adult D. suzukii was −1.1 °C in winter morphotype (WM) adults compared to 1.7 °C in non-acclimated summer morphotype (SM) adults. Dynamic acclimation reduced the lower limit to −5 °C in SM flies. At the end of our study 50% of WM flies survived 72 h at −7.5 °C. Below 0 °C pupal survival declined significantly regardless of acclimation procedure. However, pupal acclimation improved survival outcomes significantly compared to non-acclimated pupae, suggesting that while juvenile diapause is unlikely, cold hardening likely benefits those flies which may develop into the overwintering WM population. These data suggest that the degree of cold hardening is proportional to the thermal environment, a finding previously unrecognized in this species. Given the economic impact of this pest, these data may have important implications for offseason population monitoring and management. We discuss how phenotypic plasticity may drive geographical range expansion, and the impact of climate change on the spread of this species.*

Strand, E. K., Satterberg, K. L., Hudak, A. T., Byrne, J., Khalyani, A. H., & Smith, A. M. S. (2019). Does burn severity affect plant community diversity and composition in mixed conifer forests of the United States Intermountain West one decade post fire? *Fire Ecology, 15*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069720775&doi=10.1186%2fs42408-019-0038-8&partnerID=40&md5=404ccf98297c6ba05b39f4d625d36da0. doi:10.1186/s42408-019-0038-8

Research Tags: Forestry, Weather

Abstract: *Background*
Wildfire is an important ecological process in mixed conifer forests of the Intermountain West region of the USA. However, researchers and managers are concerned because climate warming has led to increased fire activity in recent decades. More area burned will result in larger land areas in early successional stages and will potentially limit tree establishment; therefore, evaluating long-term forest understory response to fire is important. We evaluate the impact of burn severity, overstory canopy cover, topography, and climate on understory plant community diversity and composition in seven wildfires, 9 to 12 years post fire, along a broad climate gradient from dry to moist mixed conifer forests in Idaho, Montana, and Washington, USA.
Results
Climate was the most important driver for species diversity and composition, but a burn severity gradient was detectable in the species data one decade post fire. A strong overlap in species composition between burn severity levels was documented, but dispersion was lower for high burn severity sites, indicating that those sites are still recovering. Local species richness and diversity had a nonlinear relationship with the burn severity index dNBR, with a maximum at low to moderate burn severity; the relationship was stronger in moist climates. Functional trait analysis revealed higher grass and forb cover in high-severity burns, higher cover of tree seedlings, residual and off-site colonizers in burned areas, and more shade-tolerant species in unburned areas. Of the 270 species recorded, 10% were introduced; however, only three were of noxious status and two were invasive annual grasses, generally occurring on dry sites.

Conclusions
The understory plant community was not fundamentally altered by these fires and fire contributed to increased species diversity both locally and regionally, suggesting that low to moderate burn severity fire is a treatment that contributes to long-term maintenance of a diverse and productive understory. Individual species traits were significant drivers of understory species assemblages and, as future change in climate and fire regimes leads to shifts in species composition, anticipation of consequences will be important. Although invasive species occurred at low cover levels, noxious weeds and invasive annual grasses will continue to be management challenges, particularly in dry regions of mixed conifer forests.

Strauch, A. M., Giardina, C. P., MacKenzie, R. A., Heider, C., Giambelluca, T. W., Salminen, E., & Bruland, G. L. (2017). Erratum to: Modeled Effects of Climate Change and Plant Invasion on Watershed Function Across a Steep Tropical Rainfall Gradient (Ecosystems, (2017), 20, 3, (583-600), 10.1007/s10021-016-0038-3). *Ecosystems, 20*(5), 1072. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85025119564&doi=10.1007%2fs10021-017-0167-3&partnerID=40&md5=bac963dda611348f26954d9091891508. doi:10.1007/s10021-017-0167-3
Research Tags: Water, Weather
No Abstract:

Strauch, A. M., Giardina, C. P., MacKenzie, R. A., Heider, C., Giambelluca, T. W., Salminen, E., & Bruland, G. L. (2017). Modeled Effects of Climate Change and Plant Invasion on Watershed Function Across a Steep Tropical Rainfall Gradient. *Ecosystems, 20*(3), 583-600. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84988733898&doi=10.1007%2fs10021-016-0038-3&partnerID=40&md5=fb6069742abb51dd090567b85fc7cda1. doi:10.1007/s10021-016-0038-3
Research Tags: Water, Weather
Abstract: *Climate change is anticipated to affect freshwater resources, but baseline data on the functioning of tropical watersheds is lacking, limiting efforts that seek to predict how watershed processes, water supply, and streamflow respond to anticipated changes in climate and vegetation change, and to management. To address this data gap, we applied the distributed hydrology soil vegetation model (DHSVM) across 88 watersheds spanning a highly constrained, 4500 mm mean annual rainfall (MAR) gradient on Hawai'i Island to quantify stream flow at 3-h time-steps for eight years in response to the independent and interactive effects of (1) large observed decrease in MAR; (2) projected warming and altered precipitation; and (3) four scenarios of forest invasion by the high water-demanding non-native tree species Psidium cattleianum. The model captured 62% of variability in measured flow at daily time scales, 95% at monthly time scales, and 98% at annual time scales. We found that low DHSVM modeled flow (Q 90) and storm flow (Q 10) responses to observed declines in rainfall dwarfed those of projected temperature increase or invasion, with flow decline positively correlated with MAR. As a percentage of streamflow, temperature and invasion reductions were negatively correlated with MAR. By comparison, warming alone had little effect on Q 90 or Q 10, but both decreased with increasing P. cattleianum cover, and projected effects of declining MAR were accentuated when combined with P. cattleianum and warming. Restoration mitigated some effects of climate warming by increasing stream base flows, with the relative effects of restoration being larger in drier versus wetter watersheds. We conclude that potential changes in climate in tropical environments are likely to exert significant effects on streamflow, but managing vegetation can provide mitigating benefits.*

Strauch, A. M., MacKenzie, R. A., Giardina, C. P., & Bruland, G. L. (2018). Influence of declining mean annual rainfall on the behavior and yield of sediment and particulate organic carbon from tropical watersheds. *Geomorphology, 306*, 28-39. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042691168&doi=10.1016%2fj.geomorph.2017.12.030&partnerID=40&md5=575f5b626f4361522f00b04238c03a43. doi:10.1016/j.geomorph.2017.12.030
Research Tags: Soil, Water, Weather
Abstract: *The capacity to forecast climate and land-use driven changes to runoff, soil erosion and sediment transport in the tropics is hindered by a lack of long-term data sets and model study systems. To address these issues we utilized three watersheds characterized by similar shape, geology, soils, vegetation cover, and land use arranged across a 900 mm gradient in mean annual rainfall (MAR). Using this space-for-time design, we*

quantified suspended sediment (SS) and particulate organic carbon (POC) export over 18 months to examine how large-scale climate trends (MAR) affect sediment supply and delivery patterns (hysteresis) in tropical watersheds. Average daily SS yield ranged from 0.128 to 0.618 t km− 2 while average daily POC ranged from 0.002 to 0.018 t km− 2. For the largest storm events, we found that sediment delivery exhibited similar clockwise hysteresis patterns among the watersheds, with no significant differences in the similarity function between watershed pairs, indicating that: (1) in-stream and near-stream sediment sources drive sediment flux; and (2) the shape and timing of hysteresis is not affected by MAR. With declining MAR, the ratio of runoff to baseflow and inter-storm length between pulse events both increased. Despite increases in daily rainfall and the number of days with large rainfall events increasing with MAR, there was a decline in daily SS yield possibly due to the exhaustion of sediment supply by frequent runoff events in high MAR watersheds. By contrast, mean daily POC yield increased with increasing MAR, possibly as a result of increased soil organic matter decomposition, greater biomass, or increased carbon availability in higher MAR watersheds. We compared results to modeled values using the Load Estimator (LOADEST) FORTRAN model, confirming the negative relationship between MAR and sediment yield. However, because of its dependency on mean daily flow, LOADEST tended to under predict sediment yield, a result of its poor ability to capture the high variability in tropical streamflow. Taken together, results indicate that declines in MAR can have contrasting effects on hydrological processes in tropical watersheds, with consequences for instream ecology, downstream water users, and nearshore habitat.

Strauch, A. M., MacKenzie, R. A., & Tingley, R. W. (2017). Base flow-driven shifts in tropical stream temperature regimes across a mean annual rainfall gradient. *Hydrological Processes*, *31*(9), 1678-1689. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85011308944&doi=10.1002%2fhyp.11084&partnerID=40&md5=2f94f025b589732518a34fac5ef1c271. doi:10.1002/hyp.11084

Research Tags: Weather, Water

Abstract: *Climate change is expected to affect air temperature and watershed hydrology, but the degree to which these concurrent changes affect stream temperature is not well documented in the tropics. How stream temperature varies over time under changing hydrologic conditions is difficult to isolate from seasonal changes in air temperature. Groundwater and bank storage contributions to stream flow (i.e., base flow [BF]) buffer water temperatures against seasonal and daily fluctuations in solar radiation and air temperature, whereas rainfall-driven runoff produces flooding events that also influence stream temperature. We used a space-for-time substitution to examine how shifts in BF and runoff alter thermal regimes in streams by analyzing hydrological and temperature data collected from similar elevations (400–510 m above sea level) across a 3,500-mm mean annual rainfall gradient on Hawai'i Island. Sub-daily water temperature and stream flow gathered for 3 years were analyzed for daily, monthly, and seasonal trends and compared with air temperature measured at multiple elevations. Results indicate that decreases in median BF increased mean, maximum, and minimum water temperatures as well as daily temperature range. Monthly and daily trends in stream temperature among watersheds were more pronounced than air temperature, driven by differences in groundwater inputs and runoff. Stream temperature was strongly negatively correlated to BF during the dry season but not during the wet season due to frequent wet season runoff events contributing to total flow. In addition to projected increases in global air temperature, climate driven shifts in rainfall and runoff are likely to affect stream flow and groundwater recharge, with concurrent influences on BF resulting in shifts in water temperature that are likely to affect aquatic ecosystems.*

Su, Z., Richardson, B. A., Zhuo, L., & Jiang, X. (2017). Divergent population genetic structure of the endangered Helianthemum (cistaceae) and its implication to conservation in Northwestern China. *Frontiers in Plant Science, 7*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85009749041&doi=10.3389%2ffpls.2016.02010&partnerID=40&md5=8ca38f38ad31d216f4e2dd02b0864da7. doi:10.3389/fpls.2016.02010

Research Tags: Grassland

Abstract: *Population genetic studies provide a foundation for conservation planning, especially for endangered species. Three chloroplast SSRs (mtrnSf-trnGr, mtrnL2-trnF, and mtrnL5-trnL3) and the internal transcribed spacer were used to examine the population structure of Helianthemum in northwestern China. A total of 15 populations of the genus were collected. Nine chloroplast haplotypes and two nuclear genotypes were detected.*

Both the nuclear and chloroplast data showed two lineages in Helianthemum songaricum, respectively, distributed in Yili Valley and western Ordos Plateau. A total of 66.81% (p < 0.001) of the genetic variation was supported by this lineage split. A Mantel test showed a significant correlation between genetic distance and geographical distance (r = 0.937, p < 0.001). Based on genetic analyses, cpSSRs data support strong genetic divergence between regions. We speculate that the climate change during the late Tertiary and early Quaternary isolated H. songaricum into their current distribution, resulting in interruption of gene flow, leading to isolation and genetic divergence between the two regions. Meanwhile, possible selfing would increase genetic drift in small fragmented populations, that might account for the observed genetic divergence in both regions. Given the loss of genetic diversity and genetic divergence in small populations of Helianthemum in northwestern China immediate conservation management steps should be taken on the species.

Suarez, C. E., Alzan, H. F., Silva, M. G., Rathinasamy, V., Poole, W. A., & Cooke, B. M. (2019). Unravelling the cellular and molecular pathogenesis of bovine babesiosis: is the sky the limit? *International Journal for Parasitology, 49*(2), 183-197. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060945801&doi=10.1016%2fj.ijpara.2018.11.002&partnerID=40&md5=b7a5d73cc4f3eccd27111ae7230dbde4. doi:10.1016/j.ijpara.2018.11.002

Research Tags: Livestock

Abstract: *The global impact of bovine babesiosis caused by the tick-borne apicomplexan parasites Babesia bovis, Babesia bigemina and Babesia divergens is vastly underappreciated. These parasites invade and multiply asexually in bovine red blood cells (RBCs), undergo sexual reproduction in their tick vectors (Rhipicephalus spp. for B. bovis and B. bigemina, and Ixodes ricinus for B. divergens) and have a trans-ovarial mode of transmission. Babesia parasites can cause acute and persistent infections to adult naïve cattle that can occur without evident clinical signs, but infections caused by B. bovis are associated with more severe disease and increased mortality, and are considered to be the most virulent agent of bovine babesiosis. In addition, babesiosis caused by B. divergens has an important zoonotic potential. The disease caused by B. bovis and B. bigemina can be controlled, at least in part, using therapeutic agents or vaccines comprising live-attenuated parasites, but these methods are limited in terms of their safety, ease of deployability and long-term efficacy, and improved control measures are urgently needed. In addition, expansion of tick habitats due to climate change and other rapidly changing environmental factors complicate efficient control of these parasites. While the ability to cause persistent infections facilitates transmission and persistence of the parasite in endemic regions, it also highlights their capacity to evade the host immune responses. Currently, the mechanisms of immune responses used by infected bovines to survive acute and chronic infections remain poorly understood, warranting further research. Similarly, molecular details on the processes leading to sexual reproduction and the development of tick-stage parasites are lacking, and such tick-specific molecules can be targets for control using alternative transmission blocking vaccines. In this review, we identify and examine key phases in the life-cycle of Babesia parasites, including dependence on a tick vector for transmission, sexual reproduction of the parasite in the midgut of the tick, parasite-dependent invasion and egression of bovine RBCs, the role of the spleen in the clearance of infected RBCs (IRBCs), and age-related disease resistance in cattle, as opportunities for developing improved control measures. The availability of integrated novel research approaches including "omics" (such as genomics, transcriptomics, and proteomics), gene modification, cytoadhesion assays, RBC invasion assays and methods for in vitro induction of sexual-stage parasites will accelerate our understanding of parasite vulnerabilities. Further, producing new knowledge on these vulnerabilities, as well as taking full advantage of existing knowledge, by filling important research gaps should result in the development of next-generation vaccines to control acute disease and parasite transmission. Creative and effective use of current and future technical and computational resources are needed, in the face of the numerous challenges imposed by these highly evolved parasites, for improving the control of this disease. Overall, bovine babesiosis is recognised as a global disease that imposes a serious burden on livestock production and human livelihood, but it largely remains a poorly controlled disease in many areas of the world. Recently, important progress has been made in our understanding of the basic biology and host-parasite interactions of Babesia parasites, yet a good deal of basic and translational research is still needed to achieve effective control of this important disease and to improve animal and human health.*

Sullivan, P. F., Pattison, R. R., Brownlee, A. H., Cahoon, S. M. P., & Hollingsworth, T. N. (2017). Limited evidence of

declining growth among moisture-limited black and white spruce in interior Alaska. *Scientific Reports, 7*(1). Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033584170&doi=10.1038%2fs41598-017-15644-7&partnerID=40&md5=f27e06ac86cf74e03e2d393b289f567e. doi:10.1038/s41598-017-15644-7
Research Tags: Forestry
Abstract: *Boreal forests play critical roles in global carbon, water and energy cycles. Recent studies suggest drought is causing a decline in boreal spruce growth, leading to predictions of widespread mortality and a shift in dominant vegetation type in interior Alaska. We took advantage of a large set of tree cores collected from random locations across a vast area of interior Alaska to examine long-term trends in carbon isotope discrimination and growth of black and white spruce. Our results confirm that growth of both species is sensitive to moisture availability, yet show limited evidence of declining growth in recent decades. These findings contrast with many earlier tree-ring studies, but agree with dynamic global vegetation model projections. We hypothesize that rising atmospheric [CO2] and/or changes in biomass allocation may have compensated for increasing evaporative demand, leaving recent radial growth near the long-term mean. Our results highlight the need for more detailed studies of tree physiological and growth responses to changing climate and atmospheric [CO2] in the boreal forest.*

Sumlin, B. J., Heinson, Y. W., Shetty, N., Pandey, A., Pattison, R. S., Baker, S., . . . Chakrabarty, R. K. (2018). UV–Vis–IR spectral complex refractive indices and optical properties of brown carbon aerosol from biomass burning. *Journal of Quantitative Spectroscopy and Radiative Transfer, 206*, 392-398. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038626189&doi=10.1016%2fj.jqsrt.2017.12.009&partnerID=40&md5=f93a33a1921593fea5cca613f4eb397c. doi:10.1016/j.jqsrt.2017.12.009
Research Tags: Research
Abstract: *Constraining the complex refractive indices, optical properties and size of brown carbon (BrC) aerosols is a vital endeavor for improving climate models and satellite retrieval algorithms. Smoldering wildfires are the largest source of primary BrC, and fuel parameters such as moisture content, source depth, geographic origin, and fuel packing density could influence the properties of the emitted aerosol. We measured in situ spectral (375–1047 nm) optical properties of BrC aerosols emitted from smoldering combustion of Boreal and Indonesian peatlands across a range of these fuel parameters. Inverse Lorenz–Mie algorithms used these optical measurements along with simultaneously measured particle size distributions to retrieve the aerosol complex refractive indices (m = n + iκ). Our results show that the real part n is constrained between 1.5 and 1.7 with no obvious functionality in wavelength (λ), moisture content, source depth, or geographic origin. With increasing λ from 375 to 532 nm, κ decreased from 0.014 to 0.003, with corresponding increase in single scattering albedo (SSA) from 0.93 to 0.99. The spectral variability of κ follows the Kramers-Kronig dispersion relation for a damped harmonic oscillator. For λ ≥ 532 nm, both κ and SSA showed no spectral dependency. We discuss differences between this study and previous work. The imaginary part κ was sensitive to changes in FPD, and we hypothesize mechanisms that might help explain this observation.*

Sumlin, B. J., Oxford, C. R., Seo, B., Pattison, R. R., Williams, B. J., & Chakrabarty, R. K. (2018). Density and Homogeneous Internal Composition of Primary Brown Carbon Aerosol. *Environmental Science and Technology, 52*(7), 3982-3989. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045011990&doi=10.1021%2facs.est.8b00093&partnerID=40&md5=3844f6bf72c20cf773fd1164ff99d219. doi:10.1021/acs.est.8b00093
Research Tags: Research
Abstract: *The presence of atmospheric brown carbon (BrC) has been the focus of many recent studies. These particles, predominantly emitted from smoldering biomass burning, absorb light in the near-ultraviolet and short visible wavelengths and offset the radiative cooling effects associated with organic aerosols. Particle density dictates their transport properties and is an important parameter in climate models and aerosol instrumentation algorithms, but our knowledge of this particle property is limited, especially as functions of combustion temperature and fuel type. We measured the effective density (ρeff) and optical properties of primary BrC aerosol emitted from smoldering combustion of Boreal peatlands. Energy transfer into the fuel was controlled by selectively altering the combustion ignition temperature, and we find that the particle ρeff ranged from 0.85 to 1.19 g cm–3 corresponding to ignition temperatures from 180 to 360 °C. BrC particles exhibited*

spherical morphology and a constant 3.0 mass–mobility exponent, indicating no internal microstructure or void spaces. Upon partial thermal volatilization, peff of the remaining particle mass was confined to a narrow range between 0.9 and 1.1 g cm–3. These findings lead us to conclude that primary BrC aerosols from biomass burning have homogeneous internal composition, and their peff is in fact their actual density.

Sumlin, B. J., Pandey, A., Walker, M. J., Pattison, R. S., Williams, B. J., & Chakrabarty, R. K. (2017). Atmospheric Photooxidation Diminishes Light Absorption by Primary Brown Carbon Aerosol from Biomass Burning. *Environmental Science and Technology Letters, 4*(12), 540-545. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038206834&doi=10.1021%2facs.estlett.7b00393&partnerID=40&md5=4ba5eaafa0c5717d30213a08a4bbc4e3. doi:10.1021/acs.estlett.7b00393
Research Tags: Research
Abstract: *Light-absorbing organic aerosols, optically defined as brown carbon (BrC), have been shown to strongly absorb short visible solar wavelengths and significantly impact Earth's radiative energy balance. There currently exists a knowledge gap regarding the potential impacts of atmospheric processing on the absorptivity of such particles generated from biomass burning. Climate models and satellite retrieval algorithms parametrize the optical properties of BrC aerosols emitted from biomass burning events as unchanging throughout their atmospheric lifecycle. Here, using contact-free optical probing techniques, we investigate the effects of multiple-day photochemical oxidation on the spectral (375–532 nm) optical properties of primary BrC aerosols emitted from smoldering combustion of boreal peatlands. We find the largest effects of oxidation in the near-UV wavelengths, with the 375 nm imaginary refractive index and absorption coefficients of BrC particles decreasing by ∼36% and 46%, respectively, and an increase in their single scattering albedo from 0.85 to 0.90. Based on simultaneous chemical characterization of particles, we infer a transition from functionalization to fragmentation reactions with increasing photooxidation. Simple radiative forcing efficiency calculations show the effects of aging on atmospheric warming attributed to BrC aerosols, which could be significant over snow and other reflective surfaces.*

Sun, G., Hallema, D., & Asbjornsen, H. (2017). Ecohydrological processes and ecosystem services in the Anthropocene: a review. *Ecological Processes, 6*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032342239&doi=10.1186%2fs13717-017-0104-6&partnerID=40&md5=ed3c38225938bd9149349e8e7711039b. doi:10.1186/s13717-017-0104-6
Research Tags: Water
Abstract: *The framework for ecosystem services has been increasingly used in integrated watershed ecosystem management practices that involve scientists, engineers, managers, and policy makers. The objective of this review is to explore the intimate connections between ecohydrological processes and water-related ecosystem services in human-dominated ecosystems in the Anthropocene. We synthesize current literature to illustrate the importance of understanding the ecohydrological processes for accurately quantifying ecosystem services under different environmental and socioeconomic settings and scales. Our synthesis focuses on managed ecosystems that are dominated by humans and explores how ecological processes affect the tradeoffs and synergies of multiple ecosystem services. We identify research gaps in studying ecological processes mainly including energy, carbon, water, and nutrient balances to better assess and quantify ecosystem services that are critical for sustaining natural resources for future generations. To better assess ecosystem services, future ecohydrological studies need to better account for the scaling effects of natural and anthropogenic stressors exerted on evapotranspiration and other water supply and demand processes. Future studies should focus on the bidirectional interactions between hydrological functions and services and human actions to solve real world problems such as water shortages, ecological degradation, and climate change adaptation.*

Sun, S., Chen, H., Ju, W., Wang, G., Sun, G., Huang, J., . . . Yan, G. (2017). On the coupling between precipitation and potential evapotranspiration: contributions to decadal drought anomalies in the Southwest China. *Climate Dynamics, 48*(11-12), 3779-3797. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84983000135&doi=10.1007%2fs00382-016-3302-5&partnerID=40&md5=3c53b45315a623bcd46707dbf6def3bb. doi:10.1007/s00382-016-3302-5
Research Tags: Weather
Abstract: *Under the exacerbation of climate change, climate extreme events, especially for drought, happened*

frequently and intensively across the globe with greater spatial differences. We used the Standardized Precipitation-Evapotranspiration Index computed from the routine meteorological observations at 269 sites in Southwest China (SWC) to study the drought characteristics (e.g., extent, duration and intensity) and their decadal variations during 1971–2012. It was revealed that the drought, in responses to the coupling between decadal precipitation and potential evapotranspiration (PET) anomalies, differed among regions and periods. For the entire SWC, droughts in 1970s and 2000s+ was generally stronger than in 1980s and 1990s with respect to their spatial extent, duration and intensity, especially in 2000s+. It was well-known that drought was closely related with a lack of precipitation; however, the impact of atmospheric demand of evaporation (reflected by PET here) on drought (e.g., duration and intensity) was rarely paid enough attentions. To that end, a spatial multi-linear regression approach was proposed in this study for quantifying the contributions of decadal PET and precipitation variations to drought duration and intensity. We have found that the contributions of decadal PET anomalies to drought duration and intensity could exceed those of precipitation, e.g., during 1980s and 1990s in SWC. Additionally, despite the strongest droughts in 2000s+, it was suggested that PET could exert comparable impacts on drought anomalies as precipitation. All these findings implied that PET plays a critical role in drought event, which acts to amplify drought duration and intensity. To sum up, this study stressed the need for enough attentions for PET processes in drought studies.

Sun, S., Chen, H., Sun, G., Ju, W., Wang, G., Li, X., . . . Hua, W. (2017). Attributing the changes in reference evapotranspiration in Southwestern China using a new separation method. *Journal of Hydrometeorology, 18*(3), 777-798. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014075228&doi=10.1175%2fJHM-D-16-0118.1&partnerID=40&md5=9c8b5e252404e45b3417695befbb49bb. doi:10.1175/JHM-D-16-0118.1

Research Tags: Weather

Abstract: *This study investigated monthly and annual reference evapotranspiration ET_o changes over southwestern China (SWC) from 1960 to 2012, using the Food and Agriculture Organization of the United Nations' report 56 (FAO-56) Penman–Monteith equation and routine meteorological observations at 269 weather sites. During 1960–2012, the monthly and annual ET_o decreased at most sites. Moreover, the SWC regional average trend in annual ET_o was significantly negative ($p < 0.05$); this trend was the same in most months. A new separation method using several numerical experiments was proposed to quantify each driving factor's contribution to ET_o changes and exhibited higher accuracy based on several validation criteria, after which an attribution analysis was performed. Across SWC, the declining annual ET_o was mainly due to decreased net radiation (RN). Spatially, the annual ET_o changes at most sites in eastern SWC (excluding southeastern West Guangxi) were generally due to RN, whereas wind speed (WND) or vapor pressure deficit (VPD) was the determinant at other sites. Nevertheless, the determinants differed among 12 months. For the whole SWC, increased VPD in February and decreased WND in April, May, and October were the determinant of decreased ; however, decreased RN was the determinant in other months. Overall, the determinant of the monthly changes exhibited a complex spatial pattern. A complete analysis of ET_o changes and the related physical mechanisms in SWC is necessary to better understand hydroclimatological extremes (e.g., droughts) and to develop appropriate strategies to sustain regional development (e.g., water resources and agriculture). Importantly, this separation method provides new perspective for quantitative attribution analyses and thus may be implemented in various scientific fields (e.g., climatology and hydrology).*

Sun, X., Tang, Z., Ryan, M. G., You, Y., & Sun, O. J. (2019). Changes in soil organic carbon contents and fractionations of forests along a climatic gradient in China. *Forest Ecosystems, 6*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060946658&doi=10.1186%2fs40663-019-0161-7&partnerID=40&md5=a757a8a1111929d345d7983733f1a4c5. doi:10.1186/s40663-019-0161-7

Research Tags: Soil, Forestry

Abstract: *Background*

Soil organic carbon (SOC) is a large reservoir of terrestrial carbon (C); it consists of different fractions of varying complexity and stability. Partitioning SOC into different pools of decomposability help better predict the trend of changes in SOC dynamics under climate change. Information on how physical fractions and chemical structures of SOC are related to climate and vegetation types is essential for spatial modelling of SOC processes and responses to global change factors.

Method
Soil samples were collected from multiple representative forest sites of three contrasting climatic zones (i.e. cool temperate, warm temperate, and subtropical) in eastern China. Measurements were made on SOC contents and physical fractions of the 0–20 cm soil layer, and the chemical composition of SOC of the 0–5 cm soil layer, along with measurements and compilation of the basic site and forest stand variables. The long-term effects of temperature, litter inputs, soil characteristics and vegetation type on the SOC contents and factions were examined by means of "space for time substitution" approach and statistical analysis.
Result
Mean annual temperature (MAT) varied from 2.1 °C at the cool temperate sites to 20.8 °C at the subtropical sites. Total SOC of the 0–20 cm soil layer decreased with increasing MAT, ranging from 89.2 g·kg− 1 in cool temperate forests to 57.7 g·kg− 1 in subtropical forests, at an average rate of 1.87% reduction in SOC with a 1 °C increase in MAT. With increasing MAT, the proportions of aromatic C and phenolic C displayed a tendency of decreases, whereas the proportion of alkyl C and A/O-A value (the ratio of alkyl C to the sum of O-alkyl C and acetal C) displayed a tendency of increases. Overall, there were no significant changes with MAT and forest type in either the physical fractions or the chemical composition. Based on the relationship between the SOC content and MAT, we estimate that SOC in the top 20 soil layer of forests potentially contribute 6.58–26.3 Pg C globally to the atmosphere if global MAT increases by 1 °C–4 °C by the end of the twenty-first century, with nearly half of which (cf. 2.87–11.5 Pg C) occurring in the 0–5 cm mineral soils.
Conclusion
Forest topsoil SOC content decreased and became chemically more recalcitrant with increasing MAT, without apparent changes in the physical fractions of SOC.

Sun, Y., Bekker, M. F., DeRose, R. J., Kjelgren, R., & Wang, S. Y. S. (2017). Statistical treatment for the wet bias in tree-ring chronologies: a case study from the Interior West, USA. *Environmental and Ecological Statistics, 24*(1), 131-150. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85003845853&doi=10.1007%2fs10651-016-0363-x&partnerID=40&md5=5ed5d1f4f357827489bf2ddc6a5e4200. doi:10.1007/s10651-016-0363-x
Research Tags: Forestry
Abstract: *Dendroclimatic research has long assumed a linear relationship between tree-ring increment and climate variables. However, ring width frequently underestimates extremely wet years, a phenomenon we refer to as 'wet bias'. In this paper, we present statistical evidence for wet bias that is obscured by the assumption of linearity. To improve tree-ring-climate modeling, we take into account wet bias by introducing two modified linear regression models: a linear spline regression (LSR) and a likelihood-based wet bias adjusted linear regression (WBALR), in comparison with a quadratic regression (QR) model. Using gridded precipitation data and tree-ring indices of multiple species from various sites in Utah, both LSR and WBALR show a significant improvement over the linear regression model and out-perform QR in terms of in-sample R2 and out-of-sample MSE. This further shows that the wet bias emerges from nonlinearity of tree-ring chronologies in reconstructing precipitation. The pattern and extent of wet bias varies by species, by site, and by precipitation regime, making it difficult to generalize the mechanisms behind its cause. However, it is likely that dis-coupling between precipitation amounts (e.g., percent received as rain/snow or percent infiltrating the soil) and its availability to trees (e.g., root zone dynamics), is the primary mechanism driving wet bias.*

Sunoj, S., Igathinathane, C., & Hendrickson, J. (2017). *Phenocam color image calibration using image analysis.* Paper presented at the 2017 ASABE Annual International Meeting.
Research Tags: Research
Abstract: *Phenocam is a network of time-lapse digital cameras installed all over North America producing images to monitor the phenological changes in plants and correlating it to the climate change patterns. Color is an important discerning feature in an image. The application of image processing in agriculture mostly relies on correlating color changes to plant health, crop stress, or nutrient deficiency. Changes in lighting conditions during image acquisition affects the color attribute even though there is no change in the plant quality. Hence, there exists a need to calibrate images to bring them to common ground for better phenological comparison. Thus, in the present study, the focus is on developing a methodology to calibrate the image color values so that the images look balanced, irrespective of the input lighting conditions. For calibration, a standard color panel*

with 24 patches of known color values was included in all the images, obtained using a digital camera at different lighting conditions. A user-coded ImageJ plugin was developed in Fiji for image calibration. The plugin developed a relationship between the color values of each color patch in the input image to the standard color values from standard color panel and a 3×3 color calibration matrix (CCM) was derived. The CCM was then applied to all pixel values in the input image, thus producing a calibrated image. The developed plugin performed well and took approximately 15 s to produce the calibrated image. New performance parameters such as difference index and calibration performance index (CPI) were developed to evaluate the calibration performance. Best calibration was characterized by minimum difference index, and CPI value. The minimum number of color patches required for efficient color calibration was also determined by including color patches one by one in different orders. The results revealed that, usage of three additive primary color patches (red, green, and blue) are sufficient for a good color calibration.

Suttles, K. M., Singh, N. K., Vose, J. M., Martin, K. L., Emanuel, R. E., Coulston, J. W., . . . Crump, M. T. (2018). Assessment of hydrologic vulnerability to urbanization and climate change in a rapidly changing watershed in the Southeast U.S. *Science of the Total Environment, 645*, 806-816. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050102116&doi=10.1016%2fj.scitotenv.2018.06.287&partnerID=40&md5=83d9aa4fa79ae30b127aa28cb420ca1f. doi:10.1016/j.scitotenv.2018.06.287

Research Tags: Water

Abstract: *This study assessed the combined effects of increased urbanization and climate change on streamflow in the Yadkin-Pee Dee watershed (North Carolina, USA) and focused on the conversion from forest to urban land use, the primary land use transition occurring in the watershed. We used the Soil and Water Assessment Tool to simulate future (2050–2070) streamflow and baseflow for four combined climate and land use scenarios across the Yadkin-Pee Dee River watershed and three subwatersheds. The combined scenarios pair land use change and climate change scenarios together. Compared to the baseline, projected streamflow increased in three out of four combined scenarios and decreased in one combined scenario. Baseflow decreased in all combined scenarios, but decreases were largest in subwatersheds that lost the most forest. The effects of land use change and climate change were additive, amplifying the increases in runoff and decreases in baseflow. Streamflow was influenced more strongly by climate change than land use change. However, for baseflow the reverse was true; land use change tended to drive baseflow more than climate change. Land use change was also a stronger driver than climate in the most urban subwatershed. In the most extreme land use and climate projection the volume of the 1-day, 100 year flood nearly doubled at the watershed outlet. Our results underscore the importance of forests as hydrologic regulators buffering streamflow and baseflow from hydrologic extremes. Additionally, our results suggest that land managers and policy makers need to consider the implications of forest loss on streamflow and baseflow when planning for future urbanization and climate change adaptation options.*

Svejcar, L. N., Peinetti, H. R., & Bestelmeyer, B. T. (2018). Effect of Climoedaphic Heterogeneity on Woody Plant Dominance in the Argentine Caldenal Region. *Rangeland Ecology and Management, 71*(4), 409-416. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044926445&doi=10.1016%2fj.rama.2018.03.001&partnerID=40&md5=570236e8137dbcfd6b2e6239cd11377a. doi:10.1016/j.rama.2018.03.001

Research Tags: Forestry

Abstract: *Woody plant encroachment is widespread throughout drylands of the world, but rates and patterns of encroachment at the regional scale can be mediated by soil and climate. Climoedaphic properties may therefore help to explain patterns of woody plant dominance. In the Caldenal region of central Argentina, which is experiencing widespread woody plant encroachment, we used stratified and targeted inventory of vegetation and soils alongside climate data to classify vegetation states and then identify factors indicating resistance to woody plant encroachment. We found that three climoedaphic contexts differed in the degree of woody plant dominance. Sandsheet landforms had the lowest likelihood of a shrub thicket state. Within loamy soils, sites with deep soil carbonates in warmer and wetter climates were less likely to feature a shrub thicket state than sites with shallow carbonates in cooler and drier climates. These contexts serve as a basis for recognizing different ecological sites to assist mapping and prioritization of management interventions in the Caldenal region. Simple inventory-based approaches can be helpful for designing land management* *recommendations in other ecosystems.*

Swails, E., Yang, X., Asefi, S., Hergoualc'h, K., Verchot, L., McRoberts, R. E., & Lawrence, D. (2019). Linking soil respiration and water table depth in tropical peatlands with remotely sensed changes in water storage from the gravity recovery and climate experiment. *Mitigation and Adaptation Strategies for Global Change, 24*(4), 575-590. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049149946&doi=10.1007%2fs11027-018-9822-z&partnerID=40&md5=5a19a4ad1e7f8b9747609086414b51f2. doi:10.1007/s11027-018-9822-z

Research Tags: Water, Soil, Emissions

Abstract: *Carbon dioxide (CO2) emissions from Southeast Asia peatlands are contributing substantially to global anthropogenic emissions to the atmosphere. Peatland emissions associated with land-use change, and fires are closely related to changes in the water table level. Remote sensing is a powerful tool that is potentially useful for estimating peat CO2 emissions over large spatial and temporal scales. We related ground measurements of total soil respiration and water table depth collected over 19 months in an Indonesian peatland to remotely sensed gravity recovery and climate experiment (GRACE) terrestrial water storage anomoly (TWSA) data. GRACE TWSA can be used to predict changes in water storage on land. We combined ground observations from undrained forest and drained smallholder oil palm plantations on peat in Central Kalimantan to produce a representation of the peatland landscape in one 0.5° × 0.5° GRACE grid cell. In both ecosystem types, total soil respiration increased with increasing water table depth. Across the landscape grid, monthly changes in water table depth were significantly related to fluctuations in GRACE TWSA. GRACE TWSA explained 76% of variation in water table depth and 75% of variation in total soil respiration measured on the ground. By facilitating regular sampling across broad spatial scales that captures essential variation in a major driver of soil respiration and peat fires, our approach could improve information available to decision makers to monitor changes in water table depth and peat CO2 emissions. This would enable measures better targeted in space and time to more effectively mitigate CO2 emissions from tropical peat drainage and fires. Testing over larger regions is needed to operationalize this exploratory approach.*

Swanston, C., Brandt, L. A., Janowiak, M. K., Handler, S. D., Butler-Leopold, P., Iverson, L., . . . Shannon, P. D. (2018). Vulnerability of forests of the Midwest and Northeast United States to climate change. *Climatic Change, 146*(1-2), 103-116. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028825585&doi=10.1007%2fs10584-017-2065-2&partnerID=40&md5=c4acd347c3ac9ebfbe61215aad660aa0. doi:10.1007/s10584-017-2065-2

Research Tags: Forestry

Abstract: *Forests of the Midwest and Northeast significantly define the character, culture, and economy of this large region but face an uncertain future as the climate continues to change. Forests vary widely across the region, and vulnerabilities are strongly influenced by regional differences in climate impacts and adaptive capacity. Not all forests are vulnerable; longer growing seasons and warmer temperatures will increase suitable habitat and biomass for many temperate species. Upland systems dominated by oak species generally have low vulnerability due to greater tolerance of hot and dry conditions, and some oak, hickory, and pine species are expected to become more competitive under hotter and physiologically drier conditions. However, changes in precipitation patterns, disturbance regimes, soil moisture, pest and disease outbreaks, and nonnative invasive species are expected to contribute forest vulnerability across the region. Northern, boreal, and montane forests have the greatest assessed vulnerability as many of their dominant tree species are projected to decline under warmer conditions. Coastal forests have high vulnerability, as sea level rise along the Atlantic coast increases damage from inundation, greater coastal erosion, flooding, and saltwater intrusion. Considering these potential forest vulnerabilities and opportunities is a critical step in making climate-informed decisions in long-term conservation planning.*

Swanston, C. W., Wei lein, T. L., Veverica, T. J., Strahm, B. D., Gallo, A., Hatten, J. A., . . . Sanclements, M. (2019). Carbon–mercury interactions in Spodosols assessed through density fractionation, radiocarbon analysis, and soil survey information. *Soil Science Society of America Journal, 83*(1), 190-202. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062173563&doi=10.2136%2fsssaj2018.06.0227&partnerID=40&md5=11fc3501fd5d31b5be71e36bde7917e2. doi:10.2136/sssaj2018.06.0227

Research Tags: Soil
Abstract: *Soils comprise the largest terrestrial pool of C and Hg on Earth, and these elements have critical feedbacks to problems ranging from atmospheric pollution and climate change to public health. Empirical evidence suggests these elements cycle closely in a wide range of soils, but mechanistic studies of their interactions within distinct soil organic matter (SOM) pools and between different soil types are needed. Here, we report findings of a novel approach to investigate C–Hg interactions, primarily in Spodosols, in which we: (i) examined density separated topsoil and illuvial horizons of four contrasting Spodosols, and used radiocarbon to investigate interactions between Hg and C cycling in distinct SOM pools; (ii) assessed broader patterns across Spodosols and other soil orders using USDA soil survey laboratory data. Consistent with other studies, C and Hg concentrations of individual soil horizons were positively related across the four contrasting Spodosols. Carbon and Hg were also positively related in the density fractions comprising individual soil horizons, but radiocarbon analysis revealed fundamental differences in Hg retention in modern, C-rich fractions vs. low-C fractions containing less modern radiocarbon. The lack of significant site-to-site variation in C and Hg across these sites (and Spodosols more broadly), contrasted against significant differences between horizons and fractions, suggests processes controlling C–Hg interactions are consistent across the taxonomic order. Furthermore, significant differences between other soil orders indicate that processes controlling soil formation—as represented by soil taxonomy—can explain differences in C–Hg interactions and their distribution across soils.*

Switanek, B. M., Troch, A. P., Castro, L. C., Leuprecht, A., Chang, H. I., Mukherjee, R., & Demaria, M. C. E. (2017). Scaled distribution mapping: A bias correction method that preserves raw climate model projected changes. *Hydrology and Earth System Sciences, 21*(6), 2649-2666. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020436712&doi=10.5194%2fhess-21-2649-2017&partnerID=40&md5=c48f7b6f9cdc0b38eef983b9e2682023. doi:10.5194/hess-21-2649-2017
Research Tags: Weather, Research
Abstract: *Commonly used bias correction methods such as quantile mapping (QM) assume the function of error correction values between modeled and observed distributions are stationary or time invariant. This article finds that this function of the error correction values cannot be assumed to be stationary. As a result, QM lacks justification to inflate/deflate various moments of the climate change signal. Previous adaptations of QM, most notably quantile delta mapping (QDM), have been developed that do not rely on this assumption of stationarity. Here, we outline a methodology called scaled distribution mapping (SDM), which is conceptually similar to QDM, but more explicitly accounts for the frequency of rain days and the likelihood of individual events. The SDM method is found to outperform QM, QDM, and detrended QM in its ability to better preserve raw climate model projected changes to meteorological variables such as temperature and precipitation.*

Talebizadeh, M., Moriasi, D., Gowda, P., Steiner, J. L., Tadesse, H. K., Nelson, A. M., & Starks, P. (2018). Simultaneous calibration of evapotranspiration and crop yield in agronomic system modeling using the APEX model. *Agricultural Water Management, 208*, 299-306. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049312885&doi=10.1016%2fj.agwat.2018.06.043&partnerID=40&md5=42bb709dd33914a5a8497d4ef77a6796. doi:10.1016/j.agwat.2018.06.043
Research Tags: Crops, Weather, Research
Abstract: *Reliable estimation of ET is especially important in semi-arid conditions where ET prediction is instrumental in cost-effective management of scarce water resources and crop production. In addition to the role of climate variables and soil characteristics, the actual ET is influenced by dynamic crop characteristics during the growing season. Therefore, accounting for the interaction between crop growth and actual ET can significantly improve the performance of models. In this study, an efficient approach is presented for simultaneous calibration of ET and crop growth parameters for the Agricultural Policy/Environmental eXtender (APEX) model for daily, weekly, and monthly ET. The proposed approach involves the development of an objective function based on a compounded time series comprising of scaled annual ET and crop yield data. An efficient search algorithm based on the DiffeRential Evolution Adaptive Metropolis (DREAM) algorithm was implemented in R language to find the parameter values that minimizes the defined objective function. The simultaneous calibration approach, which utilized annual data, improved ET prediction for annual and finer time scales (25% in RMSE reduction for 3-month, 18% for monthly, 17% for 2-week, 19% for weekly, 17% for 3-day, and 13% for daily time scales). The average of absolute relative error for crop yield predictions was also*

reduced from 43% to 16% for the calibrated model. The simulated leaf area index (LAI) for the calibrated model (i.e. calibrated using annual ET and crop yield data) was also consistent with the measured LAI values, confirming the validity of the calibrated parameter values.

Tan, M. L., Gassman, P. W., Srinivasan, R., Arnold, J. G., & Yang, X. (2019). A review of SWAT studies in Southeast Asia: Applications, challenges and future directions. *Water (Switzerland), 11*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066325106&doi=10.3390%2fw11050914&partnerID=40&md5=056992bae881bf0ce4aaecb59227bffe. doi:10.3390/w11050914

Research Tags: Soil, Water, Research

Abstract: *The Soil and Water Assessment Tool (SWAT) model is recognized as one of the top hydrological models applied for addressing hydrologic and environmental issues. This is the first review on the SWAT model studies in Southeast Asia, with an emphasis on its applications, current challenges and future research directions. A total of 126 articles were identified since 2006; roughly 50% of these studies were conducted in Vietnam or Thailand. About 16% of the studies were performed at a transnational scale, which included Cambodia, Lao PDR, Thailand, and Vietnam. Model capability assessment, land use, and climate change assessment are the main SWAT applications that have been reported for the region. Most of the SWAT calibration and validation results for these studies were classified as satisfactory to very good results based on widely recognized performance indicators. However, the parameterization, calibration and validation procedures are not well reported in some articles. Availability of reliable data is one of the main problems that SWAT users are confronted with, as these data are either not freely available or restricted from public access in some countries. Hence, future studies should be considered on identification and development of reliable input data for SWAT modeling. SWAT model modification based on the SEA climate, geographical and land use conditions is another research direction to be considered in the future. Moreover, application of SWAT for extreme events simulation requires more attention in this region.*

Tang, Y., Winkler, J., Zhong, S., Bian, X., Doubler, D., Yu, L., & Walters, C. (2017). Future changes in the climatology of the Great Plains low-level jet derived from fine resolution multi-model simulations. *Scientific Reports, 7*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022344771&doi=10.1038%2fs41598-017-05135-0&partnerID=40&md5=13dca4f199013d7c0c85a7eb6f8a34a6. doi:10.1038/s41598-017-05135-0

Research Tags: Weather

Abstract: *The southerly Great Plains low-level jet (GPLLJ) is one of the most significant circulation features of the central U.S. linking large-scale atmospheric circulation with the regional climate. GPLLJs transport heat and moisture, contribute to thunderstorm and severe weather formation, provide a corridor for the springtime migration of birds and insects, enhance wind energy availability, and disperse air pollution. We assess future changes in GPLLJ frequency using an eight member ensemble of dynamically-downscaled climate simulations for the mid-21st century. Nocturnal GPLLJ frequency is projected to increase in the southern plains in spring and in the central plains in summer, whereas current climatological patterns persist into the future for daytime and cool season GPLLJs. The relationship between future GPLLJ frequency and the extent and strength of anticyclonic airflow over eastern North America varies with season. Most simulations project a westward shift of anticyclonic airflow in summer, but uncertainty is larger for spring with only half of the simulations suggesting a westward expansion. The choice of regional climate model and the driving lateral boundary conditions have a large influence on the projected future changes in GPLLJ frequency and highlight the importance of multi-model ensembles to estimate the uncertainty surrounding the future GPLLJ climatology.*

Taylor, R. A., Ryan, S. J., Lippi, C. A., Hall, D. G., Narouei-Khandan, H. A., Rohr, J. R., & Johnson, L. R. (2019). Predicting the fundamental thermal niche of crop pests and diseases in a changing world: A case study on citrus greening. *Journal of Applied Ecology, 56*(8), 2057-2068. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068532771&doi=10.1111%2f1365-2664.13455&partnerID=40&md5=27f256ce58280cbae9aaec19a0e37ca6. doi:10.1111/1365-2664.13455

Research Tags: Weather, Crops

Abstract: *Predicting where crop pests and diseases can occur, both now and in the future under different climate change scenarios, is a major challenge for crop management. One solution is to estimate the*

fundamental thermal niche of the pest/disease to indicate where establishment is possible. Here, we develop methods for estimating and displaying the fundamental thermal niche of pests and pathogens and apply these methods to Huanglongbing (HLB), a vector-borne disease that is currently threatening the citrus industry worldwide.
We derive a suitability metric based on a mathematical model of HLB transmission between tree hosts and its vector Diaphorina citri, and incorporate the effect of temperature on vector traits using data from laboratory experiments performed at different temperatures. We validate the model using data on the historical range of HLB.
Our model predicts that transmission of HLB is possible between 16 and 33°C with peak transmission at ~25°C. The greatest uncertainty in our suitability metric is associated with the mortality of the vectors at peak transmission, and fecundity at the edges of the thermal range, indicating that these parameters need further experimental work.
We produce global thermal niche maps by plotting how many months each location is suitable for establishment of the pest/disease. This analysis reveals that the highest suitability for HLB occurs near the equator in large citrus-producing regions, such as Brazil and South-East Asia. Within the Northern Hemisphere, the Iberian peninsula and California are HLB suitable for up to 7 months of the year and are free of HLB currently.
Policy implications. We create a thermal niche map which indicates the places at greatest risk of establishment should a crop disease or pest enter these regions. This indicates where surveillance should be focused to prevent establishment. Our mechanistic method can be used to predict new areas for Huanglongbing transmission under different climate change scenarios and is easily adapted to other vector-borne diseases and crop pests.

Teets, A., Fraver, S., Hollinger, D. Y., Weiskittel, A. R., Seymour, R. S., & Richardson, A. D. (2018). Linking annual tree growth with eddy-flux measures of net ecosystem productivity across twenty years of observation in a mixed conifer forest. *Agricultural and Forest Meteorology, 249*, 479-487. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027455838&doi=10.1016%2fj.agrformet.2017.08.007&partnerID=40&md5=8a11380f2a5d7c7d965135a484750aa0. doi:10.1016/j.agrformet.2017.08.007
Research Tags: Weather, Forestry
Abstract: *Eddy covariance methodologies have greatly improved our understanding of the forest carbon cycle, including controls over year-to-year variability in productivity (measured as net ecosystem productivity, NEP, where NEP is the difference between the mass of carbon fixed by photosynthesis and that lost by ecosystem respiration). However, establishing and maintaining eddy covariance towers requires sizeable financial and logistical investments. Tree-ring methods, which can produce annual estimates of tree biomass increment from individual trees, provide an alternative approach for assessing forest productivity. Attempts to link these measures of productivity (i.e., NEP and tree biomass increment) have produced inconsistent results, in part because NEP time series are typically too short to provide robust comparisons. We here use a relatively long (20-year) NEP time series together with annual tree biomass increment (derived from tree-ring data) from the same site to determine to what extent the two productivity measures relate to each other. We conducted this study at the Howland Research Forest, central Maine USA, which supports a mature, mixed-species conifer forest. We expressed stand-level tree biomass increment on a per-area basis, which allowed direct comparisons with NEP data. Our results revealed a strong relationship between tree biomass increment and annual NEP measurements when the latter are summarized from previous-year fall to current-year fall, a marked improvement over more typical calendar-year summaries. Further, our results suggest tree biomass increment lagged one year behind NEP (i.e., assimilated carbon was not allocated to wood formation until the following year) for roughly the first half of the time-series, but later became synchronized with current-year NEP. This shift to synchrony may reflect a change in stand-level carbon allocation and growth dynamics. The apparent shift in carbon allocation from storage into current-year wood formation is most evident in two recent years with above-average spring temperatures. Although our results demonstrate a link between annual tree biomass increment and NEP, they also point to complexities that may confound our interpretation of these productivity measures.*

Teets, A., Fraver, S., Weiskittel, A. R., & Hollinger, D. Y. (2018). Quantifying climate–growth relationships at the stand level in a mature mixed-species conifer forest. *Global Change Biology, 24*(8), 3587-3602. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044977032&doi=10.1111%2fgcb.14120&partnerID=40&md5=b6dd4bd60170ca2b55773ccda7516dbc. doi:10.1111/gcb.14120
Research Tags: Forest
Abstract: *A range of environmental factors regulate tree growth; however, climate is generally thought to most strongly influence year-to-year variability in growth. Numerous dendrochronological (tree-ring) studies have identified climate factors that influence year-to-year variability in growth for given tree species and location. However, traditional dendrochronology methods have limitations that prevent them from adequately assessing stand-level (as opposed to species-level) growth. We argue that stand-level growth analyses provide a more meaningful assessment of forest response to climate fluctuations, as well as the management options that may be employed to sustain forest productivity. Working in a mature, mixed-species stand at the Howland Research Forest of central Maine, USA, we used two alternatives to traditional dendrochronological analyses by (1) selecting trees for coring using a stratified (by size and species), random sampling method that ensures a representative sample of the stand, and (2) converting ring widths to biomass increments, which once summed, produced a representation of stand-level growth, while maintaining species identities or canopy position if needed. We then tested the relative influence of seasonal climate variables on year-to-year variability in the biomass increment using generalized least squares regression, while accounting for temporal autocorrelation. Our results indicate that stand-level growth responded most strongly to previous summer and current spring climate variables, resulting from a combination of individualistic climate responses occurring at the species- and canopy-position level. Our climate models were better fit to stand-level biomass increment than to species-level or canopy-position summaries. The relative growth responses (i.e., percent change) predicted from the most influential climate variables indicate stand-level growth varies less from to year-to-year than species-level or canopy-position growth responses. By assessing stand-level growth response to climate, we provide an alternative perspective on climate–growth relationships of forests, improving our understanding of forest growth dynamics under a fluctuating climate.*

Telugu, B. P., Park, K. E., & Park, C. H. (2017). Genome editing and genetic engineering in livestock for advancing agricultural and biomedical applications. *Mammalian Genome, 28*(7-8), 338-347. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023760400&doi=10.1007%2fs00335-017-9709-4&partnerID=40&md5=ca1638999132bd6379153c76b4dbf61f. doi:10.1007/s00335-017-9709-4
Research Tags: Livestock
Abstract: *Genetic modification of livestock has a longstanding and successful history, starting with domestication several thousand years ago. Modern animal breeding strategies predominantly based on marker-assisted and genomic selection, artificial insemination, and embryo transfer have led to significant improvement in the performance of domestic animals, and are the basis for regular supply of high quality animal derived food. However, the current strategy of breeding animals over multiple generations to introduce novel traits is not realistic in responding to the unprecedented challenges such as changing climate, pandemic diseases, and feeding an anticipated 3 billion increase in global population in the next three decades. Consequently, sophisticated genetic modifications that allow for seamless introgression of novel alleles or traits and introduction of precise modifications without affecting the overall genetic merit of the animal are required for addressing these pressing challenges. The requirement for precise modifications is especially important in the context of modeling human diseases for the development of therapeutic interventions. The animal science community envisions the genome editors as essential tools in addressing these critical priorities in agriculture and biomedicine, and for advancing livestock genetic engineering for agriculture, biomedical as well as "dual purpose" applications.*

Teqja, Z., Kopali, A., Libohova, Z., & Owens, P. R. (2017). A study of the impacts of climate change scenarios on the plant hardiness zones of Albania. *Journal of Applied Meteorology and Climatology, 56*(3), 615-631. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015184604&doi=10.1175%2fJAMC-D-16-0108.1&partnerID=40&md5=8eddef7345059b1112fc66a7f02455d8. doi:10.1175/JAMC-D-16-0108.1
Research Tags: Weather
Abstract: *Maps of plant hardiness zones are useful tools for determining the extreme limits for the survival of plants. Exploration of projected climate change effects on hardiness zones can help identify areas most affected*

by climate change. Such studies are important in areas with high risks related to climate change, such as the Mediterranean Sea region. The objectives of this study were to (i) map plant hardiness zones for Albania and (ii) assess the projected effects of climate scenarios on the distribution of hardiness zones. Hardiness zones were affected by IPCC AR5 climate scenarios. The most extreme hardiness zone (6a) disappeared while a new, warmer zone (10b) appeared, reflecting rising temperature trends during the cold season. The shifts in spatial distribution of hardiness zones may represent opportunities for introducing new species to Albanian agriculture and forestry; however, the introduction of new species would require further studies on the variability of plant hardiness zones at local scales.

Thapa, R., Mirsky, S. B., & Tully, K. L. (2018). Cover crops reduce nitrate leaching in agroecosystems: A global meta-analysis. *Journal of Environmental Quality, 47*(6), 1400-1411. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056716497&doi=10.2134%2fjeq2018.03.0107&partnerID=40&md5=4e2626ce1793a044c045896c7575f456. doi:10.2134/jeq2018.03.0107

Research Tags: Crops, Water

Abstract: *Cover crops are well recognized as a tool to reduce NO3− leaching from agroecosystems. However, their effectiveness varies from site to site and year to year depending on soil, cash and cover crop management, and climate. We conducted a meta-analysis using 238 observations from 28 studies (i) to assess the overall effect of cover crops on NO3− leaching and subsequent crop yields, and (ii) to examine how soil, cash and cover crop management, and climate impact the effect of non-leguminous cover crops on NO3− leaching. There is a clear indication that nonleguminous cover crops can substantially reduce NO3− leaching into freshwater systems, on average by 56%. Nonlegume–legume cover crop mixtures reduced NO3− leaching as effectively as nonlegumes, but significantly more than legumes. The lack of variance information in most published literature prevents greater insight into the degree to which cover crops can improve water quality. Among the factors investigated, we identified cover crop planting dates, shoot biomass, and precipitation relative to long-term mean precipitation as potential drivers for the observed variability in nonleguminous cover crop effectiveness in reducing NO3− leaching. We found evidence indicating greater reduction in NO3− leaching with nonleguminous cover crops on coarse-textured soils and during years of low precipitation (<90% of the long-term normal). Earlier fall planting and greater nonleguminous shoot biomass further reduced NO3− leaching. Overall, this meta-analysis confirms many prior studies showing that nonleguminous cover crops are an effective way to reduce NO3− leaching and should be integrated into cropping systems to improve water quality.*

Thistlewood, H. M. A., Gill, P., Beers, E. H., Shearer, P. W., Walsh, D. B., Rozema, B. M., . . . Whitener, A. B. (2018). Spatial analysis of seasonal dynamics and overwintering of Drosophila suzukii (Diptera: Drosophilidae) in the Okanagan-Columbia Basin, 2010–2014. *Environmental Entomology, 47*(2), 221-232. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052053457&doi=10.1093%2fee%2fnvx178&partnerID=40&md5=3d4b7c2d478097dd0af6b5a335e300cd. doi:10.1093/ee/nvx178

Research Tags: Wildlife, Crops, Weather

Abstract: *Spotted wing drosophila, Drosophila suzukii (Matsumura) (Diptera: Drosophilidae), was monitored from 2010 to 2014 in 314–828 sites located in interior fruit-growing regions of OR and WA, United States, and BC, Canada, using traps baited with apple cider vinegar or sugar-water-yeast. Seasonal population dynamics and sex ratios were summarized for berry, cherry, stone fruit, grape, non-crop host plants, non-host sites, and for conventional IPM, certified organic, backyard, and feral sites, by region and year. Overwintering was detected in all regions and years, despite winter temperatures below −17°C. A spatial analysis was conducted using a Geographic Information System (GIS), daily weather data, geomorphometric measures of terrain, distance to water, and other variables, at each site. Overwintering success at a site, measured as Julian week of first capture of D. suzukii, was significantly related (R2 = 0.49) in cherry habitats to year, agronomic treatment, and number of winter days with temperatures >−5°C. In berry, cherry, stone fruit and grape habitats, 2011–2014, it was significantly related (R2 = 0.42) to year, agronomic treatment, the logarithm of peak population of D. suzukii in the prior autumn, latitude, elevation, and topographic wetness index. The results show that D. suzukii has adapted to exploit a succession of irrigated crops and feral habitats in mixed landscapes of a semi-arid region with cold winters and hot dry summers, and are shaping strategies for pest management and for biological control.*

Thivierge, M. N., Jégo, G., Bélanger, G., Chantigny, M. H., Rotz, C. A., Charbonneau, É., . . . Qian, B. (2017). Projected impact of future climate conditions on the agronomic and environmental performance of Canadian dairy farms. *Agricultural Systems, 157*, 241-257. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027520901&doi=10.1016%2fj.agsy.2017.07.003&partnerID=40&md5=901b6619855eb1218744bf0c5791af0a. doi:10.1016/j.agsy.2017.07.003

Research Tags: Emissions, Livestock

Abstract: *Climate change is expected to increase agricultural productivity in Canada and in other northern countries but this increase will likely affect the environmental performance of dairy farms, one of the most important agricultural sectors in Canada. The objective of this study was to project the impact of climate change on the agronomic and environmental performance of a virtual dairy farm in each of three climatically contrasting areas of Canada through near future (2020–2049) and distant future (2050–2079) periods, using the Integrated Farm System Model (IFSM) and three climate models (CanESM2, CanRCM4, and HadGEM2). Under future climate conditions and relative to a reference period (1971–2000), projected yields of perennial forages and warm-season crops increased, whereas those of small-grain cereals decreased slightly. Projected ammonia emissions increased on virtual farms of the three areas and in all future scenarios (+ 18% to + 54%). Methane emissions from manure storage increased (+ 26% to + 120%), whereas those from enteric fermentation and field manure application decreased. Projected farm N2O emissions changed only slightly relative to the reference period. Fossil fuel CO2 emissions related to field operations increased slightly, due to a larger number of forage cuts per year in future scenarios, but CO2 emissions related to grain drying decreased substantially. Projected losses of P increased on virtual farms of the three areas. The projected reactive N footprint of dairy farms in future scenarios varied more (− 15% to + 46%) relative to the reference period than the C footprint (− 5% to + 9%). Although greenhouse gas mitigation should be a priority for dairy farms under future climate conditions, it should not overshadow the need for strategies to reduce reactive N losses.*

Thomason, M. J. S., & Rice, K. J. (2017). Spatial pattern and scale influence invader demographic response to simulated precipitation change in an annual grassland community. *PLoS ONE, 12*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008517779&doi=10.1371%2fjournal.pone.0169328&partnerID=40&md5=0a26917db0a67a815acbdb6000f6b6d0. doi:10.1371/journal.pone.0169328

Research Tags: Weather

Abstract: *It is important to predict which invasive species will benefit from future changes in climate, and thereby identify those invaders that need particular attention and prioritization of management efforts. Because establishment, persistence, and spread determine invasion success, this prediction requires detailed demographic information. Explicit study of the impact of pattern on demographic response is particularly important for species that are naturally patchy, such as the invasive grass, Aegilops triuncialis. In the northern California Coast Range, where climate change may increase or decrease mean annual rainfall, we conducted a field experiment to understand the interaction of climate change and local-scale patterning on the demography of A. triuncialis. We manipulated precipitation (reduced, ambient, or augmented), seed density, and seeding pattern. Demographic and environmental data were collected for three years following initial seeding. Pattern and scale figure prominently in the demographic response of A. triuncialis to precipitation manipulation. Pattern interacts with precipitation and seeding density in its influence on per-plant seed output. Although per-plot seed production was highest when seeds were not aggregated, per-plant seed output was higher in aggregated patches. Results suggest aggregation of invasive A. triuncialis reduces the detrimental impact of interspecific competition in its invaded community, and that interspecific competition per se has a stronger impact than intraspecific competition.*

Thompson, W., Johansson, R., Meyer, S., & Whistance, J. (2018). The US biofuel mandate as a substitute for carbon cap-and-trade. *Energy Policy, 113*, 368-375. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034238611&doi=10.1016%2fj.enpol.2017.10.041&partnerID=40&md5=d24fdfc53af532b9665ffef5057402c8. doi:10.1016/j.enpol.2017.10.041

Research Tags: Economics, Energy, Emissions

Abstract: *Environmental economists might recommend a cap-and-trade program as a good way to lower emissions of greenhouse gases (GHGs), but US carbon cap-and-trade legislation was proposed and failed to*

become law. Instead, the biofuel use mandate is the primary existing GHG reduction program in the United States. The mandate effectively requires a rising amount of GHG abatement each year, but allows regulated parties to buy and sell credits to meet annual obligations. Although many aspects of the biofuel mandate look similar to a cap-and-trade program, there are additional requirements, such as feedstock eligibility limitations and waivers. The existence of the mandates is presumably conditional on all the legal requirements, but these conditions represent a departure from a strict GHG cap-and-trade program.
We estimate GHG abatement costs of the mandate and compare them to a hypothetical cap-and-trade program targeting vehicle fuels. The mandate abatement cost is found to be higher than a hypothetical GHG cap-and-trade. Our results show that the RFS might be judged as a feasible substitute for a cap-and-trade regime that can deliver GHG reductions, but at a higher cost reflecting its multiple objectives.

Thormann, I., Reeves, P., Thumm, S., Reilley, A., Engels, J. M. M., Biradar, C. M., . . . Richards, C. M. (2017). Genotypic and phenotypic changes in wild barley (Hordeum vulgare subsp. spontaneum) during a period of climate change in Jordan. *Genetic Resources and Crop Evolution, 64*(6), 1295-1312. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84986296951&doi=10.1007%2fs10722-016-0437-5&partnerID=40&md5=74a0a68868473b454f25e8b24976b8b7. doi:10.1007/s10722-016-0437-5
Research Tags: Crops
Abstract: *Climate change and other anthropogenic disturbances can lead to the loss of genetic variation and thereby affect evolutionary potential and survival of plant populations in the wild. We examined these predictions in the primary wild relative of barley, Hordeum vulgare L. subsp. spontaneum (K. Koch) Thell., within its center of diversity, in Jordan. Changes in genotypic and phenotypic diversity were assessed using seed samples collected in 1981 and 2012 from the same 18 sites across Jordan. The overall population structure was conserved, but we observed an increase of within population genetic diversity and a reduction in population differentiation. Phenotypic variation differed among years and sites but the magnitude and direction of change variated among sites. While the sampled region became significantly hotter and drier during this period, simple correlation models did not support association between measures of climate change and the observed genetic and phenotypic changes. Agricultural activities that promote disturbance and demographic fluctuations may affect crop wild relatives that grow in agricultural landscapes, in unexpected ways. The observed increase in genetic diversity within populations might be explained by increased migration or by an advantage of increased genetic variation in the face of variable environmental conditions. This study provides a new perspective on the range of possible responses of crop wild relatives to environmental pressures.*

Thormann, I., Reeves, P., Thumm, S., Reilley, A., Engels, J. M. M., Biradar, C. M., . . . Richards, C. M. (2018). Changes in barley (Hordeum vulgare L. subsp. vulgare) genetic diversity and structure in Jordan over a period of 31 years. *Plant Genetic Resources: Characterisation and Utilisation, 16*(2), 112-126. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019243085&doi=10.1017%2fS1479262117000028&partnerID=40&md5=a04827d805e31805f16b99d48d2380a7. doi:10.1017/S1479262117000028
Research Tags: Crops
Abstract: *In many regions of the world, the cultivation of landraces is still common, in particular in centres of crop diversity. Significant effort has been put into ex situ conservation of landraces but limited data exist on the changes in genetic diversity that occur over time in farmers' fields. We assessed temporal changes in barley landrace diversity in Jordan using seed samples collected in 1981 and 2012 from the same locations. We did not observe significant changes in the amount of genetic diversity, but samples collected in 2012 were more homogenous and less locally distinct. In two sites, we observed replacement of the old material. We observed a change in phenotype, and phenotypes were found to be more homogeneous among sites in 2012. Climate changed significantly over the study period, becoming hotter and dryer, but we did not identify any correlation between the changes in climate and genetic and phenotypic variations. While the amount of genetic diversity in terms of allelic richness and number of multi-locus genotypes has been maintained, local distinctiveness among landrace barley populations in Jordan was reduced.*

Thorne, J. H., Choe, H., Stine, P. A., Chambers, J. C., Holguin, A., Kerr, A. C., & Schwartz, M. W. (2018). Climate change vulnerability assessment of forests in the Southwest USA. *Climatic Change, 148*(3), 387-402. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021820948&doi=10.1007%2fs10584-017-2010-4&

partnerID=40&md5=087035dd8198876ac9f83c08953eb948. doi:10.1007/s10584-017-2010-4
Research Tags: Forestry
Abstract: *Climate change effects are already apparent in some Southwestern US forests and are expected to intensify in the coming decades, via direct (temperature, precipitation) and indirect (fire, pests, pathogens) stressors. We grouped Southwestern forests into ten major types to assess their climate exposure by 2070 using two global climate models (GCMs) and two emission scenarios representing wetter or drier conditions and current or lowered emission levels. We estimate future climate exposure over forests covering 370,144 km2 as the location and proportion of each type projected to experience climate conditions that fall outside 99% of those they currently occupy. By late century, 27–77% is climatically exposed under wetter or drier current emission levels, while lowered emission levels produce 10–50% exposure, respectively. This difference points to the benefits of reducing emissions from the RCP8.5 to the RCP4.5 track, with regard to forest retention. Exposed areas common to all four climate futures include central Arizona and the western slope of the Sierra Nevada. Vulnerability assessments also comprise sensitivity and adaptive capacity, which we scored subjectively by forest type according to the number of key stressors they are sensitive to and the resilience conferred by life history traits of their dominant tree species. Under the 2070 RCP8.5 emissions, four forest types are critically and six are highly vulnerable under the hotter GCM; and eight are highly and two moderately vulnerable under the wetter GCM. We discuss forest management adaptation strategies and the barriers to and co-benefits of such plans.*

Thornton, D. H., Wirsing, A. J., Lopez-Gonzalez, C., Squires, J. R., Fisher, S., Larsen, K. W., . . . Murray, D. L. (2018). Asymmetric cross-border protection of peripheral transboundary species. *Conservation Letters, 11*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038073173&doi=10.1111%2fconl.12430&partnerID=40&md5=1e0142bf220418e92c54967a31fa0b9c. doi:10.1111/conl.12430
Research Tags: Wildlife
Abstract: *International political boundaries challenge species conservation because they can hinder coordinated management. Peripheral transboundary species, those with a large portion of their range in one country and a small, peripheral portion in an adjacent country, may be particularly vulnerable to mismatches in management because peripheral populations are likely in greater conservation need than core populations. However, no systematic assessment of peripheral transboundary species or their status across borders has been attempted. We show that numerous species in three vertebrate taxa qualify as peripheral transboundary species in North America, and that these species are often protected differently across US–Canadian and US–Mexican borders. Asymmetries in cross-border protection may threaten populations through disruption of connectivity between periphery and core regions and are especially relevant given expected impacts of climate change and the US–Mexico border wall. Our results highlight the need for greater international collaboration in management and planning decisions for transboundary species.*

Timberlake, T., Joyce, L. A., Schultz, C., & Lampman, G. (2018). Design of a workshop process to support consideration of natural range of variation and climate change for land management planning under the 2012 planning rule. *USDA Forest Service - Research Note RMRS-RN, 2018*(RMRS-RN-82). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069512618&partnerID=40&md5=16349e655593b1a40f0219ab407b2ede.
Research Tags: Forestry, Research
Abstract: *The planning units of the National Forest System are beginning to revise their existing land management plans using the 2012 Forest Service regulations. Ecological integrity is a central concept to the regulations. However, implementing the concept is challenging in light of climate change. Historical ecology, particularly the concept of natural range of variation, informs planning for ecological integrity and climate change. This report discusses a March 2016 workshop held for the Intermountain Region to address ecological integrity, NRV, and climate change, all high priority topics for land management planning. It describes presentations included in the workshop on the evolution of the concept of natural range of variation, the 2012 planning rule, and data considerations. As part of the workshop, we developed a worksheet that managers and planners may use to consider ecological integrity, climate change, and natural range of variation. This report summarizes the use of this worksheet for two ecosystems of interest to the region: spruce-fir and alpine*

vegetation. We also provide recommendations, including to consider natural range of variation as a tool for planning for ecological integrity.

Tinkham, W. T., Mahoney, P. R., Hudak, A. T., Domke, G. M., Falkowski, M. J., Woodall, C. W., & Smith, A. M. S. (2018). Applications of the United States forest inventory and analysis dataset: A review and future directions. *Canadian Journal of Forest Research, 48*(11), 1251-1268. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056090984&doi=10.1139%2fcjfr-2018-0196&partnerID=40&md5=3d858c21860d36b0d2028b1b8eb1272c. doi:10.1139/cjfr-2018-0196
Research Tags: Forestry
Abstract: *The United States Forest Inventory and Analysis (FIA) program has been monitoring national forest resources in the United States for over 80 years; presented here is a synthesis of research applications for FIA data. A review of over 180 publications that directly utilize FIA data is broken down into broad categories of application and further organized by methodologies and niche research areas. The FIA program provides the most comprehensive forest database currently available, with permanent plots distributed across all forested lands and ownerships in the United States and plot histories dating back to the early 1930s. While the data can be incredibly powerful, users need to understand the spatial resolution of ground-based plots and the nature of the FIA plot coordinate system must be applied correctly. As the need for accurate assessments of national forest resources continues to be a global priority, particularly related to carbon dynamics and climate impacts, such national forest inventories will continue to be an important source of information on the status of and trends in these ecosystems. The advantages and limitations of FIA's national forest inventory data are highlighted, and suggestions for further expansion of the FIA program are provided.*

Tobin, J. K., Torres, R., Crow, T. W., & Bennett, E. M. (2017). Multi-decadal analysis of root-zone soil moisture applying the exponential filter across CONUS. *Hydrology and Earth System Sciences, 21*(9), 4403-4417. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029030797&doi=10.5194%2fhess-21-4403-2017&partnerID=40&md5=fc5c23f8686f15bc7b60a77f3b09db78. doi:10.5194/hess-21-4403-2017
Research Tags: Soil
Abstract: *This study applied the exponential filter to produce an estimate of root-zone soil moisture (RZSM). Four types of microwave-based, surface satellite soil moisture were used. The core remotely sensed data for this study came from NASA's long-lasting AMSR-E mission. Additionally, three other products were obtained from the European Space Agency Climate Change Initiative (CCI). These datasets were blended based on all available satellite observations (CCI-active, CCI-passive, and CCI-combined). All of these products were 0.25° and taken daily. We applied the filter to produce a soil moisture index (SWI) that others have successfully used to estimate RZSM. The only unknown in this approach was the characteristic time of soil moisture variation (T). We examined five different eras (1997–2002; 2002–2005; 2005–2008; 2008–2011; 2011–2014) that represented periods with different satellite data sensors. SWI values were compared with in situ soil moisture data from the International Soil Moisture Network at a depth ranging from 20 to 25 cm. Selected networks included the US Department of Energy Atmospheric Radiation Measurement (ARM) program (25 cm), Soil Climate Analysis Network (SCAN; 20.32 cm), SNOwpack TELemetry (SNOTEL; 20.32 cm), and the US Climate Reference Network (USCRN; 20 cm). We selected in situ stations that had reasonable completeness. These datasets were used to filter out periods with freezing temperatures and rainfall using data from the Parameter elevation Regression on Independent Slopes Model (PRISM). Additionally, we only examined sites where surface and root-zone soil moisture had a reasonably high lagged r value (r > 0. 5).*
The unknown T value was constrained based on two approaches: optimization of root mean square error (RMSE) and calculation based on the normalized difference vegetation index (NDVI) value. Both approaches yielded comparable results; although, as to be expected, the optimization approach generally outperformed NDVI-based estimates. The best results were noted at stations that had an absolute bias within 10 %. SWI estimates were more impacted by the in situ network than the surface satellite product used to drive the exponential filter. The average Nash–Sutcliffe coefficients (NSs) for ARM ranged from −0. 1 to 0.3 and were similar to the results obtained from the USCRN network (0.2–0.3). NS values from the SCAN and SNOTEL networks were slightly higher (0.1–0.5). These results indicated that this approach had some skill in providing an estimate of RZSM. In terms of RMSE (in volumetric soil moisture), ARM values actually outperformed those from other networks (0.02–0.04). SCAN and USCRN RMSE average values ranged from 0.04 to 0.06 and

SNOTEL average RMSE values were higher (0.05–0.07). These values were close to 0.04, which is the baseline value for accuracy designated for many satellite soil moisture missions.

Tomasek, B. J., Williams, M. M., & Davis, A. S. (2017). Changes in field workability and drought risk from projected climate change drive spatially variable risks in Illinois cropping systems. *PLoS ONE, 12*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013936878&doi=10.1371%2fjournal.pone.0172301&partnerID=40&md5=cd455d169c3d3945d3239ea8590f13e0. doi:10.1371/journal.pone.0172301
Research Tags: Weather, Crops
Abstract: *As weather patterns become more volatile and extreme, risks introduced by weather variability will become more critical to agricultural production. The availability of days suitable for field work is driven by soil temperature and moisture, both of which may be altered by climate change. We projected changes in Illinois season length, spring field workability, and summer drought risk under three different emissions scenarios (B1, A1B, and A2) down to the crop district scale. Across all scenarios, thermal time units increased in parallel with a longer frost-free season. An increase in late March and Early April field workability was consistent across scenarios, but a decline in overall April through May workable days was observed for many cases. In addition, summer drought metrics were projected to increase for most scenarios. These results highlight how the spatial and temporal variability in climate change may present unique challenges to mitigation and adaptation efforts.*

Tomer, M. D., Schilling, K. E., & Cole, K. J. (2019). Nitrate on a slow decline: Watershed water quality response during two decades of tallgrass prairie ecosystem reconstruction in Iowa. *Journal of Environmental Quality, 48*(3), 579-585. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066940615&doi=10.2134%2fjeq2018.07.0258&partnerID=40&md5=402e9916d1fbf4ad36378ed966d27495. doi:10.2134/jeq2018.07.0258
Research Tags: Water, Grassland
Abstract: *The Neal Smith National Wildlife Refuge was established as a tallgrass prairie ecosystem reconstruction in the Walnut Creek watershed (5238 ha), Jasper County, Iowa, with >1200 ha of prairie plantings initiated between 1993 and 2006. This study updates the documented decreases in watershed NO3–N losses that accompanied this change in land cover to a 20-yr record. Annual flow-weighted NO3–N concentrations declined by 0.15 mg NO3–N L−1 yr−1, which was not significantly different from the rate of 0.07 mg NO3–N L−1 yr−1 reported after the first decade of monitoring. There was also evidence (p < 0.1) that prairie reconstruction led to a declining trend in annual watershed water yield, which would have contributed to the trend of decreasing NO3–N loads. However, variability in climate, including 2 yr with significant flooding events followed by a major drought during the second decade of monitoring, challenged any notion that a watershed water quality record will stabilize even >10 yr after a substantial change in land cover, in this naturally drained watershed underlain by fine grained glacial deposits that exhibit multidecadal groundwater transport times. Efforts to document progress toward water quality goals will need to consider dominant flow paths and associated travel times, uncertainty in the effectiveness of management changes, and a changeable climate.*

Tor-Ngern, P., Oren, R., Oishi, A. C., Uebelherr, J. M., Palmroth, S., Tarvainen, L., . . . Näsholm, T. (2017). Ecophysiological variation of transpiration of pine forests: Synthesis of new and published results: Synthesis. *Ecological Applications, 27*(1), 118-133. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85008336814&doi=10.1002%2feap.1423&partnerID=40&md5=1cf55513ccc01aa5c28bdf540201da85. doi:10.1002/eap.1423
Research Tags: Forestry
Abstract: *Canopy transpiration (EC) is a large fraction of evapotranspiration, integrating physical and biological processes within the energy, water, and carbon cycles of forests. Quantifying EC is of both scientific and practical importance, providing information relevant to questions ranging from energy partitioning to ecosystem services, such as primary productivity and water yield. We estimated EC of four pine stands differing in age and growing on sandy soils. The stands consisted of two wide-ranging conifer species: Pinus taeda and Pinus sylvestris, in temperate and boreal zones, respectively. Combining results from these and published studies on all soil types, we derived an approach to estimate daily EC of pine forests, representing a wide range of conditions from 35° S to 64° N latitude. During the growing season and under moist soils, maximum daily*

EC (ECm) at day-length normalized vapor pressure deficit of 1 kPa (ECm-ref) increased by 0.55 ± 0.02 (mean ± SE) mm/d for each unit increase of leaf area index (L) up to L = ~5, showing no sign of saturation within this range of quickly rising mutual shading. The initial rise of ECm with atmospheric demand was linearly related to ECm-ref. Both relations were unaffected by soil type. Consistent with theoretical prediction, daily EC was sensitive to decreasing soil moisture at an earlier point of relative extractable water in loamy than sandy soils. Our finding facilitates the estimation of daily EC of wide-ranging pine forests using remotely sensed L and meteorological data. We advocate an assembly of worldwide sap flux database for further evaluation of this approach.

Tor-ngern, P., Oren, R., Palmroth, S., Novick, K., Oishi, A., Linder, S., . . . Näsholm, T. (2018). Water balance of pine forests: Synthesis of new and published results. *Agricultural and Forest Meteorology, 259*, 107-117. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046714400&doi=10.1016%2fj.agrformet.2018.04.021&partnerID=40&md5=96fcaf5156ed422fad519357feaf1ed6. doi:10.1016/j.agrformet.2018.04.021
Research Tags: Forestry, Water
Abstract: *The forest hydrologic cycle is expected to have important feedback responses to climate change, impacting processes ranging from local water supply and primary productivity to global water and energy cycles. Here, we analyzed water budgets of pine forests worldwide. We first estimated local water balance of forests dominated by two wide-ranging species: Pinus taeda (36 °N) and Pinus sylvestris (64 °N). In these stands, growing season evapotranspiration (ET) was largely insensitive to inter-annual variation of precipitation (P), consistent with the insensitivity of canopy transpiration to P. Extending the analyses to include published data from 117 studies on 27 pine species, we found that pine forests annually use ~66% ± 17% (SD) of P as ET, regardless of climatic regime, leaving a third of P as runoff to downstream aquatic ecosystems and users. However, during the growing season, pine forests used more water as ET than P in regions where P ≤ 326 ± 39 (SE) mm. Forests in regions of low growing season P exist in their current state only where the rooting depth is sufficient to supply trees with water from soil storage in addition to P, and these forests are likely to support only ephemeral streams that dry down during the growing season. Thus, globally, water use by pine forests is adapted to mean annual P, but shows a limited capacity to respond to inter-annual variability in P. Forests with a small buffer of growing season water availability (P + soil water storage - ET), are likely to be most sensitive to variation in P regimes, changing canopy leaf area, tree density, and species composition depending on the degree, direction and persistence of the change in P.*

Trabue, S. L., Kerr, B. J., & Scoggin, K. D. (2019). Swine diets impact manure characteristics and gas emissions: Part I sulfur level. *Science of the Total Environment, 687*, 800-807. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067316033&doi=10.1016%2fj.scitotenv.2019.06.130&partnerID=40&md5=04348f4918f962d93a09f2da965eea3b. doi:10.1016/j.scitotenv.2019.06.130
Research Tags: Livestock, Emissions
Abstract: *Sulfur is an essential nutrient for animal growth but is also associated with odor and morbidity of animals from swine operations. A study was conducted to determine the effects of increasing dietary S levels in swine diets on DM, pH, C, N, S, VFA, indole, and phenol concentrations in the manure, and on the emissions of C-, N-, and S-containing gases. A total of 24 gilts averaging 152 kg BW were fed diets containing 0.19, 0.30, 0.43, or 0.64% dietary S, as supplied by CaSO4, for 31 d, with an ADFI of 3.034 kg d−1. Feces and urine were collected after each feeding and added to manure storage containers. At the end of the study, manure slurries were monitored for gas emissions and chemical properties. Increasing dietary S lowered manure pH by 0.3 units and increased DM, N, and S by 10% for each 1.0 g S increase kg−1 feed intake. Increased dietary S increased NH3, sulfide, butanoic, and pentanoic acid concentrations in manure. Carbon and N emissions were not significantly impacted by dietary S, but S emissions in the form of hydrogen sulfide (H2S) increased by 8% for each 1.0 g S increase kg−1 feed intake. Odor increased by 2% for each 1.0 g increase of S consumed kg−1 feed intake. Phenolic compounds and H2S were the major odorants emitted from manure that increased with increasing dietary S.*

Tracy, B. F., Foster, J. L., Butler, T. J., Islam, M. A., Toledo, D., & Vendramini, J. M. B. (2018). Resilience in forage and grazinglands. *Crop Science, 58*(1), 31-42. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040708459&doi=10.2135%2fcropsci2017.05.0317&partnerID=40&md5=638d1eb21e743fcd6c8b86c76f6e2f17. doi:10.2135/cropsci2017.05.0317
Research Tags: Grassland
Abstract: *The current reality of population growth, resource scarcity, and climate change requires resilient agroecosystems to sustain food production and protect the environment. This manuscript reflects a combined effort of speakers at the 2017 C6 Forage and Grazinglands Division Symposium, which was titled "Resiliency in Forage and Grazinglands." The symposium brought together speakers representing a diverse cross-section of forage systems across the United States. Each speaker discussed resilience-related topics from their specific region, including: the importance of diversity and use of complementary forages in grazing systems, how grazing and defoliation affect resilience, the importance of soil fertility and pest management, and development of decision aids to evaluate resilience in grazinglands. Several themes emerged that we propose would help improve the resilience of forage and grazingland systems: (i) identifying moderately diverse, site-specific mixtures (grasses–legumes) for use in specific regions of the United States, (ii) greater use of complementary forage species such as C3 and C4 grasses to lengthen the grazing season and provide a buffer against weather variation, (iii) adoption of moderate defoliation intensities to help stabilize forage production and species composition, (iv) more attention to maintaining and improving soil fertility to improve the productivity of desirable forage species and reduce weed pressure, and (v) increase adoption of assessment tools to evaluate the relative "health" and potential resilience of forage-livestock systems. An integrative management approach that combines many of these elements would help improve the resilience of forage and grazinglands to sustain high productivity under increasingly erratic and extreme weather.*

Trammell, T. L. E., Pouyat, R. V., Carreiro, M. M., & Yesilonis, I. (2017). Drivers of soil and tree carbon dynamics in urban residential lawns: A modeling approach. *Ecological Applications, 27*(3), 991-1000. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017190050&doi=10.1002%2feap.1502&partnerID=40&md5=ee4af57ec888ca927378e931a18fb18b. doi:10.1002/eap.1502
Research Tags: Grassland, Soil
Abstract: *Soils constitute the largest sink of terrestrial carbon (C), and urban soils have the potential to provide significant soil C storage. Soils in urbanized landscapes experience a multitude of human alterations, such as compaction and management subsidies, that impact soil C dynamics. While field studies may provide data on urban soil C storage, modeling soil C dynamics under various human impact scenarios will provide a basis for identifying drivers of urban soil C dynamics and for predicting the potential for these highly altered soils to store C over time intervals not typically amenable to empirical validation. The goal of this study was to model soil C dynamics in residential lawns using CENTURY, a dynamic mechanistic model, to determine whether drivers of soil C dynamics in natural systems (e.g., soil texture) were equally useful for estimating soil C content of highly modified soils in urban residential areas. Without incorporating human impacts, we found no relationship between initial CENTURY model simulations and observed soil C ($P > 0.05$). Factors that best explained soil C accumulation for the observed soil C (bulk density, $r2 = 0.30$; home age, $r2 = 0.37$; $P < 0.01$) differed from those found important for the CENTURY model simulations (percent sand, $r2 = 0.72$, $P < 0.001$). Therefore, we conducted a modeling exercise to test whether simulating potential construction disturbance and lawn management practices would improve modeled soil and tree C. We found that incorporating these factors did improve CENTURY's ability to model soil and tree C ($P < 0.001$). The results from this analysis suggest that incorporating various human disturbances and management practices that occur in urban landscapes into CENTURY model runs will improve its ability to predict urban soil C dynamics, at least within a 100-yr time frame. Thus, enhancing our ability to provide recommendations for management and development practices that result in increasing urban soil C storage.*

Tran, Y. L., Siry, J. P., Bowker, J. M., & Poudyal, N. C. (2018). The role of the U.S. mayors and urban forests in addressing climate change mitigation and adaptation. *Mathematical and Computational Forestry and Natural-Resource Sciences, 10*(2), 33-45. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056820195&partnerID=40&md5=ca75013bcb624fa2e9a66664b723766b.
Research Tags: Forestry
Abstract: *Leadership at cities and municipalities can be instrumental in beginning local conversation regarding*

climate change and urban forest policies. Much research has been devoted to national climate change actions, but little is currently known about initiatives and actions at the local level. This study presents results of a survey of U.S. Conference of Mayors Climate Protection Agreement (MCPA) members, representing 1,054 cities and 93.6 million people, conducted to improve the understanding of how mayors view urban forest policies related to climate change. The goals of the study were to examine local government initiatives for climate change and urban forests and how mayors prioritize these investments. The results indicated that a variety of local climate change mitigation and adaptation actions were being pursued by member MCPA cities. This is important as the international climate change regime rarely acknowledges the role of cities tackling climate change, though they are vulnerable settlements and at the same time important emitters. Since MCPA represents the most heavily populated states as well as the majority of the state capitals in the United States, policymakers should seriously consider integrating the roles of these local institutions in the national climate change policy process, and emphasize adaptation and urban forests' role in these efforts.

Tranmer, A. W., Marti, C. L., Tonina, D., Benjankar, R., Weigel, D., Vilhena, L., . . . Imberger, J. (2018). A hierarchical modelling framework for assessing physical and biochemical characteristics of a regulated river. *Ecological Modelling, 368*, 78-93. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034819260&doi=10.1016%2fj.ecolmodel.2017.11.010&partnerID=40&md5=1062f0c2b73116f4909b3d1b9b3cb177. doi:10.1016/j.ecolmodel.2017.11.010
Research Tags: Water
Abstract: *Regulated rivers below dams have traditionally been managed using a minimum instream flow to provide adequate aquatic habitat. However, dam management, in conjunction with changes in climate and land use, challenges downstream ecosystem functions that cannot be properly addressed by a simple minimum flow requirement. Depending upon the river system, additional parameters such as water temperature and nutrient loading provide more critical ecological value for organisms than ensuring a constant minimum release. A new modelling methodology, utilizing a cascading hierarchical approach, is proposed and tested on a 614 km2 headwater basin in central Idaho, USA. Application of the methodology illustrates that below large dams the river discharge becomes independent of the seasonal hydrology and specifying the discharge alone is insufficient for evaluating ecosystem response. Upstream reservoirs interrupt the watershed continuum and internally modify the thermal, chemical, and biological properties of water prior to release into a downstream river. These water properties depend on the annual hydrologic regime, characteristics of the reservoir and the offtake strategies, offtake structure depth, dam discharge, and the water column thermal stratification. This study describes the use of climatically driven hydrologic forcing and variable dam operations in a coupled reservoir-river system to optimize river ecosystem health by linking physical processes with in situ observations and incorporating multi-trophic species requirements. Such an approach can support real-time decision making on existing reservoir-river systems and provide a virtual means of evaluating ecosystem impacts prior to disturbance from new dam construction or implementation of restoration activities in a watershed.*

Tredennick, A. T., Kleinhesselink, A. R., Bret Taylor, J., & Adler, P. B. (2018). Ecosystem functional response across precipitation extremes in a sagebrush steppe. *PeerJ, 2018*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043517879&doi=10.7717%2fpeerj.4485&partnerID=40&md5=cf626fd47372e0c8337c30749d0581f5. doi:10.7717/peerj.4485
Research Tags: Weather, Grassland
Abstract: *Background*
Precipitation is predicted to become more variable in the western United States, meaning years of above and below average precipitation will become more common. Periods of extreme precipitation are major drivers of interannual variability in ecosystem functioning in water limited communities, but how ecosystems respond to these extremes over the long-term may shift with precipitation means and variances. Long-term changes in ecosystem functional response could reflect compensatory changes in species composition or species reaching physiological thresholds at extreme precipitation levels.
Methods
We conducted a five year precipitation manipulation experiment in a sagebrush steppe ecosystem in Idaho, United States. We used drought and irrigation treatments (approximately 50% decrease/increase) to investigate whether ecosystem functional response remains consistent under sustained high or low precipitation. We

recorded data on aboveground net primary productivity (ANPP), species abundance, and soil moisture. We fit a generalized linear mixed effects model to determine if the relationship between ANPP and soil moisture differed among treatments. We used nonmetric multidimensional scaling to quantify community composition over the five years.
Results
Ecosystem functional response, defined as the relationship between soil moisture and ANPP, was similar among irrigation and control treatments, but the drought treatment had a greater slope than the control treatment. However, all estimates for the effect of soil moisture on ANPP overlapped zero, indicating the relationship is weak and uncertain regardless of treatment. There was also large spatial variation in ANPP within-years, which contributes to the uncertainty of the soil moisture effect. Plant community composition was remarkably stable over the course of the experiment and did not differ among treatments.
Discussion
Despite some evidence that ecosystem functional response became more sensitive under sustained drought conditions, the response of ANPP to soil moisture was consistently weak and community composition was stable. The similarity of ecosystem functional responses across treatments was not related to compensatory shifts at the plant community level, but instead may reflect the insensitivity of the dominant species to soil moisture. These species may be successful precisely because they have evolved life history strategies that buffer them against precipitation variability.

Truettner, C., Anderegg, W. R. L., Biondi, F., Koch, G. W., Ogle, K., Schwalm, C., . . . Ziaco, E. (2018). Conifer radial growth response to recent seasonal warming and drought from the southwestern USA. *Forest Ecology and Management, 418*, 55-62. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041896552&doi=10.1016%2fj.foreco.2018.01.044&partnerID=40&md5=134da001fa73d0b2a2cd722fe3cea979. doi:10.1016/j.foreco.2018.01.044
Research Tags: Forestry, Weather
Abstract: *Future droughts are expected to become more severe and frequent under future climate change scenarios, likely causing widespread tree mortality in the western USA. Coping with an uncertain future requires an understanding of long-term ecosystem responses in areas where prolonged drought is projected to increase. Tree-ring records are ideally suited for this task. We developed 24 tree-ring chronologies from 20 U.S. Forest Service Forest Inventory and Analysis (FIA) plots in the southwestern USA. Climate variables were derived from the PRISM climate dataset (800-m grid cells) to capture the bimodal precipitation regime of winter snow and summer monsoonal rainfall, as well as warm-season vapor-pressure deficit (VPD) and winter minimum temperature. Based on mixed linear models, radial growth from 1948 to 2013 for four conifer species (Pinus edulis, Juniperus osteosperma, Pinus ponderosa, and Picea engelmannii) responded negatively to warm-season VPD and positively to cold-season precipitation. Pinus spp. benefited from warm-season precipitation linked to the North American monsoon, and Pinus spp. and J. osteosperma radial growth increased with warmer cold-season minimum temperature. However, warmer cold-season minimum temperatures countered the beneficial influence of cold-season precipitation for radial growth in Pinus spp. and J. osteosperma, while P. engelmannii was unaffected. Also, enhanced drying effects of warm-season VPD associated with decreased cold-season precipitation negatively affected radial growth of Pinus spp. and P. engelmannii. Of the four conifer species studied, Pinus spp. are most affected by droughts since 1948, while P. engelmannii and J. osteosperma appear to be more resilient. Investigating seasonal climate responses and interaction effects on radial growth in areas impacted by severe drought helps identify species that may be particularly at risk from climate change impacts in the Anthropocene.*

Turner, S. B., Turner, D. P., Gray, A. N., & Fellers, W. (2019). An approach to estimating forest biomass change over a coniferous forest landscape based on tree-level analysis from repeated lidar surveys. *International Journal of Remote Sensing, 40*(7), 2558-2575. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055107210&doi=10.1080%2f01431161.2018.1528401&partnerID=40&md5=2f04d3ee82585198aaae65c1903ea9b6. doi:10.1080/01431161.2018.1528401
Research Tags: Forestry, Research
Abstract: *Forests represent a significant opportunity for carbon sequestration, but quantifying biomass change at the landscape scale and larger remains a challenge. Here we develop an approach based on repeated*

tree-level analysis using high-resolution airborne lidar (around 8 pulses/m2). The study area was 53 km2 of actively managed coniferous forestland in the Coast Range Mountains in western Oregon. The study interval was 2006–2012. Tree heights and crown areas were determined from the lidar data using point cloud clustering. Biomass per tree was estimated with allometry. Tree-level data (N = 14,709) from local USDA Forest Service Forest Inventory and Analysis plots provided the basis for the allometry. Estimated biomass change over the 6-year interval averaged −1.3 kg m−2 year−1, with the average gain in undisturbed areas of 1.0 kg m−2 year−1. Full harvest occurred on 3% of the area per year. For surviving trees, the mean change in height was 0.5 m year−1 (SD = 0.3) and the mean change in biomass was 45.3 kg year−1 (SD = 6.7). The maximum bin-average increase in biomass per tree (57.3 kg year−1) was observed in trees of intermediate height (35–40 m). In addition to high spatially resolved tracking of forest biomass change, potential applications of repeated tree-level surveys include analysis of mortality. In this relatively productive forest landscape, an interval of 6 years between lidar acquisitions was adequate to resolve significant changes in tree height and area-wide biomass.

Turschwell, M. P., Balcombe, S. R., Steel, E. A., Sheldon, F., & Peterson, E. E. (2017). Thermal habitat restricts patterns of occurrence in multiple life-stages of a headwater fish. *Freshwater Science, 36*(2), 402-414. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020134319&doi=10.1086%2f691553&partnerID=40&md5=e5813f98b54ed6d43c91a7d43a1e152a. doi:10.1086/691553

Research Tags: Wildlife

Abstract: *Our lack of knowledge on the spatiotemporal drivers of the distribution of many freshwater fishes, particularly as they differ among life-history stages, is a challenge to conservation of these species. We used 2-stage hurdle models to investigate drivers of occurrence and abundance of locally threatened adult and juvenile Northern River Blackfish in the upper Condamine River, Queensland, Australia. Different processes drive occurrence and abundance between the 2 life-history stages. Both adult and juvenile occurrences were negatively associated with high-magnitude, extended warming events, suggesting Northern River Blackfish are thermally restricted to cooler headwaters. Juveniles had greater sensitivity than adults to high stream temperatures. In contrast, drivers of abundance differed between life-history stages. Adult fish were negatively associated with increased fine-sediment loads, whereas juveniles were negatively associated with a hydrologically active inverse-distance-weighted grazing metric that accounted for the greater influence of grazed land close to the stream or in areas of high overland flow. Teasing apart environmental drivers affecting multiple life-history stages of a locally threatened headwater species enabled us to provide direct management recommendations for conserving this species and ecologically similar headwater fishes and their associated habitats.*

Underwood, E. C., Hollander, A. D., Flint, L. E., Flint, A. L., & Safford, H. D. (2018). Climate change impacts on hydrological services in southern California. *Environmental Research Letters, 13*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060142117&doi=10.1088%2f1748-9326%2faaeb59&partnerID=40&md5=737745dba5b671d4779cfde605451e13. doi:10.1088/1748-9326/aaeb59

Research Tags: Water

Abstract: *Water availability is one of the most critical issues facing southern California. Consequently, the role and management of intact watersheds on public lands that supply water are paramount. We undertake the first regional study of climate impacts on hydrological services (runoff, recharge, and climatic water deficit) across the four national forests of southern California—the Angeles, Los Padres, Cleveland and San Bernardino. We assess the exposure, sensitivity, and vulnerability of water resources by comparing current conditions (1981–2010) to mid-century (2040–2069) and end-of-century (2070–2099) using three general circulation models (GCMs) under RCP8.5. Half of the study area is projected to exceed 2015's drought conditions in 10%–30% of the years between now and end-of-century under the moderate GCM (CCSM4), and one-third of the area is projected to exceed 2015 in 50% of the years under the hotter, drier projection (MIROC-ESM). Under a moderate projection, mean runoff increased by 1.2× by the end-of-century for three of the national forests, while mean recharge decreased by 0.9× across all forests. Projected end-of-century climatic water deficit increased on average 1.1× across the four forests. We assessed the vulnerability of watersheds by comparing the projected mean change between current and future climates with the current inter-annual variability using three categories of vulnerability. Under the moderate projection, one-third of the 385 watersheds were* *moderately vulnerable to changes in runoff and recharge (+/−0.2 to +/−1× the standard deviation of current inter-annual variability) and ~12 watersheds were highly vulnerable, suggesting an era of new hydrological conditions by the end-of-century. Half of the Forest Service's priority management watersheds had moderate or high vulnerability for runoff and recharge. Spatial data on hydrological services and their vulnerability can directly assist in climate-smart planning, allowing tradeoffs to be assessed between proposed management actions and their effect on hydrological services.*

Upperman, C. R., Parker, J. D., Akinbami, L. J., Jiang, C., He, X., Murtugudde, R., . . . Sapkota, A. (2017). Exposure to Extreme Heat Events Is Associated with Increased Hay Fever Prevalence among Nationally Representative Sample of US Adults: 1997-2013. *Journal of Allergy and Clinical Immunology: In Practice, 5*(2), 435-441.e432. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006255907&doi=10.1016%2fj.jaip.2016.09.016&partnerID=40&md5=5151dc0446c2a0652ca4fd170f19468b. doi:10.1016/j.jaip.2016.09.016

Research Tags: Weather

Abstract: *Background*

Warmer temperature can alter seasonality of pollen as well as pollen concentration, and may impact allergic diseases such as hay fever. Recent studies suggest that extreme heat events will likely increase in frequency, intensity, and duration in coming decades in response to changing climate.

Objective

The overall objective of this study was to investigate if extreme heat events are associated with hay fever.

Methods

We linked National Health Interview Survey (NHIS) data from 1997 to 2013 (n = 505,386 respondents) with extreme heat event data, defined as days when daily maximum temperature (TMAX) exceeded the 95th percentile values of TMAX for a 30-year reference period (1960-1989). We used logistic regression to investigate the associations between exposure to annual and seasonal extreme heat events and adult hay fever prevalence among the NHIS respondents.

Results

During 1997-2013, hay fever prevalence among adults 18 years and older was 8.43%. Age, race/ethnicity, poverty status, education, and sex were significantly associated with hay fever status. We observed that adults in the highest quartile of exposure to extreme heat events had a 7% increased odds of hay fever compared with those in the lowest quartile of exposure (odds ratios: 1.07, 95% confidence interval: 1.02-1.11). This relationship was more pronounced for extreme heat events that occurred during spring season, with evidence of an exposure-response relationship (Ptrend < .01).

Conclusions

Our data suggest that exposure to extreme heat events is associated with increased prevalence of hay fever among US adults.

Vadeboncoeur, M. A., Green, M. B., Asbjornsen, H., Campbell, J. L., Adams, M. B., Boyer, E. W., . . . Shanley, J. B. (2018). Systematic variation in evapotranspiration trends and drivers across the Northeastern United States. *Hydrological Processes, 32*(23), 3547-3560. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053756907&doi=10.1002%2fhyp.13278&partnerID=40&md5=73247511153f1bc7a9f40927cf4af864. doi:10.1002/hyp.13278

Research Tags: Weather

Abstract: *The direction and magnitude of responses of evapotranspiration (ET) to climate change are important to understand, as ET represents a major water and energy flux from terrestrial ecosystems, with consequences that feed back to the climate system. We inferred multidecadal trends in water balance in 11 river basins (1940–2012) and eight smaller watersheds (with records ranging from 18 to 61 years in length) in the Northeastern United States. Trends in river basin actual ET (AET) varied across the region, with an apparent latitudinal pattern: AET increased in the cooler northern part of the region (Maine) but decreased in some warmer regions to the southwest (Pennsylvania–Ohio). Of the four small watersheds with records longer than 45 years, two fit this geographic pattern in AET trends. The differential effects of the warming climate on AET across the region may indicate different mechanisms of change in more- vs. less-energy-limited watersheds, even though annual precipitation greatly exceeds potential ET across the entire region. Correlations between*

AET and time series of temperature and precipitation also indicate differences in limiting factors for AET across the Northeastern U.S. climate gradient. At many sites across the climate gradient, water-year AET correlated with summer precipitation, implying that water limitation is at least transiently important in some years, whereas correlations with temperature indices were more prominent in northern than southern sites within the region.

Valdes-Abellan, J., Pachepsky, Y., & Martinez, G. (2018). Obtaining soil hydraulic parameters from soil water content data assimilation under different climatic/soil conditions. *Catena, 163*, 311-320. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039809215&doi=10.1016%2fj.catena.2017.12.022&partnerID=40&md5=ac2e345b583fe9ef7f0ae47fe3b722a8. doi:10.1016/j.catena.2017.12.022

Research Tags: Soil, Water

Abstract: *Obtaining reliable soil hydraulic properties is essential for correct simulations of soil water content (SWC), which is a key variable in countless applications such as agricultural management, soil remediation, aquifer protection, etc. Soil hydraulic properties can be measured in the laboratory; however, the procedures are laborious and costly, and may provide estimates different from those observed in the field. An alternative approach is to obtain soil hydraulic properties using a soil water flow model in conjunction with SWC monitoring data. The goal of the present study was to analyze the efficiency of obtaining hydraulic properties utilizing data assimilation (DA) based on the Ensemble Kalman Filter method. Two soil textures in homogeneous soil profiles, and four climatic conditions were considered; observations of soil moisture data were synthetically generated using HYDRUS-1D and subsequently perturbed by the application of the conditional multivariate normal distribution. When observed SWC varied in relatively narrow range as a consequence of the forcing imposed by dry climate atmospheric boundary conditions, data assimilation provided sets of properties that led to good Richards model performance, with the RMSE below 0.02 and/or R2 above 0.8 after a period of just 100 days and above 0.98 after a period of three years in all climate/soil conditions. However, the closeness of parameters from DA to the parameters used to generate the synthetic data depended on weather conditions and soil properties. One year was adequate to obtain reliable soil hydraulic properties with data assimilation.*

Van Beusekom, A. E., Gould, W. A., Monmany, A. C., Khalyani, A. H., Quiñones, M., Fain, S. J., . . . González, G. (2018). Fire weather and likelihood: characterizing climate space for fire occurrence and extent in Puerto Rico. *Climatic Change, 146*(1-2), 117-131. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027685024&doi=10.1007%2fs10584-017-2045-6&partnerID=40&md5=3b9d2f6abfaa477429a69f9278b16df5. doi:10.1007/s10584-017-2045-6

Research Tags: Research, Weather

Abstract: *Assessing the relationships between weather patterns and the likelihood of fire occurrence in the Caribbean has not been as central to climate change research as in temperate regions, due in part to the smaller extent of individual fires. However, the cumulative effect of small frequent fires can shape large landscapes, and fire-prone ecosystems are abundant in the tropics. Climate change has the potential to greatly expand fire-prone areas to moist and wet tropical forests and grasslands that have been traditionally less fire-prone, and to extend and create more temporal variability in fire seasons. We built a machine learning random forest classifier to analyze the relationship between climatic, socio-economic, and fire history data with fire occurrence and extent for the years 2003–2011 in Puerto Rico, nearly 35,000 fires. Using classifiers based on climate measurements alone, we found that the climate space is a reliable associate, if not a predictor, of fire occurrence and extent in this environment. We found a strong relationship between occurrence and a change from average weather conditions, and between extent and severity of weather conditions. The probability that the random forest classifiers will rank a positive example higher than a negative example is 0.8–0.89 in the classifiers for deciding if a fire occurs, and 0.64–0.69 in the classifiers for deciding if the fire is greater than 5 ha. Future climate projections of extreme seasons indicate increased potential for fire occurrence with larger extents.*

Van Beusekom, A. E., & Viger, R. J. (2018). A Physically Based Daily Simulation of the Glacier-Dominated Hydrology of the Copper River Basin, Alaska. *Water Resources Research, 54*(7), 4983-5000. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051223056&doi=10.1029%2f2018WR022625&part

nerID=40&md5=73cdbdeecfbf7bfa282bf183eeed9c2b. doi:10.1029/2018WR022625
Research Tags: Water
Abstract: *The large, highly glacierized Copper River basin is an important water resource for the south-central region of Alaska. Thus, information is needed on the reaction of its hydrologic timing and streamflow volumes to historical changes in climate, in order to assess the possible impact of future changes. However, the basin is remote, and therefore, it has proved difficult to collect field data in a frequent temporal and spatial manner. An extension of the distributed-parameter, physical-process code Precipitation Runoff Modeling System, PRMSglacier, has been specifically developed to simulate daily hydrology without requiring extensive input data. In this study, PRMSglacier was used to characterize the hydrology of the Copper River basin from 1959 to 2015. The basin was split into subbasins for specific regional climatic calibrations and finer resolution characterization. The model was calibrated and performed well against data of glacier mass balance, glacier area change, snow cover, gaged streamflow, evapotranspiration, and solar radiation. Ice melt contributed 26% of the total basin streamflow, with differences temporally from climate oscillations. Furthermore, differences were seen geographically in subbasins depending on the state of the glaciers in each subbasin. Decreasing trends in ice melt volume were mostly seen on smaller steeper glaciers responding to a critical level of glacier recession, while increasing trends in ice melt volume were mostly seen on larger valley glaciers responding to increasing temperature. The areas with substantially decreasing ice melt had decreasing streamflow, possibly indicating health concerns for the ecosystems therein.*

Van Beusekom, E. A., González, G., & Scholl, A. M. (2017). Analyzing cloud base at local and regional scales to understand tropical montane cloud forest vulnerability to climate change. *Atmospheric Chemistry and Physics, 17*(11), 7245-7259. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020897714&doi=10.5194%2facp-17-7245-2017&partnerID=40&md5=662f302c3e2594bdba8f9b60cdb70884. doi:10.5194/acp-17-7245-2017
Research Tags: Weather, Forestry
Abstract: *The degree to which cloud immersion provides water in addition to rainfall, suppresses transpiration, and sustains tropical montane cloud forests (TMCFs) during rainless periods is not well understood. Climate and land use changes represent a threat to these forests if cloud base altitude rises as a result of regional warming or deforestation. To establish a baseline for quantifying future changes in cloud base, we installed a ceilometer at 100 m altitude in the forest upwind of the TMCF that occupies an altitude range from ∼600 m to the peaks at 1100 m in the Luquillo Mountains of eastern Puerto Rico. Airport Automated Surface Observing System (ASOS) ceilometer data, radiosonde data, and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite data were obtained to investigate seasonal cloud base dynamics, altitude of the trade-wind inversion (TWI), and typical cloud thickness for the surrounding Caribbean region. Cloud base is rarely quantified near mountains, so these results represent a first look at seasonal and diurnal cloud base dynamics for the TMCF. From May 2013 to August 2016, cloud base was lowest during the midsummer dry season, and cloud bases were lower than the mountaintops as often in the winter dry season as in the wet seasons. The lowest cloud bases most frequently occurred at higher elevation than 600 m, from 740 to 964 m. The Luquillo forest low cloud base altitudes were higher than six other sites in the Caribbean by ∼200–600 m, highlighting the importance of site selection to measure topographic influence on cloud height. Proximity to the oceanic cloud system where shallow cumulus clouds are seasonally invariant in altitude and cover, along with local trade-wind orographic lifting and cloud formation, may explain the dry season low clouds. The results indicate that climate change threats to low-elevation TMCFs are not limited to the dry season; changes in synoptic-scale weather patterns that increase frequency of drought periods during the wet seasons (periods of higher cloud base) may also impact ecosystem health.*

van Doorn, N. S., & McPherson, E. G. (2018). Demographic trends in Claremont California's street tree population. *Urban Forestry and Urban Greening, 29*, 200-211. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038009326&doi=10.1016%2fj.ufug.2017.11.018&partnerID=40&md5=6840237b61c3ebcd1f50a9f26438bb03. doi:10.1016/j.ufug.2017.11.018
Research Tags: Forestry
Abstract: *The aim of this study was to quantify street tree population dynamics in the city of Claremont, CA. A repeated measures survey (2000 and 2014) based on a stratified random sampling approach across size classes*

and for the most abundant 21 species was analyzed to calculate removal, growth, and replacement planting rates. Demographic rates were estimated using a hierarchical Bayesian framework. The community-level (all species) median growth rate was 1.41% per year (95% CI: 1.21–1.65%) with Pinus brutia and Pistacia chinensis growing significantly faster than the community-level median. The community-level median removal rate was 1.03% per year (95% CI: 0.66–1.68%), with no significant differences between species and the community-level medium. Once removed, only 7.2% (95% CI: 4.4–12.9%) were replaced annually. Presence of overhead utility lines influenced tree removal rates while age, diameter-at-breast-height, and prior tree condition influenced tree growth. Overall live aboveground biomass in sampled sites was 713.29 Mg in 2000 and increased to 877.36 Mg by 2014. Biomass gain from growth outweighed loss from removals nearly three-fold; replacement contributed 0.5% of the total biomass gain. We conclude that to increase the resilience of the street tree population will require 1) an increase in percent of full stocking or biomass stock and 2) a shift in the species palette to favor species less vulnerable to pests and expected disturbance from climate change and 3) ongoing monitoring to detect departures from baseline demographic rates

Van Etten, M. L., & Brunet, J. (2017) Using population matrix models to reduce the spread of wild carrot. In*: Vol. 1153. Acta horticulturae* (pp. 273-278).

Research Tags: Crops

Abstract: *Wild carrot was most likely introduced to North America from Europe as a weed. It has since spread to every state in the USA and has been declared invasive. Wild carrot can easily hybridize with cultivated carrots leading to the potential transfer of genes from the crop to wild carrot. Hybridization could become an issue if the genes transferred to wild carrot conferred a selective advantage and increased its competitiveness or invasiveness. A better understanding of the demography of wild carrot would permit the identification of the life history stages that most affect its population growth. Such knowledge would facilitate the design of management practices to best control its spread. In this study, we used data collected from wild carrot populations on reproduction, germination rate, overwinter survival and flowering rate to parameterize a stage structure model for a biennial lifecycle with a non-reproductive and a reproductive stage. Carrot populations were predicted to increase in size ($\lambda > 1$), with growth rate (λ) of 1.9 when germination was low and 6.1 with high germination. Overwinter survival and flowering rate were the life history parameters that most affected population growth. Therefore, milder winter temperatures resulting from global warming could increase overwinter survival and the potential for spread of wild carrots. Effective management methods to control the spread of wild carrot and of the genes introduced into wild carrot populations should focus on lowering flowering rate and overwinter survival. For example, mowing should occur before flowering because our models predict that a single plant setting seeds could increase the population to 382 individuals within 3 years.*

van Lingen, H. J., Niu, M., Kebreab, E., Valadares Filho, S. C., Rooke, J. A., Duthie, C. A., . . . Hristov, A. N. (2019). Prediction of enteric methane production, yield and intensity of beef cattle using an intercontinental database. *Agriculture, Ecosystems and Environment, 283*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067265264&doi=10.1016%2fj.agee.2019.106575&partnerID=40&md5=ef62b0307770a7e6a5d664577f29da35. doi:10.1016/j.agee.2019.106575

Research Tags: Livestock, Emissions

Abstract: *Enteric methane (CH4) production attributable to beef cattle contributes to global greenhouse gas emissions. Reliably estimating this contribution requires extensive CH4 emission data from beef cattle under different management conditions worldwide. The objectives were to: 1) predict CH4 production (g d−1 animal−1), yield [g (kg dry matter intake; DMI)−1] and intensity [g (kg average daily gain)−1] using an intercontinental database (data from Europe, North America, Brazil, Australia and South Korea); 2) assess the impact of geographic region, and of higher- and lower-forage diets. Linear models were developed by incrementally adding covariates. A K-fold cross-validation indicated that a CH4 production equation using only DMI that was fitted to all available data had a root mean square prediction error (RMSPE; % of observed mean) of 31.2%. Subsets containing data with ≥25% and ≤18% dietary forage contents had an RMSPE of 30.8 and 34.2%, with the all-data CH4 production equation, whereas these errors decreased to 29.3 and 28.4%, respectively, when using CH4 prediction equations fitted to these subsets. The RMSPE of the ≥25% forage subset further decreased to 24.7% when using multiple regression. Europe- and North America-specific subsets predicted by the best performing ≥25% forage multiple regression equation had RMSPE of 24.5 and 20.4%,*

whereas these errors were 24.5 and 20.0% with region-specific equations, respectively. The developed equations had less RMSPE than extant equations evaluated for all data (22.5 vs. 23.2%), for higher-forage (21.2 vs. 23.1%), but not for the lower-forage subsets (28.4 vs. 27.9%). Splitting the dataset by forage content did not improve CH4 yield or intensity predictions. Predicting beef cattle CH4 production using energy conversion factors, as applied by the Intergovernmental Panel on Climate Change, indicated that adequate forage content-based and region-specific energy conversion factors improve prediction accuracy and are preferred in national or global inventories.

van Oppen, M. J. H., Gates, R. D., Blackall, L. L., Cantin, N., Chakravarti, L. J., Chan, W. Y., . . . Putnam, H. M. (2017). Shifting paradigms in restoration of the world's coral reefs. *Global Change Biology, 23*(9), 3437-3448. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014009497&doi=10.1111%2fgcb.13647&partnerID=40&md5=21fb5bf7814c5e88c2cf6e12206531ed. doi:10.1111/gcb.13647

Research Tags: Water

Abstract: *Many ecosystems around the world are rapidly deteriorating due to both local and global pressures, and perhaps none so precipitously as coral reefs. Management of coral reefs through maintenance (e.g., marine-protected areas, catchment management to improve water quality), restoration, as well as global and national governmental agreements to reduce greenhouse gas emissions (e.g., the 2015 Paris Agreement) is critical for the persistence of coral reefs. Despite these initiatives, the health and abundance of corals reefs are rapidly declining and other solutions will soon be required. We have recently discussed options for using assisted evolution (i.e., selective breeding, assisted gene flow, conditioning or epigenetic programming, and the manipulation of the coral microbiome) as a means to enhance environmental stress tolerance of corals and the success of coral reef restoration efforts. The 2014–2016 global coral bleaching event has sharpened the focus on such interventionist approaches. We highlight the necessity for consideration of alternative (e.g., hybrid) ecosystem states, discuss traits of resilient corals and coral reef ecosystems, and propose a decision tree for incorporating assisted evolution into restoration initiatives to enhance climate resilience of coral reefs.*

Vangestel, C., Eckert, A. J., Wegrzyn, J. L., St. Clair, J. B., & Neale, D. B. (2018). Linking phenotype, genotype and environment to unravel genetic components underlying cold hardiness in coastal Douglas-fir (Pseudotsuga menziesii var. menziesii). *Tree Genetics and Genomes, 14*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85040443656&doi=10.1007%2fs11295-017-1225-x&partnerID=40&md5=21cf3b30a05ec88c86916621c9dd8848. doi:10.1007/s11295-017-1225-x

Research Tags: Weather, Forestry

Abstract: *Global climate change may detrimentally affect future generations of numerous forest tree species, hampering their long-term sustainability if appropriate evolutionary responses remain lacking. To face these novel threats, conservation biologists are in need of a thorough understanding and identification of adaptive variation in key fitness traits. We here provide an elaborate synthesis of pre-existing and novel analyses of an association mapping, genecological and landscape genomic study integrating genotypic, environmental and phenotypic data to gain insights into the genetic basis of cold-hardiness adaptation in coastal Douglas-fir (Pseudotsuga menziesii var. menziesii). Data were collected across part of the natural range for a total of 643 individuals. A landscape genomic approach revealed 28 putative non-neutral genes, although a variance partitioning analysis indicated only moderate power of this gene set in explaining cold-hardiness-related phenotypic variation, and suggests many important genes await discovery. Integrating these results within the entire phenotype-genotype-environment spectrum allowed us to delineate the six most promising candidate genes under selection. By combining genomic, phenotypic and environmental data, this study attempts to gain insights in the genetic basis of key adaptations, which may ultimately aid forestry managers to establish resilient ecosystems in face of future climate change.*

Vaughan, D., Auty, D., Kolb, T. E., Sánchez Meador, A. J., Mackes, K. H., Dahlen, J., & Moser, W. K. (2019). Climate has a larger effect than stand basal area on wood density in Pinus ponderosa var. scopulorum in the southwestern USA. *Annals of Forest Science, 76*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070371004&doi=10.1007%2fs13595-019-0869-0&partnerID=40&md5=92e5c02b9eef8ff24fcf559bf120b164. doi:10.1007/s13595-019-0869-0

Research Tags: Forestry
Abstract: *Key message*
Stand basal area of ponderosa pine (Pinus ponderosa var. scopulorum Engelm.) in the US Southwest has little effect on the density of the wood produced, but climatic fluctuations have a strong effect. Wood density increases during drought, particularly if the drought occurs in late winter/early spring. Future droughts, as are predicted to increase in the US Southwest, may lead to production of smaller radial increments of higher density wood in ponderosa pine.
Context
Forest restoration treatments in the US Southwest are generating large quantities of small-diameter logs. Due to negative perceptions about ponderosa pine wood quality, this material is often seen as a "waste disposal" problem rather than a high-value resource.
Aims
Our objective was to understand more about variation in southwestern US ponderosa pine wood density, an important indicator of wood quality. Specifically, we investigated the effect of stand basal area on wood density, and the effect of annual and quarterly climatic variation on wood density.
Methods
We collected samples from 54 trees grown at six different basal area levels from a replicated stand density experiment. Pith-to-bark strips were used in an X-ray densitometer to obtain annual density and growth measurements from 1919 to the present.
Results
Stand density had a strong effect on growth rate, but little effect on wood density. However, climatic variation did influence wood density, which increased in drought years before quickly returning to pre-drought levels.
Conclusion
Stand basal area is not a good indicator of wood density for foresters planning to utilize material from timber harvests in the southwestern USA. Future droughts, as are predicted to increase in the region, will likely reduce wood volume production but may increase wood density in ponderosa pine.

Vaughan, M. M., Block, A., Christensen, S. A., Allen, L. H., & Schmelz, E. A. (2018). The effects of climate change associated abiotic stresses on maize phytochemical defenses. *Phytochemistry Reviews, 17*(1), 37-49. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018350590&doi=10.1007%2fs11101-017-9508-2&partnerID=40&md5=4ce78be2fba2a7cd0a2695363089d4ec. doi:10.1007/s11101-017-9508-2
Research Tags: Crops, Weather
Abstract: *Reliable large-scale maize production is an essential component of global food security; however, sustained efforts are needed to ensure optimized resilience under diverse crop stress conditions. Climate changes are expected to increase the frequency and intensity of both abiotic and biotic stress. Protective phytochemicals play an important role in both abiotic stress resilience and resistance to biotic challenges, yet the concentration and composition of these phytochemicals are also dependent on climate variables. We review the research on the effects of climate change associated abiotic stresses on three classes of maize defense metabolites, including benzoxazinoids, volatile organic compounds, and terpenoid phytoalexins. Despite significant knowledge gaps that still exist, it is evident that climate change will influence maize phytochemicals associated with resilient productivity. While broad generalizations are not yet possible, climate induced changes in phytochemicals are context specific and dependent upon developmental stage and tissue type. Under conditions of drought, maize modulates different classes of defense phytochemicals to protect the above-and belowground tissues. Aboveground the benzoxazinoid defenses are stimulated, but belowground terpenoid phytoalexins are predominantly deployed. Changes in the allocation or distribution of the different classes of defense metabolites or signaling molecules have the potential to further shape the biodiversity and abundance of pests within the maize agroecosystem. A better understanding of the underlying genetics, biosynthetic pathways, regulation and precise biological roles of maize phytochemicals modulated by arrays of climatic conditions will be required to ensure optimal plant resilience and productivity in the face of combined biotic and abiotic stresses.*

Vaughn, S. F., Kenar, J. A., Tisserat, B., Jackson, M. A., Joshee, N., Vaidya, B. N., & Peterson, S. C. (2017). Chemical and

physical properties of Paulownia elongata biochar modified with oxidants for horticultural applications. *Industrial crops and products, 97*, 260-267. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007302063&doi=10.1016%2fj.indcrop.2016.12.017&partnerID=40&md5=aee786e9bb65a3fc36894469ccd717a3. doi:10.1016/j.indcrop.2016.12.017
Research Tags: Soil
Abstract: *Treatment of biochar with oxidants such as acids and hydrogen peroxide has been shown to alter porosity, increase adsorption of chemicals, and introduce functional groups on the biochar surfaces, all of which are desirable for their use in horticultural applications. Biochar was produced from the pyrolysis of wood from seven-year-old Paulownia elongata (PE) trees using a top-lit updraft design stove. PE biochar was subsequently treated with 30% (v/v) sulfuric acid, 30% (w/v) oxalic acid, and 10 and 30% (w/w) H2O2. After thorough rinsing with deionized water to remove residual acids and H2O2, biochars were examined for chemical and physical properties. All of the biochars had high carbon percentages, due to the high temperatures (>1000 °C) reached during pyrolysis. Surface areas, micropore surface areas, % micropore surface areas, pH values, cation exchange capacities and electrical conductivities decreased with all oxidant treatments. Analysis of surface functionality by ATR-FTIR showed limited changes resulting from the treatments. TPO/MS analysis showed that all treatments resulted in chars with higher oxidation temperatures suggesting that these are more stable toward oxidation. Unlike reports of biochar derived from different feedstocks and different pyrolysis methods, it appears that treatment of PE biochar with oxidants is unnecessary for its use in horticultural applications.*

Vega-Nieva, D. J., Briseño-Reyes, J., Nava-Miranda, M. G., Calleros-Flores, E., López-Serrano, P. M., Corral-Rivas, J. J., . . . Preisler, H. K. (2018). Developing models to predict the number of fire hotspots from an accumulated fuel dryness index by vegetation type and region in Mexico. *Forests, 9*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045121748&doi=10.3390%2ff9040190&partnerID=40&md5=866e304a2e758344422f524089ce3880. doi:10.3390/f9040190
Research Tags: Weather, Forestry
Abstract: *Understanding the linkage between accumulated fuel dryness and temporal fire occurrence risk is key for improving decision-making in forest fire management, especially under growing conditions of vegetation stress associated with climate change. This study addresses the development of models to predict the number of 10-day observed Moderate-Resolution Imaging Spectroradiometer (MODIS) active fire hotspots—expressed as a Fire Hotspot Density index (FHD)—from an Accumulated Fuel Dryness Index (AcFDI), for 17 main vegetation types and regions in Mexico, for the period 2011–2015. The AcFDI was calculated by applying vegetation-specific thresholds for fire occurrence to a satellite-based fuel dryness index (FDI), which was developed after the structure of the Fire Potential Index (FPI). Linear and non-linear models were tested for the prediction of FHD from FDI and AcFDI. Non-linear quantile regression models gave the best results for predicting FHD using AcFDI, together with auto-regression from previously observed hotspot density values. The predictions of 10-day observed FHD values were reasonably good with R2 values of 0.5 to 0.7 suggesting the potential to be used as an operational tool for predicting the expected number of fire hotspots by vegetation type and region in Mexico. The presented modeling strategy could be replicated for any fire danger index in any region, based on information from MODIS or other remote sensors.*

Vega-Nieva, D. J., Nava-Miranda, M. G., Calleros-Flores, E., López-Serrano, P. M., Briseño-Reyes, J., López-Sánchez, C., . . . Ruiz-González, A. D. (2019). Temporal patterns of active fire density and its relationship with a satellite fuel greenness index by vegetation type and region in Mexico during 2003–2014. *Fire Ecology, 15*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070405465&doi=10.1186%2fs42408-019-0042-z&partnerID=40&md5=0bd9036e8135b9eba7d2cb73b6ccbfa2. doi:10.1186/s42408-019-0042-z
Research Tags: Weather, Forestry
Abstract: *Background*
Understanding the temporal patterns of fire occurrence and their relationships with fuel dryness is key to sound fire management, especially under increasing global warming. At present, no system for prediction of fire occurrence risk based on fuel dryness conditions is available in Mexico. As part of an ongoing national-scale project, we developed an operational fire risk mapping tool based on satellite and weather information.
Results

We demonstrated how differing monthly temporal trends in a fuel greenness index, dead ratio (DR), and fire density (FDI) can be clearly differentiated by vegetation type and region for the whole country, using MODIS satellite observations for the period 2003 to 2014. We tested linear and non-linear models, including temporal autocorrelation terms, for prediction of FDI from DR for a total of 28 combinations of vegetation types and regions. In addition, we developed seasonal autoregressive integrated moving average (ARIMA) models for forecasting DR values based on the last observed values. Most ARIMA models showed values of the adjusted coefficient of determination (R2 adj) above 0.7 to 0.8, suggesting potential to forecast fuel dryness and fire occurrence risk conditions. The best fitted models explained more than 70% of the observed FDI variation in the relation between monthly DR and fire density.
Conclusion
These results suggest that there is potential for the DR index to be incorporated in future fire risk operational tools. However, some vegetation types and regions show lower correlations between DR and observed fire density, suggesting that other variables, such as distance and timing of agricultural burn, deserve attention in future studies.

Veltman, K., Jones, C. D., Gaillard, R., Cela, S., Chase, L., Duval, B. D., . . . Jolliet, O. (2017). Comparison of process-based models to quantify nutrient flows and greenhouse gas emissions associated with milk production. *Agriculture, Ecosystems and Environment, 237*, 31-44. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007206577&doi=10.1016%2fj.agee.2016.12.018&partnerID=40&md5=4ba8094dafb3eadfa654ebbf6df79960. doi:10.1016/j.agee.2016.12.018
Research Tags: Livestock, Emissions, Water
Abstract: *Assessing and improving the sustainability of dairy production systems is essential to secure future food production. This requires a holistic approach to reveal trade-offs between emissions of the different greenhouse gases (GHG) and nutrient-based pollutants and to ensure that interactions between farm components are taken into account. Process-based models are essential to support whole-farm mass balance accounting. However, since variation between process-based model results can be large, there is a need to compare and better understand the strengths and limitations of various models. Here, we use a whole-farm mass-balance approach to compare five process-based models in terms of predicted carbon (C), nitrogen (N) and phosphorus (P) flows and potential global warming impact (GWI) associated with milk production at the animal, field and farm-scale. We include two whole-farm models complemented by two field-scale models and one animal-based model. A whole-farm mass-balance framework was used to facilitate model comparison at different scales. GWIs were calculated from predicted emissions of methane (CH4) and nitrous oxide (N2O) and soil C change. Results show that predicted whole-farm GWIs were similar for the two whole farm models, ManureDNDC and IFSM, with a predicted GWI of 9.3 and 10.8 Gg CO2eq. year−1 for ManureDNDC and IFSM, respectively. Enteric CH4 emissions were the single most important source of greenhouse gas emissions contributing 47%–70% of the total farm GWI. Model predictions were comparable, that is, within a factor of 1.5, for most flows related to the animal, barn and manure management system. In contrast, predicted field emissions of N2O and ammonia (NH3) to air, N and P losses to the hydrosphere and soil C change, were highly variable across models. This indicates that there is a need to further our understanding of soil and crop N, P and C flows and that measurement data on nutrient and C flows are particularly needed for the field. In addition, there is a need to further understand how anaerobic digestion influences manure composition and subsequent emissions of N2O and NH3 after application of digestate to the field. Empirical data on manure composition before and after anaerobic digestion are essential for model evaluation.*

Veltman, K., Rotz, C. A., Chase, L., Cooper, J., Ingraham, P., Izaurralde, R. C., . . . Jolliet, O. (2018). A quantitative assessment of Beneficial Management Practices to reduce carbon and reactive nitrogen footprints and phosphorus losses on dairy farms in the US Great Lakes region. *Agricultural Systems, 166*, 10-25. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050100163&doi=10.1016%2fj.agsy.2018.07.005&partnerID=40&md5=0584be3ec128cda20bcfa3260b97e406. doi:10.1016/j.agsy.2018.07.005
Research Tags: Water, Livestock, Emissions
Abstract: *Assessing and improving the sustainability of dairy production is essential to secure future food production. Implementation of Beneficial Management Practices (BMP) can mitigate GHG emissions and*

nutrient losses and reduce the environmental impact of dairy production, but comprehensive, whole-farm studies that evaluate the efficacy of multiple BMPs to reduce multiple environmental impacts and that include an assessment of productivity and farm profitability, are scarce. We used a process-based model (IFSM) to assess the efficacy of (10+) individual BMPs to reduce the carbon (C) footprint expressed per unit of milk produced of two model dairy farms, a 1500 cow farm and a 150 cow farm, with farming practices representative for the Great Lakes region. In addition to the C footprint, we assessed the effect of BMP implementation on the reactive nitrogen (N) footprint and total phosphorus (P) losses (per unit of milk produced), as well as milk production and farm profitability. We evaluated individual farm-component specific BMPs, that is, 5 dietary manipulations, 3 (150 cow farm) or 4 (1500 cow farm) manure interventions, and 6 field interventions, as well as an integrated whole-farm mitigation strategy based on the best performing individual BMPs. Our results show that reductions in the C footprint expressed per unit of milk are greatest with individual manure management interventions (4–20% reduction) followed by dietary manipulations (0–12% reduction) for both farm types. Field management BMPs had a modest effect on reducing this footprint (0–3% reduction), but showed substantial potential to reduce the reactive N footprint (0–19% reduction) and P losses (1–47% reduction). We found that the whole-farm mitigation strategy can substantially reduce the C footprint, reactive N footprint and total P loss of both farms with predicted reductions of approximately 41%, 41% and 46% respectively, while increasing milk production and the net return per cow by approximately 11% and 27%. To contextualize IFSM predictions for the whole-farm mitigation, we compared components of IFSM predictions to those of three other process-based models (CNCPS, Manure-DNDC and EPIC). While we did observe differences in model predictions for individual flows (particularly P erosion and P leaching losses), with exception of the total P loss, the models generally predicted similar overall mitigation potentials. Overall, our analysis shows that an integrated set of BMPs can be implemented to reduce GHG emissions and nutrient losses of dairy farms in the Great Lakes region without sacrificing productivity or profit to the farmer.

Venette, R. C. (2017). Climate Analyses to Assess Risks from Invasive Forest Insects: Simple Matching to Advanced Models. *Current Forestry Reports, 3*(3), 255-268. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050394343&doi=10.1007%2fs40725-017-0061-4&partnerID=40&md5=8e4272151ca4adfc19edef88af1568b8. doi:10.1007/s40725-017-0061-4
Research Tags: Wildlife, Forestry
Abstract: *Purpose of Review*
The number of invasive alien insects that adversely affect trees and forests continues to increase as do associated ecological, economic, and sociological impacts. Prevention strategies remain the most cost-effective approach to address the issue, but risk management decisions, particularly those affecting international trade, must be supported by scientifically credible pest risk assessments. Pest risk assessments typically include an evaluation of the suitability of the climate for pest establishment within an area of concern. A number of species distribution models have been developed to support those efforts, and these models vary in complexity from simple climate matching to mechanistic models. This review discusses the rationale for species distribution models and describes some common and influential approaches.
Recent Findings
Species distribution models that use distributional records and environmental covariates are routinely applied when ecological information about a species of concern is limited, an all-too common situation for pest risk assessors. However, fundamental assumptions of the models may not always hold.
Summary
A structured literature review suggests that many common species distribution models are not regularly applied to alien insects that may threaten trees and forests. For ten high-impact alien insect species that are invading North America, MaxEnt and CLIMEX were applied more often than other modeling approaches. Some impediments to model development and publication exist. More applications of species distribution models to forest insects are needed in the peer-reviewed literature to ensure the credibility of pest risk maps for regulatory decision making, to deepen understanding of the factors that dictate species' distributions, and to better characterize uncertainties associated with these models.

Vicca, S., Stocker, B. D., Reed, S., Wieder, W. R., Bahn, M., Fay, P. A., . . . Ciais, P. (2018). Using research networks to create the comprehensive datasets needed to assess nutrient availability as a key determinant of terrestrial

carbon cycling. *Environmental Research Letters, 13*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060140999&doi=10.1088%2f1748-9326%2faaeae7&partnerID=40&md5=86372ff7606bb7f3bfb721a1a7194d8c. doi:10.1088/1748-9326/aaeae7
Research Tags: Soil, Emissions
Abstract: *A wide range of research shows that nutrient availability strongly influences terrestrial carbon (C) cycling and shapes ecosystem responses to environmental changes and hence terrestrial feedbacks to climate. Nonetheless, our understanding of nutrient controls remains far from complete and poorly quantified, at least partly due to a lack of informative, comparable, and accessible datasets at regional-to-global scales. A growing research infrastructure of multi-site networks are providing valuable data on C fluxes and stocks and are monitoring their responses to global environmental change and measuring responses to experimental treatments. These networks thus provide an opportunity for improving our understanding of C-nutrient cycle interactions and our ability to model them. However, coherent information on how nutrient cycling interacts with observed C cycle patterns is still generally lacking. Here, we argue that complementing available C-cycle measurements from monitoring and experimental sites with data characterizing nutrient availability will greatly enhance their power and will improve our capacity to forecast future trajectories of terrestrial C cycling and climate. Therefore, we propose a set of complementary measurements that are relatively easy to conduct routinely at any site or experiment and that, in combination with C cycle observations, can provide a robust characterization of the effects of nutrient availability across sites. In addition, we discuss the power of different observable variables for informing the formulation of models and constraining their predictions. Most widely available measurements of nutrient availability often do not align well with current modelling needs. This highlights the importance to foster the interaction between the empirical and modelling communities for setting future research priorities.*

Vitharana, U. W. A., Mishra, U., Jastrow, J. D., Matamala, R., & Fan, Z. (2017). Observational needs for estimating Alaskan soil carbon stocks under current and future climate. *Journal of Geophysical Research: Biogeosciences, 122*(2), 415-429. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013477439&doi=10.1002%2f2016JG003421&partnerID=40&md5=809e3d3bf402c4ce0d78b5550e1ce73a. doi:10.1002/2016JG003421
Research Tags: Soil
Abstract: *Representing land surface spatial heterogeneity when designing observation networks is a critical scientific challenge. Here we present a geospatial approach that utilizes the multivariate spatial heterogeneity of soil-forming factors—namely, climate, topography, land cover types, and surficial geology—to identify observation sites to improve soil organic carbon (SOC) stock estimates across the State of Alaska, USA. Standard deviations in existing SOC samples indicated that 657, 870, and 906 randomly distributed pedons would be required to quantify the average SOC stocks for 0–1 m, 0–2 m, and whole-profile depths, respectively, at a confidence interval of 5 kg C m−2. Using the spatial correlation range of existing SOC samples, we identified that 309, 446, and 484 new observation sites are needed to estimate current SOC stocks to 1 m, 2 m, and whole-profile depths, respectively. We also investigated whether the identified sites might change under future climate by using eight decadal (2020–2099) projections of precipitation, temperature, and length of growing season for three representative concentration pathway (RCP 4.5, 6.0, and 8.5) scenarios of the Intergovernmental Panel on Climate Change. These analyses determined that 12 to 41 additional sites (906 + 12 to 41; depending upon the emission scenarios) would be needed to capture the impact of future climate on Alaskan whole-profile SOC stocks by 2100. The identified observation sites represent spatially distributed locations across Alaska that captures the multivariate heterogeneity of soil-forming factors under current and future climatic conditions. This information is needed for designing monitoring networks and benchmarking of Earth system model results.*

Voelker, S. L., DeRose, R. J., Bekker, M. F., Sriladda, C., Leksungnoen, N., & Kjelgren, R. K. (2018). Anisohydric water use behavior links growing season evaporative demand to ring-width increment in conifers from summer-dry environments. *Trees - Structure and Function, 32*(3), 735-749. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041891758&doi=10.1007%2fs00468-018-1668-1&partnerID=40&md5=88945f3688eb7f3389321a35d9164fe3. doi:10.1007/s00468-018-1668-1
Research Tags: Water, Forestry

Abstract: *Key message*
Compared to isohydric Pinaceae, anisohydric Cupressaceae exhibited: (1) a threefold larger hydroscape area; (2) growth at lower pre-dawn water potentials that extended longer into the growing season; and (3) stronger coupling of growth to growing season atmospheric moisture demand in summer-dry environments.
Abstract
Conifers in the Pinaceae and Cupressaceae from dry environments have been shown to broadly differ in their stomatal sensitivity to soil drying that result in isohydric versus anisohydric water use behavior, respectively. Here, we first employ a series of drought experiments and field observations to confirm the degree of isohydric versus anisohydric water use behavior in species of these two families that are representative of the Interior West of the United States. We then use experimental soil drying to demonstrate how growth of anisohydric Juniperus osteosperma was more closely tied to pre-dawn water potentials than isohydric Pinus monophylla. Finally, we confirm that measured leaf gas-exchange and growth responses to drying hold real-world consequences for conifers from the Interior West. More specifically, across the past ~ 100 years of climate variation, pairwise comparisons of annual ring-width increment responses indicate that growth of Cupressaceae species (J. osteosperma and J. scopulorum) was more strongly coupled to growing season evaporative demand than co-occurring Pinaceae species (Pinus monophylla, P. edulis, P. flexilis, P. longaeva, P. ponderosa, and Pseudotsuga menziesii). Overall, these experimental and observational results suggest that an a priori distinction based on family and associated hydric water use behavior should lead to more accurate and mechanistically correct dendrochronological reconstructions of growing season evaporative demand (i.e., Cupressaceae) versus antecedent precipitation (i.e., Pinaceae) in summer-dry environments. Moreover, these differences in growth sensitivity to evaporative demand among these groups suggest that incorporating hydric water use behavior into models of forest responses to global warming can provide more accurate projections of future forest composition and functioning.

Voelker, S. L., Stambaugh, M. C., Renée Brooks, J., Meinzer, F. C., Lachenbruch, B., & Guyette, R. P. (2017). Evidence that higher [CO<inf>2</inf>] increases tree growth sensitivity to temperature: a comparison of modern and paleo oaks. *Oecologia, 183*(4), 1183-1195. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013149507&doi=10.1007%2fs00442-017-3831-6&partnerID=40&md5=8681b1b04771c3fde52c0443abcbdec5. doi:10.1007/s00442-017-3831-6
Research Tags: Forestry
Abstract: *To test tree growth sensitivity to temperature under different ambient CO2 concentrations, we determined stem radial growth rates as they relate to variation in temperature during the last deglacial period, and compare these to modern tree growth rates as they relate to spatial variation in temperature across the modern species distributional range. Paleo oaks were sampled from Northern Missouri, USA and compared to a pollen-based, high-resolution paleo temperature reconstruction from Northern Illinois, USA. Growth data were from 53 paleo bur oak log cross sections collected in Missouri. These oaks were preserved in river and stream sediments and were radiocarbon-dated to a period of rapid climate change during the last deglaciation (10.5 and 13.3 cal kyr BP). Growth data from modern bur oaks were obtained from increment core collections paired with USDA Forest Service Forest Inventory and Analysis data collected across the Great Plains, Midwest, and Upper Great Lakes regions. For modern oaks growing at an average [CO2] of 330 ppm, growth sensitivity to temperature (i.e., the slope of growth rate versus temperature) was about twice that of paleo oaks growing at an average [CO2] of 230 ppm. These data help to confirm that leaf-level predictions that photosynthesis and thus growth will be more sensitive to temperature at higher [CO2] in mature trees—suggesting that tree growth forest productivity will be increasingly sensitive to temperature under projected global warming and high-[CO2] conditions.*

Volk, G., Samarina, L., Kulyan, R., Gorshkov, V., Malyarovskaya, V., Ryndin, A., . . . Stover, E. (2018). Citrus genebank collections: international collaboration opportunities between the US and Russia. *Genetic Resources and Crop Evolution, 65*(2), 433-447. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026434235&doi=10.1007%2fs10722-017-0543-z&partnerID=40&md5=cd415f09901050e035343ac940549425. doi:10.1007/s10722-017-0543-z
Research Tags: Crops
Abstract: *Citrus germplasm is conserved in genebanks at sites around the world to provide genetic resources*

for breeding and research programs. The value of genebank collections is particularly evident as diseases and climate change threaten citrus production areas. We provide historical, inventory, and maintenance information about national citrus collections in Russia and in the United States. The Russian Research Institute of Floriculture and Subtropical Crops (RRIFSC) in Sochi, Russia maintains a collection of 132 citrus accessions representing 50 taxa. Southern Russia is one of the most northerly citrus growing areas in the world and many accessions in the RRIFSC collection were specifically selected for cold tolerance to facilitate citrus production in this region. Tree response data taken during the frequent severe winters in Sochi has provided an understanding of the relative cold tolerance of many RRIFSC accessions. Particularly noteworthy is the array of cold-tolerant lemon accessions maintained at the RRIFSC. The Aurantioideae collections at the United States Department of Agriculture (USDA), Agricultural Research Service (ARS) National Clonal Germplasm Repository for Citrus and Dates (NCGRCD) and at the University of California Citrus Variety Collection in Riverside, California, maintain 1328 accessions of citrus cultivars and wild relatives. Because of federal and state quarantine regulations, accessions at this facility are tested for graft-transmissible pathogens and undergo therapy to eliminate known pathogens. In contrast to Sochi, desert-adapted lemon and grapefruit varieties are a major interest of the California-based collection. The collection of citrus and citrus relatives is being screened for resistance and/or tolerance genes to diseases such as huanglongbing which is currently threatening the US citrus industry. Through collaborative exchange efforts, the diversity in the two genebanks could be expanded to increase availability of desirable genetic resources to breeding and research communities throughout the world.

Volta, C., Ho, D. T., Friederich, G., Engel, V. C., & Bhat, M. (2018). Influence of water management and natural variability on dissolved inorganic carbon dynamics in a mangrove-dominated estuary. *Science of the Total Environment, 635*, 479-486. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045582132&doi=10.1016%2fj.scitotenv.2018.04.088&partnerID=40&md5=e5392d5d742941b4bbba1bb7885f2783. doi:10.1016/j.scitotenv.2018.04.088

Research Tags: Water, Forestry

Abstract: *High-resolution time series measurements of temperature, salinity, pH and pCO2 were made during the period October 2014–September 2015 at the midpoint of Shark River, a 15 km tidal river that originates in the freshwater Everglades of south Florida (USA) and discharges into the Gulf of Mexico. Dissolved inorganic carbon dynamics in this system vary over time, and during this study could be classified into three distinct regimes corresponding to October 2014–February 2015 (a wet to dry season transition period), March–May 2015 (dry period) and July–September 2015 (wet period). Average net longitudinal dissolved inorganic carbon (DIC) fluxes and air-water CO2 fluxes from the Shark River estuary were determined for the three periods. Net DIC fluxes to the coast were estimated to vary between 23.2 and 25.4 × 105 mol d−1 with an average daily DIC flux of 24.3 × 105 mol d−1 during the year of study. CO2 emissions ranged between 5.5 and 7.8 × 105 mol d−1 with an average daily value of 6.4 × 105 mol d−1 during the year. The differences in estuarine carbon fluxes during the study period are attributed to differences in the relative importance of hydro-climatological drivers. Results suggest that, during months characterized by reduced rainfall, carbon fluxes are affected by water management via control structures in the upstream Everglades marshes. During months with high rainfall, when culverts are closed and rainfall events are more frequent, carbon fluxes depend more on other forcings, such as rainfall and groundwater discharge.*

Von Buttlar, J., Zscheischler, J., Rammig, A., Sippel, S., Reichstein, M., Knohl, A., . . . Mahecha, M. D. (2018). Impacts of droughts and extreme-temperature events on gross primary production and ecosystem respiration: A systematic assessment across ecosystems and climate zones. *Biogeosciences, 15*(5), 1293-1318. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042916984&doi=10.5194%2fbg-15-1293-2018&partnerID=40&md5=03c9c5cf0c6769b9fcb908ea31b8f0f5. doi:10.5194/bg-15-1293-2018

Research Tags:

Abstract: *Extreme climatic events, such as droughts and heat stress, induce anomalies in ecosystem–atmosphere CO2 fluxes, such as gross primary production (GPP) and ecosystem respiration (Reco), and, hence, can change the net ecosystem carbon balance. However, despite our increasing understanding of the underlying mechanisms, the magnitudes of the impacts of different types of extremes on GPP and Reco within and between ecosystems remain poorly predicted.*

Here we aim to identify the major factors controlling the amplitude of extreme-event impacts on GPP, Reco, and the resulting net ecosystem production (NEP). We focus on the impacts of heat and drought and their combination. We identified hydrometeorological extreme events in consistently downscaled water availability and temperature measurements over a 30-year time period. We then used FLUXNET eddy covariance flux measurements to estimate the CO2 flux anomalies during these extreme events across dominant vegetation types and climate zones.
Overall, our results indicate that short-term heat extremes increased respiration more strongly than they downregulated GPP, resulting in a moderate reduction in the ecosystem's carbon sink potential. In the absence of heat stress, droughts tended to have smaller and similarly dampening effects on both GPP and Reco and, hence, often resulted in neutral NEP responses. The combination of drought and heat typically led to a strong decrease in GPP, whereas heat and drought impacts on respiration partially offset each other. Taken together, compound heat and drought events led to the strongest C sink reduction compared to any single-factor extreme. A key insight of this paper, however, is that duration matters most: for heat stress during droughts, the magnitude of impacts systematically increased with duration, whereas under heat stress without drought, the response of Reco over time turned from an initial increase to a downregulation after about 2 weeks. This confirms earlier theories that not only the magnitude but also the duration of an extreme event determines its impact.
Our study corroborates the results of several local site-level case studies but as a novelty generalizes these findings on the global scale. Specifically, we find that the different response functions of the two antipodal land–atmosphere fluxes GPP and Reco can also result in increasing NEP during certain extreme conditions. Apparently counterintuitive findings of this kind bear great potential for scrutinizing the mechanisms implemented in state-of-the-art terrestrial biosphere models and provide a benchmark for future model development and testing.

Wagena, M. B., Collick, A. S., Ross, A. C., Najjar, R. G., Rau, B., Sommerlot, A. R., . . . Easton, Z. M. (2018). Impact of climate change and climate anomalies on hydrologic and biogeochemical processes in an agricultural catchment of the Chesapeake Bay watershed, USA. *Science of the Total Environment, 637-638*, 1443-1454. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047096785&doi=10.1016%2fj.scitotenv.2018.05.116&partnerID=40&md5=8c9f14833e1e6555753756a4c444ca8d. doi:10.1016/j.scitotenv.2018.05.116
Research Tags: Water
Abstract: *Nutrient export from agricultural landscapes is a water quality concern and the cause of mitigation activities worldwide. Climate change impacts hydrology and nutrient cycling by changing soil moisture, stoichiometric nutrient ratios, and soil temperature, potentially complicating mitigation measures. This research quantifies the impact of climate change and climate anomalies on hydrology, nutrient cycling, and greenhouse gas emissions in an agricultural catchment of the Chesapeake Bay watershed. We force a calibrated model with seven downscaled and bias-corrected regional climate models and derived climate anomalies to assess their impact on hydrology and the export of nitrate (NO3-), phosphorus (P), and sediment, and emissions of nitrous oxide (N2O) and di-nitrogen (N2). Model-average (±standard deviation) results indicate that climate change, through an increase in precipitation and temperature, will result in substantial increases in winter/spring flow (10.6 ± 12.3%), NO3- (17.3 ± 6.4%), dissolved P (32.3 ± 18.4%), total P (24.8 ± 16.9%), and sediment (25.2 ± 16.6%) export, and a slight increases in N2O (0.3 ± 4.8%) and N2 (0.2 ± 11.8%) emissions. Conversely, decreases in summer flow (−29.1 ± 24.6%) and the export of dissolved P (−15.5 ± 26.4%), total P (−16.3 ± 20.7%), sediment (−20.7 ± 18.3%), and NO3- (−29.1 ± 27.8%) are driven by greater evapotranspiration from increasing summer temperatures. Decreases in N2O (−26.9 ± 15.7%) and N2 (−36.6 ± 22.9%) are predicted in the summer and driven by drier soils. While the changes in flow are related directly to changes in precipitation and temperature, the changes in nutrient and sediment export are, to some extent, driven by changes in agricultural management that climate change induces, such as earlier spring tillage and altered nutrient application timing and by alterations to nutrient cycling in the soil.*

Wagle, P., Gowda, P. H., Moorhead, J. E., Marek, G. W., & Brauer, D. K. (2018). Net ecosystem exchange of CO<inf>2</inf> and H<inf>2</inf>O fluxes from irrigated grain sorghum and maize in the Texas High Plains. *Science of the Total Environment, 637-638*, 163-173. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046657653&doi=10.1016%2fj.scitotenv.2018.05.018&partnerID=40&md5=17be9e4a36083b57fab59648b10aac96. doi:10.1016/j.scitotenv.2018.05.018
Research Tags: Crops, Emissions
Abstract: *Net ecosystem exchange (NEE) of carbon dioxide (CO2) and water vapor (H2O) fluxes from irrigated grain sorghum (Sorghum bicolor L. Moench) and maize (Zea mays L.) fields in the Texas High Plains were quantified using the eddy covariance (EC) technique during 2014–2016 growing seasons and examined in terms of relevant controlling climatic variables. Eddy covariance measured evapotranspiration (ETEC) was also compared against lysimeter measured ET (ETLys). Daily peak (7-day averages) NEE reached approximately −12 g C m−2 for sorghum and −14.78 g C m−2 for maize. Daily peak (7-day averages) ETEC reached approximately 6.5 mm for sorghum and 7.3 mm for maize. Higher leaf area index (5.7 vs 4–4.5 m2 m−2) and grain yield (14 vs 8–9 t ha−1) of maize compared to sorghum caused larger magnitudes of NEE and ETEC in maize. Comparisons of ETEC and ETLys showed a strong agreement (R2 = 0.93–0.96), while the EC system underestimated ET by 15–24% as compared to lysimeter without any corrections or energy balance adjustments. Both NEE and ETEC were not inhibited by climatic variables during peak photosynthetic period even though diurnal peak values (~2-weeks average) of photosynthetic photon flux density (PPFD), air temperature (Ta), and vapor pressure deficit (VPD) had reached over 2000 μmol m−2 s−1, 30 °C, and 2.5 kPa, respectively, indicating well adaptation of both C4 crops in the Texas High Plains under irrigation. However, more sensitivity of NEE and H2O fluxes beyond threshold Ta and VPD for maize than for sorghum indicated higher adaptability of sorghum for the region. These findings provide baseline information on CO2 fluxes and ET for a minimally studied grain sorghum and offer a robust geographic comparison for maize outside the United States Corn Belt. However, longer-term measurements are required for assessing carbon and water dynamics of these globally important agro-ecosystems.*

Wagle, P., Gowda, P. H., & Northup, B. K. (2019). Annual dynamics of carbon dioxide fluxes over a rainfed alfalfa field in the U.S. Southern Great Plains. *Agricultural and Forest Meteorology, 265*, 208-217. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057099533&doi=10.1016%2fj.agrformet.2018.11.022&partnerID=40&md5=a1421d4fe0875cfc5802b85ca62f70f3. doi:10.1016/j.agrformet.2018.11.022
Research Tags: Emissions, Grassland
Abstract: *A thorough investigation of annual dynamics of carbon dioxide (CO2) fluxes with respect to major controlling factors and harvest management is lacking for rainfed alfalfa (Medicago sativa L.), a high quality perennial legume forage. To address this knowledge gap, this study reports two years (April 2016 - March 2018) of eddy covariance measurements of CO2 fluxes over a rainfed alfalfa field in central Oklahoma, USA. Alfalfa yields were strongly regulated by amount and timing of rainfall. As a result, cumulative dry forage yield was ~7.5 t ha−1 (four harvests) in 2016 (dry year) and ~10 t ha−1 (five harvests) in 2017 (wet year). An optimum air temperature (Ta) and vapor pressure deficit (VPD) for net ecosystem CO2 exchange (NEE) was approximately 25 °C and 2.2 kPa, respectively. The response of gross primary production (GPP) to photosynthetically active radiation (PAR) varied with growth stage of alfalfa and climatic conditions (i.e., dry or normal/wet periods). Daily (8-day averages) NEE and gross primary production (GPP) reached -8.17 and 16.69 g C m-2 d−1, respectively. Magnitudes of GPP (GPPMOD) derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) were < 50% of tower-derived GPP, most likely due to a smaller value (0.15 g C mol−1 PAR) for light use efficiency in the GPPMOD algorithm. The observed 8-day composite ecosystem light use efficiency (ELUE) was up to 0.36 g C mol−1 PAR in this study. The rainfed alfalfa field with 4–5 hay harvests per year showed large carbon uptake potential (e.g., cumulative NEE of -454 g C m-2 in 2017) at an annual scale. The GPP and ELUE showed a strong correspondence with MODIS-derived vegetation indices, indicating the potential of applying satellite remote sensing to upscale site-level observations of CO2 fluxes for alfalfa to larger spatial scales.*

Wagle, P., Gowda, P. H., & Northup, B. K. (2019). Dynamics of evapotranspiration over a non-irrigated alfalfa field in the Southern Great Plains of the United States. *Agricultural Water Management, 223*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069901075&doi=10.1016%2fj.agwat.2019.105727&partnerID=40&md5=eb4a9468a8dc10693d79cc9324ce71a2. doi:10.1016/j.agwat.2019.105727
Research Tags: Weather, Grassland
Abstract: *Accurately quantifying the dynamics of evapotranspiration (ET) is crucial for efficient water*

management and improved water use efficiency. However, details on the magnitudes and annual dynamics of ET with respect to environmental/biophysical factors and harvesting of hay in non-irrigated alfalfa (Medicago sativa L.) are lacking. Using the eddy covariance (EC) technique, daily magnitudes and seasonal/annual dynamics and budgets of ET were quantified from April 2016 to May 2018 over a non-irrigated alfalfa field in central Oklahoma, USA. The field was harvested periodically for hay, and cumulative dry forage yield was approximately 7.5 and 10 t ha−1 in 2016 (dry year) and 2017 (wet year), respectively. Daily ET reached up to 6.9 mm d−1 and 8-day average ET reached up to 5.64 mm d−1. Cumulative seasonal (April-October) ET was 652 mm (~1.3 times of precipitation) in 2016 and 734 mm (~0.8 times of precipitation) in 2017. Annual ET in 2017 was ~900 mm (~0.8 times of annual precipitation). Optimum air temperature (Ta) and vapor pressure deficit (VPD) for ET were approximately 30 °C and 3 kPa, respectively. Higher forage production was associated with a greater increase (~22%) in carbon uptake (gross primary production, GPP) than ET (~13%) in 2017 compared to 2016. Consequently, ecosystem water use efficiency (EWUE) at the seasonal scale (seasonal sums of GPP to ET) was 2.38 and 2.57 g C mm−1 ET in 2016 and 2017, respectively. Despite strong correspondence (R2 = 0.73) between EC-measured ET and Moderate Resolution Imaging Spectroradiometer (MODIS)-derived ET (ETMOD16), the standard ETMOD16 product underestimated ET by 36% compared to EC-measured ET. The MODIS-derived enhanced vegetation index (EVI) and photosynthetically active radiation (PAR) explained 83% of variations in alfalfa ET, indicating the potential of integrating remote sensing observations and climate data to extrapolate site-level alfalfa ET at larger areas.

Wagle, P., Xiao, X., Gowda, P., Basara, J., Brunsell, N., Steiner, J., & Anup, K. C. (2017). Analysis and estimation of tallgrass prairie evapotranspiration in the central United States. *Agricultural and Forest Meteorology, 232*, 35-47. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84989840472&doi=10.1016%2fj.agrformet.2016.08.005&partnerID=40&md5=230d34507b5beffdb7528f20efc57cb5. doi:10.1016/j.agrformet.2016.08.005

Research Tags: Grassland, Weather

Abstract: *Understanding the factors controlling evapotranspiration (ET) of spatially distributed tallgrass prairie is crucial to accurately upscale ET and to predict the response of tallgrass prairie ecosystems to current and future climate. The Moderate Resolution Imaging Spectroradiometer (MODIS)-derived enhanced vegetation index (EVI) and ground-based climate variables were integrated with eddy covariance tower-based ET (ETEC) at six AmeriFlux tallgrass prairie sites in the central United States to determine major climatic factors that control ET over multiple timescales and to develop a simple and robust statistical model for predicting ET. Variability in ET was nearly identical across sites over a range of timescales, and it was most strongly driven by photosynthetically active radiation (PAR) at hourly-to-weekly timescales, by vapor pressure deficit (VPD) at weekly-to-monthly timescales, and by temperature at seasonal-to-interannual timescales at all sites. Thus, the climatic drivers of ET change over multiple timescales. The EVI tracked the seasonal variation of ETEC well at both individual sites (R2 > 0.70) and across six sites (R2 = 0.76). The inclusion of PAR further improved the ET-EVI relationship (R2 = 0.86). Based on this result, we used ETEC, EVI, and PAR (MJ m−2 d−1) data from four sites (15 site-years) to develop a statistical model (ET = 0.11 PAR + 5.49 EVI − 1.43, adj. R2 = 0.86, P < 0.0001) for predicting daily ET at 8-day intervals. This predictive model was evaluated against additional two years of ETEC data from one of the four model development sites and two independent sites. The predicted ET (ETEVI+PAR) captured the seasonal patterns and magnitudes of ETEC, and correlated well with ETEC, with R2 of 0.87-0.96 and RMSE of 0.35-0.49 mm d−1, and it was significantly improved compared to the standard MODIS ET product. This study demonstrated that tallgrass prairie ET can be accurately predicted using a multiple regression model that uses EVI and PAR which can be readily derived from remote sensing data.*

Wagner, M., Wang, M., Miguez-Macho, G., Miller, J., VanLoocke, A., Bagley, J. E., . . . Georgescu, M. (2017). A realistic meteorological assessment of perennial biofuel crop deployment: a Southern Great Plains perspective. *GCB Bioenergy, 9*(6), 1024-1041. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84990831224&doi=10.1111%2fgcbb.12403&partnerID=40&md5=ce3c599e75f8a3f623dd2056dc9d0a03. doi:10.1111/gcbb.12403

Research Tags: Grassland, Energy

Abstract: *Utility of perennial bioenergy crops (e.g., switchgrass and miscanthus) offers unique opportunities to transition toward a more sustainable energy pathway due to their reduced carbon footprint, averted* *competition with food crops, and ability to grow on abandoned and degraded farmlands. Studies that have examined biogeophysical impacts of these crops noted a positive feedback between near-surface cooling and enhanced evapotranspiration (ET), but also potential unintended consequences of soil moisture and groundwater depletion. To better understand hydrometeorological effects of perennial bioenergy crop expansion, this study conducted high-resolution (2-km grid spacing) simulations with a state-of-the-art atmospheric model (Weather Research and Forecasting system) dynamically coupled to a land surface model. We applied the modeling system over the Southern Plains of the United States during a normal precipitation year (2007) and a drought year (2011). By focusing the deployment of bioenergy cropping systems on marginal and abandoned farmland areas (to reduce the potential conflict with food systems), the research presented here is the first realistic examination of hydrometeorological impacts associated with perennial bioenergy crop expansion. Our results illustrate that the deployment of perennial bioenergy crops leads to widespread cooling (1–2 °C) that is largely driven by an enhanced reflection of shortwave radiation and, secondarily, due to an enhanced ET. Bioenergy crop deployment was shown to reduce the impacts of drought through simultaneous moistening and cooling of the near-surface environment. However, simulated impacts on near-surface cooling and ET were reduced during the drought relative to a normal precipitation year, revealing differential effects based on background environmental conditions. This study serves as a key step toward the assessment of hydroclimatic sustainability associated with perennial bioenergy crop expansion under diverse hydrometeorological conditions by highlighting the driving mechanisms and processes associated with this energy pathway.*

Waldo, S., Russell, E. S., Kostyanovsky, K., Pressley, S. N., O'Keeffe, P. T., Huggins, D. R., . . . Lamb, B. K. (2019). N<inf>2</inf>O Emissions From Two Agroecosystems: High Spatial Variability and Long Pulses Observed Using Static Chambers and the Flux-Gradient Technique. *Journal of Geophysical Research: Biogeosciences*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068604508&doi=10.1029%2f2019JG005032&partnerID=40&md5=7aa8b6d77c7bd8a511c8e348a99e8074. doi:10.1029/2019JG005032
Research Tags: Emissions, Soil
Abstract: *Nitrous oxide (N2O) is a greenhouse gas and stratospheric ozone depleting substance that is emitted by soils. Agricultural soils tend to emit more N2O than natural soils due to the addition of nitrogen fertilizers. N2O emissions are not well understood on the scale of individual farms, as emissions are difficult to measure at this resolution because they are irregular over time and space. This variability is due to the dependence of N2O production and emission on soil properties, that is, moisture, nitrogen, and the microbiome. In this study we monitored N2O emissions from two agricultural fields under different tillage regimes using two complementary methods: the flux-gradient technique and automated chambers. The flux-gradient technique measures N2O emissions at the field scale, which is relevant to agronomic management. Using both techniques together improves confidence in our results, which give us information on total N2O emissions from these fields, as well as the relationships between N2O emissions and rainfall, temperature, and carbon dioxide respiration.*

Walker, A. P., Carter, K. R., Gu, L., Hanson, P. J., Malhotra, A., Norby, R. J., . . . Weston, D. J. (2017). Biophysical drivers of seasonal variability in Sphagnum gross primary production in a northern temperate bog. *Journal of Geophysical Research: Biogeosciences, 122*(5), 1078-1097. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018407537&doi=10.1002%2f2016JG003711&partnerID=40&md5=bde05071486c3fe8febe1891e5d4e71c. doi:10.1002/2016JG003711
Research Tags: Soil
Abstract: *Sphagnum mosses are the keystone species of peatland ecosystems. With rapid rates of climate change occurring in high latitudes, vast reservoirs of carbon accumulated over millennia in peatland ecosystems are potentially vulnerable to rising temperature and changing precipitation. We investigate the seasonal drivers of Sphagnum gross primary production (GPP)—the entry point of carbon into wetland ecosystems. Continuous flux measurements and flux partitioning show a seasonal cycle of Sphagnum GPP that peaked in the late summer, well after the peak in photosynthetically active radiation. Wavelet analysis showed that water table height was the key driver of weekly variation in Sphagnum GPP in the early summer and that temperature was the primary driver of GPP in the late summer and autumn. Flux partitioning and a process-based model of Sphagnum photosynthesis demonstrated the likelihood of seasonally dynamic*

maximum rates of photosynthesis and a logistic relationship between the water table and photosynthesizing tissue area when the water table was at the Sphagnum surface. The model also suggested that variability in internal resistance to CO2 transport, a function of Sphagnum water content, had minimal effect on GPP. To accurately model Sphagnum GPP, we recommend the following: (1) understanding seasonal photosynthetic trait variation and its triggers in Sphagnum; (2) characterizing the interaction of Sphagnum photosynthesizing tissue area with water table height; (3) modeling Sphagnum as a "soil" layer for consistent simulation of water dynamics; and (4) measurement of Sphagnum "canopy" properties: extinction coefficient (k), clumping (Ω), and maximum stem area index (SAI).

Walker, R. B., Coop, J. D., Parks, S. A., & Trader, L. (2018). Fire regimes approaching historic norms reduce wildfire-facilitated conversion from forest to non-forest. *Ecosphere, 9*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044399941&doi=10.1002%2fecs2.2182&partnerID=40&md5=ddfdfea1f434f4d4f18b2b0efabc46f5. doi:10.1002/ecs2.2182

Research Tags: Weather, Forestry

Abstract: *Extensive high-severity wildfires have driven major losses of ponderosa pine and mixed-conifer forests in the southwestern United States, in some settings catalyzing enduring conversions to non-forested vegetation types. Management interventions to reduce the probability of stand-replacing wildfire have included mechanical fuel treatments, prescribed fire, and wildfire managed for resource benefit. In 2011, the Las Conchas fire in northern New Mexico burned forested areas not exposed to fire for >100 yr, but also reburned numerous prescribed fire units and/or areas previously burned by wildfire. At some sites, the combination of recent prescribed fire and wildfire approximated known pre-settlement fire frequency, with two or three exposures to fire between 1977 and 2007. We analyzed gridded remotely sensed burn severity data (differenced normalized burn ratio), pre- and post-fire field vegetation samples, and pre- and post-fire measures of surface fuels to assess relationships and interactions between prescribed fire, prior wildfire, fuels, subsequent burn severity, and patterns of post-fire forest retention vs. conversion to non-forest. We found that Las Conchas burn severity was lowest, and tree survival was highest, in sites that had experienced both prescribed fire and prior wildfire. Sites that had experienced only prescribed or prior wildfire exhibited moderate burn severity and intermediate levels of forest retention. Sites lacking any recent prior fire burned at the highest severity and were overwhelmingly converted to non-forested vegetation including grassland, oak scrub, and weedy, herbaceous-dominated types. Burn severity in the Las Conchas fire was closely linked to surface woody fuel loads, which were reduced by prior wildfire and prescribed fire. Our results support the restoration of fire regimes via prescribed fire and resource benefit wildfire to promote the resiliency of forest types vulnerable to fire-mediated type conversion. The application of prescribed fire to reduce surface fuels following wildfire may reduce forest loss during subsequent fire under more extreme conditions. These findings are especially relevant given likely increases in vulnerability associated with climate change impacts to wildfire and forest dynamics.*

Wallace, C. W., Flanagan, D. C., & Engel, B. A. (2017). Quantifying the effects of conservation practice implementation on predicted runoff and chemical losses under climate change. *Agricultural Water Management, 186*, 51-65. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014418950&doi=10.1016%2fj.agwat.2017.02.014&partnerID=40&md5=bdd3f60e1b8a42d8c1cc8621b7f78f13. doi:10.1016/j.agwat.2017.02.014

Research Tags: Soil, Water, Weather

Abstract: *The Soil and Water Assessment Tool with downscaled weather data generated using the MarkSim weather file generator was used to evaluate the impact of long-term conservation practice implementation on runoff, sediment, atrazine, nitrogen (N) and phosphorus (P) losses in an agricultural watershed located in northeastern Indiana. As part of the Conservation Effects Assessment Project, evaluation of these conservation practices is required to provide insight on how their implementation is benefiting the environment. The results indicate that individual conservation practices were effective in reducing a particular pollutant load, but combined practices were more effective in reducing multiple pollutant loads simultaneously. Of the individual best management practices (BMPs) assessed, no-till was the most effective in reducing multiple pollutant loads (reduced surface runoff by an average of 25%, sediment by 46%, atrazine by 46%, total N by 9%, soluble P by 16%, and total P by 29%). When BMPs were combined, pollutant load reductions were increased significantly (at $\alpha = 0.05$) for all pollutants, both under baseline and future climate scenarios. The reductions in runoff and* *pollutant loads for each decade of future climate ranged from 15 to 25% for surface runoff, 32–68% for sediment loss, 37–60% for atrazine loss, 5–13% for soluble N loss, 12–35% for total N loss, 9–41% for soluble P loss, and 33–60% for total P loss.*

Wallace, C. W., Flanagan, D. C., & Engel, B. A. (2017). Quantifying the effects of future climate conditions on runoff, sediment, and chemical losses at different watershed sizes. *Transactions of the ASABE, 60*(3), 915-929. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85022321356&doi=10.13031%2ftrans.12094&partnerID=40&md5=645913fa052863d5a7261647e31b4c23. doi:10.13031/trans.12094

Research Tags: Water

Abstract: *Quantifying the effects of climate change on watershed hydrology and agricultural chemical losses is imperative when developing appropriate management practices for agricultural watersheds. Agricultural management practices are often assessed at the watershed scale; therefore, understanding the influence of climate change at different watershed sizes can provide insight into the effectiveness of watershed management strategies. In this study, the Soil and Water Assessment Tool (SWAT) and downscaled weather data generated using the MarkSim weather file generator were used to evaluate the potential impact of climate change in the hydrologically modified Cedar Creek (CCW), F34, AXL, and ALG watersheds located in northeastern Indiana. This study evaluated changes in surface flow, tile flow, sediment, and agricultural chemical losses based on an ensemble mean of the 17 general circulation models (GCMs) from the Coupled Model Intercomparison Project Phase 5 (CMIP5). We found no clear evidence that watershed size had an impact on the simulation of climate change effects on discharge or nutrient losses. Results of this study indicated that predicted surface flow decreased significantly toward the end of this century (ranging from 9% in CCW to 22% in ALG), while predicted subsurface tile flow increased significantly (ranging from 20% in CCW to 26% in AXL). The percentage increases in predicted sediment loss for the CCW, AXL, and ALG watersheds were significant at $\alpha = 0.05$, although the magnitudes of overall sediment losses were low, especially in the smaller monitored watersheds (F34, AXL, and ALG) in which several best management practices are implemented. Differences in predicted atrazine, soluble N, total N, and total P losses between the baseline period (1961-1990) and the end of this century were not significant for any of the watersheds, while increased predicted soluble P losses were only significant for the larger CCW and F34 watersheds.*

Walters, W. A., Jin, Z., Youngblut, N., Wallace, J. G., Sutter, J., Zhang, W., . . . Ley, R. E. (2018). Large-scale replicated field study of maize rhizosphere identifies heritable microbes. *Proceedings of the National Academy of Sciences of the United States of America, 115*(28), 7368-7373. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049610439&doi=10.1073%2fpnas.1800918115&partnerID=40&md5=c84fbb0a3fea910291e1102678d03da4. doi:10.1073/pnas.1800918115

Research Tags: Crops, Soil

Abstract: *Soil microbes that colonize plant roots and are responsive to differences in plant genotype remain to be ascertained for agronomically important crops. From a very large-scale longitudinal field study of 27 maize inbred lines planted in three fields, with partial replication 5 y later, we identify root-associated microbiota exhibiting reproducible associations with plant genotype. Analysis of 4,866 samples identified 143 operational taxonomic units (OTUs) whose variation in relative abundances across the samples was significantly regulated by plant genotype, and included five of seven core OTUs present in all samples. Plant genetic effects were significant amid the large effects of plant age on the rhizosphere microbiome, regardless of the specific community of each field, and despite microbiome responses to climate events. Seasonal patterns showed that the plant root microbiome is locally seeded, changes with plant growth, and responds to weather events. However, against this background of variation, specific taxa responded to differences in host genotype. If shown to have beneficial functions, microbes may be considered candidate traits for selective breeding.*

Wan, H. Y., Cushman, S. A., & Ganey, J. L. (2019). Recent and projected future wildfire trends across the ranges of three spotted owl subspecies under climate change. *Frontiers in Ecology and Evolution, 7*(MAR). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065424219&doi=10.3389%2ffevo.2019.00037&partnerID=40&md5=861226aee7790e341db6a6d640fc18bd. doi:10.3389/fevo.2019.00037

Research Tags: Wildlife, Forestry, Weather

Abstract: *A major task for researchers in the twenty-first century is to predict how climate-mediated stressors such as wildfires may affect biodiversity under climate change. Previous model predictions typically did not address non-stationarity in climate-fire relationships across time and space. In this study, we applied spatially-explicit non-stationary area burned projection models to evaluate recent and future climate-driven trends in area burned across the ranges of three spotted owl subspecies in the western United States. We also used high-severity fire probability models to evaluate the risk of high-severity fire in recent times. Results suggest that the proportion of area burned will increase within the range of all three subspecies under climate change, but the extent of that increase will vary both among subspecies and among ecoregions within subspecies. Similarly, the current risk of high-severity wildfire varies both among subspecies and among regions within subspecies. The Mexican spotted owl is expected to have a 13-fold increase in area burned within its range by the 2080s. The combination of increased climate-driven fire extent and risk of high-severity fire suggests a potential for large-scale future loss or modification of spotted owl habitat. We recommend conducting further studies to understand the interaction and synergistic effects of climate change and wildfire on the spotted owl, especially in regions that are understudied such as Mexico.*

Wan, H. Y., Ganey, J. L., Vojta, C. D., & Cushman, S. A. (2018). Managing emerging threats to spotted owls. *Journal of Wildlife Management, 82*(4), 682-697. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041226257&doi=10.1002%2fjwmg.21423&partnerID=40&md5=a7df0460ac58325f7f3342b6c8233e36. doi:10.1002/jwmg.21423
Research Tags: Wildlife
Abstract: *The 3 spotted owl (Strix occidentalis) subspecies in North America (i.e., northern spotted owl [S. o. caurina], California spotted owl [S. o. occidentalis], Mexican spotted owl [S. o. lucida]) have all experienced population declines over the past century due to habitat loss and fragmentation from logging. Now, the emerging influences of climate change, high-severity fire, and barred owl (Strix varia) invasion also appear to be synergistically and differentially affecting population trends of each subspecies. Our objective was to review the existing literature on the spotted owl to describe historical and emerging threats and whether those threats have been adequately examined for each subspecies. Using 527 publications from a Web of Science search of the literature from 1900–2015, we statistically evaluated the emphasis placed on each subspecies regarding 4 influences: mechanical tree removal, fire, climate change, and barred owl invasion. There were 98 papers that explicitly examined the effects of ≥1 of these influences. Most of these papers were focused on the northern spotted owl, and for all 3 subspecies, most papers examined short-term effects only. We used our results to identify significant information gaps relative to historical and emerging threats. Commercial timber harvesting remains a potential threat for all 3 spotted owl subspecies, but effects from forest thinning may be increasing because of the heightened emphasis on fuels reduction and forest restoration treatments on public lands. Owl response to mechanical tree removal, especially forest thinning, remains understudied. Climate change also may threaten all 3 subspecies. Changes in climate likely affect survival and reproduction of spotted owls and their prey, and alter habitat availability by affecting disturbance regimes and vegetation composition and succession, but little empirical information is available describing specific responses to climate change. The literature on response to high-severity fire is sparse for some subspecies, primarily short-term in nature, and not consistent. Barred owl invasion is a major threat to the northern spotted owl and the California spotted owl but does not currently threaten the Mexican spotted owl. Rigorous research on the response of spotted owls to all factors influencing population change, particularly for the Mexican spotted owl, is needed. The most useful information for predicting owl response to these threats stems primarily from long-term studies of owl demography. The lack of such studies within the range of the Mexican spotted owl greatly limits our understanding of its population dynamics and our ability to predict the effects of various threats on Mexican spotted owl populations. For all 3 subspecies, we encourage long-term studies of their responses to threats, using uniquely marked owls across large spatial extents to account for spatiotemporal variability in ecological conditions within and among subspecies.*

Wan, H. Y., McGarigal, K., Ganey, J. L., Lauret, V., Timm, B. C., & Cushman, S. A. (2017). Meta-replication reveals nonstationarity in multi-scale habitat selection of Mexican spotted owl. *Condor, 119*(4), 641-658. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031319798&doi=10.1650%2fCONDOR-17-32.1&p

artnerID=40&md5=84c8ee986fae0e1fe786560bb5507439. doi:10.1650/CONDOR-17-32.1
Research Tags: Wildlife
Abstract: *Anthropogenic environmental changes are leading to habitat loss and degradation, driving many species to extinction. In this context, habitat models become increasingly important for effective species management and conservation. However, most habitat studies lack replicated study areas and do not properly address the role of nonstationarity and spatial scales in determining factors that limit species occurrence under different environmental settings. Here we provide an optimized multi-scale framework for analyzing habitat selection of the threatened Mexican Spotted Owl (Strix occidentalis lucida) between 2 meta-replicated study areas: the Sacramento Mountains, New Mexico, and the Mogollon Plateau, Arizona. The optimized scales of habitat variables strongly differed between the 2 study areas. Percent cover of mixed-conifer was more strongly associated with the relative likelihood of Mexican Spotted Owl occurrence in the Sacramento Mountains than in the Mogollon Plateau. Topographic covariates strongly explained variance in the habitat model in the Mogollon Plateau, but not in the Sacramento Mountains. Topographically constrained habitat availability may be affecting the relative likelihood of owl occurrence in the Mogollon Plateau, but not in the Sacramento Mountains. In the Sacramento Mountains, suitable habitat and owl distributions show dissimilar spatial autocorrelation patterns, indicating that the relative likelihood of occurrence may be influenced by factors in addition to habitat. Owl distribution shows a periodic spatial pattern, suggesting that the relative likelihood of owl occurrence in the Sacramento Mountains might be influenced by territoriality. Differences in habitat relationships between the 2 study areas suggest that management strategies should be tailored to local conditions. This study underscores the advantage of scale optimization and replicated studies in analyzing nonstationary habitat selection.*

Wang, A., Goslee, S. C., Miller, D. A., Sanderson, M. A., & Gonet, J. M. (2017). Topographic variables improve climatic models of forage species abundance in the northeastern United States. *Applied Vegetation Science*, *20*(1), 84-93. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85007500051&doi=10.1111%2favsc.12284&partnerID=40&md5=f2e8e4018d90fee3f1b74e53be38f932. doi:10.1111/avsc.12284
Research Tags: Grassland Livestock
Abstract: *Question*
Species distribution modelling has most commonly been applied to presence-only data and to woody species. Can similar methods be used to create detailed predicted abundance maps for forage species? These predictions would be of great value for agricultural management and land-use planning.
Location
Northeastern USA.
Methods
We used field data from 31 grazed farms to model abundances for six forage species with three statistical methods: GLM, GAM and Random Forest models. A hierarchical ecological framework encompassing climatic, edaphic and topographic variables related to the plant species requirements for water, light and temperature was used to guide variable selection.
Results
Although many species distribution modelling studies have used only climatic variables, the inclusion of topography greatly improved explanatory power. Edaphic variables contributed little more beyond the information already provided by climate and topography. Random Forest models had higher overall predictive capability, and were used to produce the final potential abundance maps for the six forage species.
Conclusions
Climate-only predictions may be suitable for state or regional planning, but topographic variables must be included in species distribution models used to support decision-making at the farm and field scales.

Wang, E., Martre, P., Zhao, Z., Ewert, F., Maiorano, A., Rötter, R. P., . . . Asseng, S. (2017). The uncertainty of crop yield projections is reduced by improved temperature response functions. *Nature Plants, 3*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85025114987&doi=10.1038%2fnplants.2017.102&partnerID=40&md5=16c1411d43875545912829ec572e5dce. doi:10.1038/nplants.2017.102
Research Tags: Crops, Weather

Abstract: *Increasing the accuracy of crop productivity estimates is a key element in planning adaptation strategies to ensure global food security under climate change. Process-based crop models are effective means to project climate impact on crop yield, but have large uncertainty in yield simulations. Here, we show that variations in the mathematical functions currently used to simulate temperature responses of physiological processes in 29 wheat models account for >50% of uncertainty in simulated grain yields for mean growing season temperatures from 14 °C to 33 °C. We derived a set of new temperature response functions that when substituted in four wheat models reduced the error in grain yield simulations across seven global sites with different temperature regimes by 19% to 50% (42% average). We anticipate the improved temperature responses to be a key step to improve modelling of crops under rising temperature and climate change, leading to higher skill of crop yield projections.*

Wang, G., Li, J., Ravi, S., Scott Van Pelt, R., Costa, P. J. M., & Dukes, D. (2017). Tracer techniques in aeolian research: Approaches, applications, and challenges. *Earth-Science Reviews, 170*, 1-16. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019398215&doi=10.1016%2fj.earscirev.2017.05.001&partnerID=40&md5=d45a2b2a77bd7819da1609c11c00f734. doi:10.1016/j.earscirev.2017.05.001

Research Tags: Soil

Abstract: *Aeolian processes, the entrainment, transport and deposition of sediments by wind, impacts climate, biogeochemical cycles, food security, environmental quality and human health. Considering the multitude of interactions between aeolian processes and all the major components of the Earth system, there is a growing interest in the scientific community to quantify the wind-related sediment movement process and redistribution rates at different spatial and temporal scales. However, this quantification is rather challenging, due to the complexities of physical mechanisms involved in aeolian processes and the inherent fundamental differences from the rather well-studied processes controlling fluvial erosion. Traditional techniques, such as erosion plots and surveying methods for monitoring wind erosion, are capable of quantifying sediment movement on small scales but they have a number of limitations in terms of the representativeness of the data obtained, spatial and temporal resolution and the patterns over extended areas, and the costs involved. The demand for alternative methods of soil loss and sediment redistribution assessment, in order to complement and enhance the existing methods, has directed attention to use tracing approaches for monitoring rates and spatial patterns of sediment redistribution at various scales. A comprehensive synthesis of available information from different scientific disciplines on aeolian tracer techniques, their applications and limitations are important in understanding the role of aeolian processes and their interactions with the Earths systems in changing climate and management scenarios. The objective of this paper is to provide a scientific review of the current tracer approaches in aeolian studies, including fallout radionuclides, rare earth elements, sediment finger printing and soil magnetism, as well as giving an introduction of the potential tracers that are in development.*

Wang, J., Fu, X., Sainju, U. M., & Zhao, F. (2018). Soil carbon fractions in response to straw mulching in the Loess Plateau of China. *Biology and Fertility of Soils, 54*(4), 423-436. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043365751&doi=10.1007%2fs00374-018-1271-z&partnerID=40&md5=bf4e1d3b4dfc2ba3d9cba72749ed4ccc. doi:10.1007/s00374-018-1271-z

Research Tags: Soil

Abstract: *Straw mulching has been used to conserve soil water and sustain dryland crop yields, but the impact of the quantity and time of mulching on soil C fractions are not well documented. We studied the effects of various amounts and times of wheat (Triticum aestivum L.) straw mulching on soil C fractions at 0–10- and 10–20-cm depths from 2009 to 2017 in the Loess Plateau of China. Treatments were no mulching (CK), straw mulching at 9.0 (HSM) and 4.5 Mg ha−1 (LSM) in the winter wheat growing season, and straw mulching at 9.0 Mg ha−1 in the summer fallow period (FSM). Soil C fractions were soil organic C (SOC), particulate organic C (POC), microbial biomass C (MBC), and potential C mineralization (PCM). All C fractions at 0–10 and 10–20 cm were 8–27% greater with HSM and LSM than FSM and CK. Both SOC and POC at 0–10 cm increased at 0.32 and 0.27 Mg ha−1 year−1 with HSM and at 0.40 and 0.30 Mg C ha−1 year−1 with LSM, respectively, from 2009 to 2017. Winter wheat grain yield was lower with HSM and LSM, but total aboveground biomass was greater with HSM than other treatments. All C fractions at most depths were correlated with the estimated wheat root residue returned to the soil and PCM at 0–10 and 0–20 cm was correlated with wheat grain yield. Wheat straw mulching during the growing season increased soil C sequestration and microbial biomass and*

activity compared with mulching during the fallow period or no mulching, regardless of mulching rate, due to increased C input, although it reduced wheat grain yield. Continuous application of straw mulching over time can increase soil C sequestration by increasing nonlabile C fractions while decreasing labile fractions. Straw mulching at higher rate and mulching during the summer fallow period had no additional benefits in soil C sequestration.

Wang, J., Fu, X., Zhao, F., & Sainju, U. M. (2018). Response of soil carbon fractions and dryland maize yield to mulching. *Soil Science Society of America Journal, 82*(2), 371-381. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044458263&doi=10.2136%2fsssaj2017.11.0397&partnerID=40&md5=46850160a8a0416e0182cff3b0bebf0d. doi:10.2136/sssaj2017.11.0397

Research Tags: Soil, Crops

Abstract: *Stimulation of root growth from mulching may enhance soil C fractions under maize (Zea mays L.). We studied the 5-yr straw (SM) and plastic film (PM) mulching effect on soil C fractions and maize yield compared with no mulching (CK) in the Loess Plateau of China. Soil samples collected from 0- to 10- and 10- to 20-cm depths after maize harvest in the fall, 2011 to 2015, were analyzed for soil organic C (SOC), particulate organic C (POC), potential C mineralization (PCM), and microbial biomass C (MBC). At both depths, all C fractions were 7 to 35% greater with SM than PM and CK. At 0 to 20 cm, SOC increased at 0.87 Mg C ha–1 yr–1 with PM and POC increased at 0.18 and 0.54 Mg C ha–1 yr–1 with SM and PM, respectively, from 2011 to 2015. Maize grain yield and aboveground biomass were 5 to 33% greater with PM and SM than CK. The PCM and MBC at all depths were negatively correlated with maize grain yield, but SOC and POC at 10 to 20 cm were positively correlated with estimated maize root residue returned to the soil. Plastic film mulching increased maize yield, but reduced soil C fractions compared with straw mulching. Because of favorable effect on soil C fractions and maize yield, straw mulching can enhance soil C sequestration by increasing labile and intermediate C fractions and sustain maize yield compared with no mulching under dryland cropping systems.*

Wang, J., Xiao, X., Bajgain, R., Starks, P., Steiner, J., Doughty, R. B., & Chang, Q. (2019). Estimating leaf area index and aboveground biomass of grazing pastures using Sentinel-1, Sentinel-2 and Landsat images. *ISPRS Journal of Photogrammetry and Remote Sensing, 154*, 189-201. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067567474&doi=10.1016%2fj.isprsjprs.2019.06.007&partnerID=40&md5=c975b09f89def22a5d325310b5337a43. doi:10.1016/j.isprsjprs.2019.06.007

Research Tags: Grassland, Livestock

Abstract: *Grassland degradation has accelerated in recent decades in response to increased climate variability and human activity. Rangeland and grassland conditions directly affect forage quality, livestock production, and regional grassland resources. In this study, we examined the potential of integrating synthetic aperture radar (SAR, Sentinel-1) and optical remote sensing (Landsat-8 and Sentinel-2) data to monitor the conditions of a native pasture and an introduced pasture in Oklahoma, USA. Leaf area index (LAI) and aboveground biomass (AGB) were used as indicators of pasture conditions under varying climate and human activities. We estimated the seasonal dynamics of LAI and AGB using Sentinel-1 (S1), Landsat-8 (LC8), and Sentinel-2 (S2) data, both individually and integrally, applying three widely used algorithms: Multiple Linear Regression (MLR), Support Vector Machine (SVM), and Random Forest (RF). Results indicated that integration of LC8 and S2 data provided sufficient data to capture the seasonal dynamics of grasslands at a 10–30-m spatial resolution and improved assessments of critical phenology stages in both pluvial and dry years. The satellite-based LAI and AGB models developed from ground measurements in 2015 reasonably predicted the seasonal dynamics and spatial heterogeneity of LAI and AGB in 2016. By comparison, the integration of S1, LC8, and S2 has the potential to improve the estimation of LAI and AGB more than 30% relative to the performance of S1 at low vegetation cover (LAI < 2 m2/m2, AGB < 500 g/m2) and optical data of LC8 and S2 at high vegetation cover (LAI > 2 m2/m2, AGB > 500 g/m2). These results demonstrate the potential of combining S1, LC8, and S2 monitoring grazing tallgrass prairie to provide timely and accurate data for grassland management.*

Wang, L., Cherkauer, K. A., & Flanagan, D. C. (2018). Impacts of climate change on soil Erosion in the great Lakes Region. *Water (Switzerland), 10*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047566394&doi=10.3390%2fw10060715&partnerID=40&md5=c4b98419534ef6184a112cb4266fdb65. doi:10.3390/w10060715

Research Tags: Soil, Water
Abstract: *Quantifying changes in potential soil erosion under projections of changing climate is important for the sustainable management of land resources, as soil loss estimates will be helpful in identifying areas susceptible to erosion, targeting future erosion control efforts, and/or conservation funding. Therefore, the macro-scale Variable Infiltration Capacity—Water Erosion Prediction Project (VIC-WEPP) soil erosion model was utilized to quantify soil losses under three climate change scenarios (A2, A1B, B1) using projections from three general circulation models (GFDL, PCM, HadCM3) for the Great Lakes region from 2000 to 2100. Soil loss was predicted to decrease throughout three future periods (2030s, 2060s, and 2090s) by 0.4–0.7 ton ha−1 year−1 (4.99–23.2%) relative to the historical period (2000s) with predicted air temperature increases of 0.68–4.34 °C and precipitation increases of 1.74–63.7 mm year−1 (0.23–8.6%). In the forested northern study domain erosion kept increasing by 0.01–0.18 ton ha−1 year−1 over three future periods due to increased precipitation of 9.7–68.3 mm year−1. The southern study domain covered by cropland and grassland had predicted soil loss decreases of 0.01–1.43 ton ha−1 year−1 due to air temperature increases of 1.75–4.79 °C and reduced precipitation in the summer. Fall and winter had greater risks of increased soil loss based on predictions for these two seasons under the A2 scenario, with the greatest cropland soil loss increase due to increased fall precipitation, and combined effects of increases in both precipitation and air temperature in the winter. Fall was identified with higher risks under the A1B scenario, while spring and summer were identified with the greatest risk of increased soil losses under the B1 scenario due to the increases in both precipitation and air temperature.*

Wang, L., Flanagan, D. C., Wang, Z., & Cherkauer, K. A. (2018). Climate change impacts on nutrient losses of two watersheds in the Great Lakes region. *Water (Switzerland), 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047520305&doi=10.3390%2fw10040442&partnerID=40&md5=74e1f838dc020e2529c8595ff1767000. doi:10.3390/w10040442
Research Tags: Soil, Water
Abstract: *Non-point sources (NPS) of agricultural chemical pollution are one major reason for the water quality degradation of the Great Lakes, which impacts millions of residents in the states and provinces that are bordering them. Future climate change will further impact water quality in both direct and indirect ways by influencing the hydrological cycle and processes of nutrient transportation and transformation, but studies are still rare. This study focuses on quantifying the impacts of climate change on nutrient (Nitrogen and Phosphorus) losses from the two small watersheds (Walworth watershed and Green Lake watershed) within the Great Lakes region. Analysis focused on changes through this century (comparing the nutrient loss prediction of three future periods from 2015 to 2099 with 30 years for each period against the historical nutrient estimation data from 1985 to 2008). The effects on total phosphorus and nitrate-nitrogen losses due to changes in precipitation quantity, intensity, and frequency, as well as air temperature, are evaluated for the two small watersheds, under three special report emission scenarios (SRES A2, A1B, B1). The newly developed Water Erosion Prediction Project-Water Quality (WEPP-WQ) model is utilized to simulate nutrient losses with downscaled and bias corrected future climate forcing from two General Circulation Models (GFDL, HadCM3). For each watershed, the observed runoff and nutrient loads are used to calibrate and validate the model before the application of the WEPP-WQ model to examine potential impacts from future climate change. Total phosphorus loss is projected to increase by 28% to 89% for the Green Lake watershed and 25% to 108% for the Walworth watershed mainly due to the combined effects of increase of precipitation quantity, extreme storm events in intensity and frequency, and air temperature. Nitrate-nitrogen losses are projected to increase by 1.1% to 38% for the Green Lake watershed and 8% to 95% for the Walworth watershed with the different major influencing factors in each future periods.*

Wang, M., Wagner, M., Miguez-Macho, G., Kamarianakis, Y., Mahalov, A., Moustaoui, M., . . . Georgescu, M. (2017). On the long-term hydroclimatic sustainability of perennial bioenergy crop expansion over the United States. *Journal of Climate, 30*(7), 2535-2557. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015861177&doi=10.1175%2fJCLI-D-16-0610.1&partnerID=40&md5=38cfb7ac4c264a7a3c0f6a93e2e9e7a3. doi:10.1175/JCLI-D-16-0610.1
Research Tags: Water, Energy, Grassland
Abstract: *Large-scale cultivation of perennial bioenergy crops (e.g., miscanthus and switchgrass) offers unique*

opportunities to mitigate climate change through avoided fossil fuel use and associated greenhouse gas reduction. Although conversion of existing agriculturally intensive lands (e.g., maize and soy) to perennial bioenergy cropping systems has been shown to reduce near-surface temperatures, unintended consequences on natural water resources via depletion of soil moisture may offset these benefits. The hydroclimatic impacts associated with perennial bioenergy crop expansion over the contiguous United States are quantified using the Weather Research and Forecasting Model dynamically coupled to a land surface model (LSM). A suite of continuous (2000–09) medium-range resolution (20-km grid spacing) ensemble-based simulations is conducted using seasonally evolving biophysical representation of perennial bioenergy cropping systems within the LSM based on observational data. Deployment is carried out only over suitable abandoned and degraded farmlands to avoid competition with existing food cropping systems. Results show that near-surface cooling (locally, up to 5°C) is greatest during the growing season over portions of the central United States. For some regions, principal impacts are restricted to a reduction in near-surface temperature (e.g., eastern portions of the United States), whereas for other regions deployment leads to soil moisture reduction in excess of 0.15–0.2 m3 m−3 during the simulated 10-yr period (e.g., western Great Plains). This reduction (~25%–30% of available soil moisture) manifests as a progressively decreasing trend over time. The large-scale focus of this research demonstrates the long-term hydroclimatic sustainability of large-scale deployment of perennial bioenergy crops across the continental United States, revealing potential hot spots of suitable deployment and regions to avoid.

Wang, P., Niu, G. Y., Fang, Y. H., Wu, R. J., Yu, J. J., Yuan, G. F., . . . Scott, R. L. (2018). Implementing Dynamic Root Optimization in Noah-MP for Simulating Phreatophytic Root Water Uptake. *Water Resources Research, 54*(3), 1560-1575. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045665210&doi=10.1002%2f2017WR021061&partnerID=40&md5=87e6fc249ad37ec9375744e6486a7a24. doi:10.1002/2017WR021061
Research Tags: Water, Soil
Abstract: *Widely distributed in arid and semiarid regions, phreatophytic roots extend into the saturated zone and extract water directly from groundwater. In this paper, we implemented a vegetation optimality model of root dynamics (VOM-ROOT) in the Noah land surface model with multiparameterization options (Noah-MP LSM) to model the extraction of groundwater through phreatophytic roots at a riparian site with a hyperarid climate (with precipitation of 35 mm/yr) in northwestern China. VOM-ROOT numerically describes the natural optimization of the root profile in response to changes in subsurface water conditions. The coupled Noah-MP/VOM-ROOT model substantially improves the simulation of surface energy and water fluxes, particularly during the growing season, compared to the prescribed static root profile in the default Noah-MP. In the coupled model, more roots are required to grow into the saturated zone to meet transpiration demand when the groundwater level declines over the growing season. The modeling results indicate that at the study site, the modeled annual transpiration is 472 mm, accounting for 92.3% of the total evapotranspiration. Direct root water uptake from the capillary fringe and groundwater, which is supplied by lateral groundwater flow, accounts for approximately 84% of the total transpiration. This study demonstrates the importance of implementing a dynamic root scheme in a land surface model for adequately simulating phreatophytic root water uptake and the associated latent heat flux.*

Wang, Q., Chun, J. A., Fleisher, D., Reddy, V., Timlin, D., & Resop, J. (2017). Parameter estimation of the Farquhar-von Caemmerer-Berry biochemical model from photosynthetic carbon dioxide response curves. *Sustainability (Switzerland), 9*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026478224&doi=10.3390%2fsu9071288&partnerID=40&md5=1dcf1fc7d23e291a54ff80fc4845f95f. doi:10.3390/su9071288
Research Tags: Research
Abstract: *The Farquhar—von Caemmerer—Berry (FvCB) biochemical model of photosynthesis, commonly used to estimate CO2 assimilation at various spatial scales from leaf to global, has been used to assess the impacts of climate change on crop and ecosystem productivities. However, it is widely known that the parameters in the FvCB model are difficult to accurately estimate. The objective of this study was to assess the methods of Sharkey et al. and Gu et al., which are often used to estimate the parameters of the FvCB model. We generated An/Ci datasets with different data accuracies, numbers of data points, and data point distributions. The results*

showed that neither method accurately estimated the parameters; however, Gu et al.'s approach provided slightly better estimates. Using Gu et al.'s approach and datasets with measurement errors and the same accuracy as a typical open gas exchange system (i.e., Li-6400), the majority of the estimated parameters—Vcmax (maximal Rubisco carboxylation rate), Kco (effective Michaelis-Menten coefficient for CO2), gm (internal (mesophyll) conductance to CO2 transport) and Γ (chloroplastic CO2 photocompensation point)—were underestimated, while the majority of Rd (day respiration) and α (the non-returned fraction of the glycolate carbon recycled in the photorespiratory cycle) were overestimated. The distributions of Tp (the rate of triose phosphate export from the chloroplast) were evenly dispersed around the 1:1 line using both approaches. This study revealed that a high accuracy of leaf gas exchange measurements and sufficient data points are required to correctly estimate the parameters for the biochemical model. The accurate estimation of these parameters can contribute to the enhancement of food security under climate change through accurate predictions of crop and ecosystem productivities. A further study is recommended to address the question of how the measurement accuracies can be improved.*

Wang, R., Chen, J., Anderson, J. A., Zhang, J., Zhao, W., Wheeler, J., . . . Dong, Y. (2017). Genome-wide association mapping of Fusarium head blight resistance in spring wheat lines developed in the Pacific Northwest and CIMMYT. *Phytopathology, 107*(12), 1486-1495. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85035203119&doi=10.1094%2fPHYTO-02-17-0073-R&partnerID=40&md5=bf5b0e690ecada43f7efc794193e1777. doi:10.1094/PHYTO-02-17-0073-R

Research Tags: Crops

Abstract: *Fusarium head blight (FHB) is a destructive disease of wheat in humid and semihumid areas of the world. It has emerged in the Pacific Northwest (PNW) in recent years because of changing climate and crop rotation practices. Our objectives in the present study were to identify and characterize quantitative trait loci (QTL) associated with FHB resistance in spring wheat lines developed in the PNW and the International Maize and Wheat Improvement Center. In total, 170 spring wheat lines were evaluated in field and greenhouse trials in 2015 and 2016. Fourteen lines showing consistent resistance in multiple environments were identified. These lines are valuable resources in wheat variety improvement of FHB resistance because they have no Sumai 3 or Sumai 3-related background. The 170 lines were genotyped using a high-density Illumina 90K single-nucleotide polymorphisms (SNP) assay and 10 other non-SNP markers. A genome-wide association analysis was conducted with a mixed model (Q+K). Consistent, significant SNP associations with multiple traits were found on chromosomes 1B, 2B, 4B, 5A, 5B, and 6A. The locus on chromosome 5B for reduced deoxynivalenol content may be novel. The identified QTL are being validated in additional mapping studies and the identified resistant lines are being used in variety development for FHB resistance and facilitated by marker-assisted selection.*

Wang, W., Flanagan, D. C., Yin, S., & Yu, B. (2018). Assessment of CLIGEN precipitation and storm pattern generation in China. *Catena, 169*, 96-106. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047737211&doi=10.1016%2fj.catena.2018.05.024&partnerID=40&md5=26182f7753d5f583509b6766bea4e010. doi:10.1016/j.catena.2018.05.024

Research Tags: Weather, Research

Abstract: *The applicability of the uncalibrated CLIGEN (CLImate GENerator) model was assessed using long-term precipitation data at 1-min interval from 18 sites in eastern and central China. The model performance was evaluated in terms of daily precipitation depth, storm duration and peak intensities of 1-min (I1), 5-min (I5) and 30-min (I30) for all storms and four categories grouped by daily precipitation depth: light (<10 mm), moderate (10–25 mm), heavy (25–50 mm), and intense (≥50 mm) storms. Additionally, the applicability of CLIGEN in generating climate inputs for the Revised Universal Soil Loss Equation (RUSLE) in China and calculating the intensity-duration-frequency (IDF) values for a series of storm duration (5-min to 24-h) and return periods (2 to 100-years) were assessed. Results showed that CLIGEN was able to accurately reproduce the statistics and probability distributions of daily precipitation depth for all storms and the four categories. The mean storm duration was underestimated for 3 of the 4 storm categories but was overestimated for light storms. CLIGEN underestimated I1 and overestimated I30 in general, whereas no obvious bias was observed in I5 for these 18 sites. In addition, the relative error in the generated duration and peak intensity increased as the magnitude of precipitation increased from moderate to intense storms, which implies that the*

model does not perform as well for intense storms as other storms. Rainfall erosivity generated with CLIGEN outputs was systematically larger than, but well correlated with, the measured erosivity values (slope = 0.547, R2 = 0.96 for the R-factor; slope = 0.576, R2 = 0.81 for the 10-year storm erosivity). Extreme intensities for given duration and return periods were systematically over-predicted using the output from CLIGEN, and the bias between measured and CLIGEN generated intensity-duration-frequency (IDF) values varied with duration intervals. The average of the regression slopes for the six return periods (2-year to 100-year) between measured (X) and generated (Y) intensities (Y = b X) increased from 1.19 (5-min) to 1.43 (1-h), then decreased to 1.01 (12-h) and 0.96 (24-h). As a stochastic weather generator, CLIGEN is able to reproduce daily precipitation very well, but its capacity to simulate storm duration and the peak intensity for a given time interval needs to be improved, especially for heavy and intense storms, based on this study.

Wang, W., Yin, S., Flanagan, D. C., & Yu, B. (2018). Comparing CLIGEN-generated storm patterns with 1-Minute and Hourly precipitation data from China. *Journal of Applied Meteorology and Climatology, 57*(9), 2005-2017. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053444335&doi=10.1175%2fJAMC-D-18-0079.1&partnerID=40&md5=9e87ef6073212cb427d6a1ae294e6fdb. doi:10.1175/JAMC-D-18-0079.1

Research Tags: Weather, Research

Abstract: *Climate Generator (CLIGEN) is a stochastic weather generator that has been widely used to generate daily precipitation and storm patterns for hydrological and erosion prediction models. Rainfall data with measurement intervals ≤ 30 min are required to compute two parameters for generating storm patterns, namely, the cumulative distribution of the time to peak rainfall intensity (TimePk) and the mean daily maximum 30-min rainfall intensity (MX.5P). High-resolution rainfall data, however, are not widely available around the world. One-minute precipitation data for 18 stations in eastern and central China were aggregated into hourly intervals to evaluate methods to optimally prepare TimePk and MX.5P for CLIGEN. Four sets of the two parameters were used to run CLIGEN for comparison: C0, using the original 1-min data; C1, replacing TimePk with those computed with hourly data; C2, replacing MX.5P with those computed with hourly data with an adjustment factor; and C3, replacing both parameters with those computed with hourly data, and the MX.5P was adjusted as for C2. Results showed that 1) MX.5P computed with hourly data was systematically lower than that computed with the 1-min data, and the bias could be corrected by multiplying by an adjustment factor of 1.40; 2) the difference in generated storm patterns between C0 and C1 was insignificant; and 3) results from C2 and C3 agreed well with those generated from C0. Hourly precipitation data can be used to prepare CLIGEN input parameter values for generating storm patterns for sites where only hourly data are available.*

Wang, W. J., He, H. S., Thompson, F. R., Fraser, J. S., & Dijak, W. D. (2017). Changes in forest biomass and tree species distribution under climate change in the northeastern United States. *Landscape Ecology, 32*(7), 1399-1413. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84982113138&doi=10.1007%2fs10980-016-0429-z&partnerID=40&md5=06cd5ad38ccb6e199a70f40d8655af4c. doi:10.1007/s10980-016-0429-z

Research Tags: Forestry

Abstract: *Context*
Forests in the northeastern United States are currently in early- and mid-successional stages recovering from historical land use. Climate change will affect forest distribution and structure and have important implications for biodiversity, carbon dynamics, and human well-being.
Objective
We addressed how aboveground biomass (AGB) and tree species distribution changed under multiple climate change scenarios (PCM B1, CGCM A2, and GFDL A1FI) in northeastern forests.
Methods
We used the LANDIS PRO forest landscape model to simulate forest succession and tree harvest under current climate and three climate change scenarios from 2000 to 2300. We analyzed the effects of climate change on AGB and tree species distribution.
Results
AGB increased from 2000 to 2120 irrespective of climate scenario, followed by slight decline, but then increased again to 2300. AGB averaged 10 % greater in the CGCM A2 and GFDL A1FI scenarios than the PCM B1 and

current climate scenarios. Climate change effects on tree species distribution were not evident from 2000 to 2100 but by 2300 some northern hardwood and conifer species decreased in occurrence and some central hardwood and southern tree species increased in occurrence.
Conclusions
Climate change had positive effects on forest biomass under the two climate scenarios with greatest warming but the patterns in AGB over time were similar among climate scenarios because succession was the primary driver of AGB dynamics. Our approach, which simulated stand dynamics and dispersal, demonstrated that a northward shift in tree species distributions may take 300 or more years.

Wang, W. J., He, H. S., Thompson, F. R., Spetich, M. A., & Fraser, J. S. (2018). Effects of species biological traits and environmental heterogeneity on simulated tree species distribution shifts under climate change. *Science of the Total Environment, 634*, 1214-1221. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045250905&doi=10.1016%2fj.scitotenv.2018.03.353&partnerID=40&md5=da11acbdf24b8e0494d01a60b77c716c. doi:10.1016/j.scitotenv.2018.03.353
Research Tags: Forestry
Abstract: *Demographic processes (fecundity, dispersal, colonization, growth, and mortality) and their interactions with environmental changes are not well represented in current climate-distribution models (e.g., niche and biophysical process models) and constitute a large uncertainty in projections of future tree species distribution shifts. We investigate how species biological traits and environmental heterogeneity affect species distribution shifts. We used a species-specific, spatially explicit forest dynamic model LANDIS PRO, which incorporates site-scale tree species demography and competition, landscape-scale dispersal and disturbances, and regional-scale abiotic controls, to simulate the distribution shifts of four representative tree species with distinct biological traits in the central hardwood forest region of United States. Our results suggested that biological traits (e.g., dispersal capacity, maturation age) were important for determining tree species distribution shifts. Environmental heterogeneity, on average, reduced shift rates by 8% compared to perfect environmental conditions. The average distribution shift rates ranged from 24 to 200 m year−1 under climate change scenarios, implying that many tree species may not able to keep up with climate change because of limited dispersal capacity, long generation time, and environmental heterogeneity. We suggest that climate-distribution models should include species demographic processes (e.g., fecundity, dispersal, colonization), biological traits (e.g., dispersal capacity, maturation age), and environmental heterogeneity (e.g., habitat fragmentation) to improve future predictions of species distribution shifts in response to changing climates.*

Wang, W. J., Thompson, F. R., He, H. S., Fraser, J. S., Dijak, W. D., & Jones-Farrand, T. (2019). Climate change and tree harvest interact to affect future tree species distribution changes. *Journal of Ecology, 107*(4), 1901-1917. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061905761&doi=10.1111%2f1365-2745.13144&partnerID=40&md5=273aeaeadddfdc5028732a430425098a. doi:10.1111/1365-2745.13144
Research Tags: Forestry
Abstract: *Tree harvest and climate change can interact to have synergistic effects on tree species distribution changes. However, few studies have investigated the interactive effects of tree harvest and climate change on tree species distributions.*
We assessed the interactive effects of tree harvest and climate change on the distribution of 29 dominant tree species at 270 m resolution in the southern United States, while accounting for species demography, competition, urban growth and natural fire. We simulated tree species distribution changes to year 2100 using a coupled forest dynamic model (LANDIS PRO), ecosystem process model (LINKAGES) and urban growth model (SLEUTH).
The distributions of 20 tree species contracted and nine species expanded within the region under climate change by end of 21st century. Distribution changes for all tree species were very slow and lagged behind the changes in potential distributions that were in equilibrium with new climatic conditions.
Tree harvest and climate change interacted to affect species occurrences and colonization but not extinction. Occurrence and colonization were mainly affected by tree harvest and its interaction with climate change while extinctions were mainly affected by tree harvest and climate change.

Synthesis and applications. Interactive effects of climate and tree harvest acted in the same direction as climate change effects on species occurrences, thereby accelerating climate change induced contraction or expansion of distributions. The overall interactive effects on species colonization were negative, specifically with positive interactive effects at leading edges of species ranges and negative interactive effects at trailing edges. Tree harvest generally did not interact with climate change to greatly facilitate or ameliorate species extinction. Our modelling results highlight the importance of considering disturbances and species demography (e.g. post-harvest regeneration dynamics) when predicting changes in tree distributions.

Wang, W. J., Thompson, F. R., He, H. S., Fraser, J. S., Dijak, W. D., & Spetich, M. A. (2018). Population dynamics has greater effects than climate change on tree species distribution in a temperate forest region. *Journal of Biogeography, 45*(12), 2766-2778. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056289681&doi=10.1111%2fjbi.13467&partnerID=40&md5=7f7b8faae6d71beae584b0155310a627. doi:10.1111/jbi.13467

Research Tags: Forestry

Abstract: *Aim*

Population dynamics and disturbances have often been simplified or ignored when predicting regional-scale tree species distributions in response to climate change in current climate-distribution models (e.g., niche and biophysical process models). We determined the relative importance of population dynamics, tree harvest, climate change, and their interaction in affecting tree species distribution changes.

Location

Central Hardwood Forest Region of the United States.

Major taxa studied

Tree species.

Methods

We used a forest dynamic model, LANDIS PRO that accounted for population dynamics, tree harvest, and climate change to predict tree species' distributions at 270 m resolution from 2000 to 2300. We quantified the relative importance of these factors using a repeated measures analysis of variance. We further investigated the effects of each factor on changes in species distributions by summarizing extinction and colonization rates.

Results

On average, population dynamics was the most important factor affecting tree species distribution changes. Tree harvest was more important than climate change by 2100 whereas climate change was more important than harvest by 2300. By end of the 21st century, most tree species expanded their distributions irrespective of any climate or harvest scenario. By 2300, most northern, some southern, and most widely distributed species contracted their distributions while most southern species, some widely distributed species, and few northern species expanded their distributions under warmer climates with tree harvest. Harvest accelerated or ameliorated the contractions and expansions for species that were negatively or positively affected by climate change.

Main conclusions

Our results suggest that population dynamics and tree harvest can be more important than climate change and thus should be explicitly included when predicting future tree species' distributions. Understanding the underlying mechanisms that drive tree species distributions will enable better predictions of tree species distributions under climate change.

Wang, Z., Schaaf, C. B., Sun, Q., Kim, J., Erb, A. M., Gao, F., . . . Papuga, S. A. (2017). Monitoring land surface albedo and vegetation dynamics using high spatial and temporal resolution synthetic time series from Landsat and the MODIS BRDF/NBAR/albedo product. *International Journal of Applied Earth Observation and Geoinformation, 59*, 104-117. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028694954&doi=10.1016%2fj.jag.2017.03.008&partnerID=40&md5=0934dfdbff565b1b513274f7aa855d1d. doi:10.1016/j.jag.2017.03.008

Research Tags: Research

Abstract: *Seasonal vegetation phenology can significantly alter surface albedo which in turn affects the global energy balance and the albedo warming/cooling feedbacks that impact climate change. To monitor and quantify the surface dynamics of heterogeneous landscapes, high temporal and spatial resolution synthetic* *time series of albedo and the enhanced vegetation index (EVI) were generated from the 500 m Moderate Resolution Imaging Spectroradiometer (MODIS) operational Collection V006 daily BRDF/NBAR/albedo products and 30 m Landsat 5 albedo and near-nadir reflectance data through the use of the Spatial and Temporal Adaptive Reflectance Fusion Model (STARFM). The traditional Landsat Albedo (Shuai et al., 2011) makes use of the MODIS BRDF/Albedo products (MCD43) by assigning appropriate BRDFs from coincident MODIS products to each Landsat image to generate a 30 m Landsat albedo product for that acquisition date. The available cloud free Landsat 5 albedos (due to clouds, generated every 16 days at best) were used in conjunction with the daily MODIS albedos to determine the appropriate 30 m albedos for the intervening daily time steps in this study. These enhanced daily 30 m spatial resolution synthetic time series were then used to track albedo and vegetation phenology dynamics over three Ameriflux tower sites (Harvard Forest in 2007, Santa Rita in 2011 and Walker Branch in 2005). These Ameriflux sites were chosen as they are all quite nearby new towers coming on line for the National Ecological Observatory Network (NEON), and thus represent locations which will be served by spatially paired albedo measures in the near future. The availability of data from the NEON towers will greatly expand the sources of tower albedometer data available for evaluation of satellite products. At these three Ameriflux tower sites the synthetic time series of broadband shortwave albedos were evaluated using the tower albedo measurements with a Root Mean Square Error (RMSE) less than 0.013 and a bias within the range of ±0.006. These synthetic time series provide much greater spatial detail than the 500 m gridded MODIS data, especially over more heterogeneous surfaces, which improves the efforts to characterize and monitor the spatial variation across species and communities. The mean of the difference between maximum and minimum synthetic time series of albedo within the MODIS pixels over a subset of satellite data of Harvard Forest (16 km by 14 km) was as high as 0.2 during the snow-covered period and reduced to around 0.1 during the snow-free period. Similarly, we have used STARFM to also couple MODIS Nadir BRDF Adjusted Reflectances (NBAR) values with Landsat 5 reflectances to generate daily synthetic times series of NBAR and thus Enhanced Vegetation Index (NBAR-EVI) at a 30 m resolution. While normally STARFM is used with directional reflectances, the use of the view angle corrected daily MODIS NBAR values will provide more consistent time series. These synthetic times series of EVI are shown to capture seasonal vegetation dynamics with finer spatial and temporal details, especially over heterogeneous land surfaces.*

Ward, S. F., Eidson, E. L., Kees, A. M., Venette, R. C., & Aukema, B. H. (2019). Allopatric populations of the invasive larch casebearer differ in cold tolerance and phenology. *Ecological Entomology*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068775078&doi=10.1111%2feen.12773&partnerID=40&md5=e4727cfdd1e69b0acc1c60f6ddc12220. doi:10.1111/een.12773

Research Tags: Forestry, Wildlife, Weather

Abstract: *Traits of non-native insect herbivores may vary spatially due to local genetic differences, rapid post-introduction evolution, and/or novel host plant associations.*

Populations of larch casebearer, Coleophora laricella Hübner, originally from Europe have likely been isolated for > 60 years in North America on eastern larch, Larix laricina (Du Roi) K. Koch, and western larch, Larix occidentalis Nutt.

This study investigated cold tolerance and phenology of larvae collected from eastern larch in Minnesota, and western larch in Oregon, Idaho, and Montana, U.S.A.

Mean supercooling points of larvae from Minnesota were up to 10 °C lower than supercooling points of larvae from Oregon, Idaho, and Montana.

At ambient environmental conditions in spring, overwintering larvae from Minnesota required a mean (± SE) of 172 ± 19 degree-days above 5 °C to break winter quiescence and actively wander, significantly more than required by larvae from Oregon (66 ± 4), Idaho (64 ± 1), and Montana (60 ± 2).

Across all assays and despite substantial latitudinal and elevational variation among western larch sites, no significant differences in any traits were detected among larvae collected from western larch.

Spatial variation in cold tolerance and phenological traits of larch casebearer may be attributable to insect genetic differences and/or host plant effects, but exact mechanisms remain unknown. Differences in thermal biology between regions may result in disparate effects of climate change on insect populations and should be accounted for when forecasting insect dynamics across large spatial scales.

Ward, S. F., Venette, R. C., & Aukema, B. H. (2019). Cold tolerance of the invasive larch casebearer and implications for

invasion success. *Agricultural and Forest Entomology, 21*(1), 88-98. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055474915&doi=10.1111%2fafe.12311&partnerID=40&md5=99682956b2af6a39d1401d478f5e2374. doi:10.1111/afe.12311
Research Tags: Forestry, Wildlife, Weather
Abstract: *Larch casebearer became established in North America in the late 1800s. Cold temperatures are considered a limiting factor for the insect's range, yet the cold hardiness of larch casebearer has never been quantified.*
We investigated (i) larval survival after acute and prolonged exposure to subzero temperatures and (ii) supercooling points (i.e. temperatures causing the onset of freezing) of overwintering and active larvae from November 2015 to April 2017.
We developed models linking exposure temperatures to survival and evaluated them with larvae from field conditions. Historical minimum temperature data were used to estimate changes in survival across time at a site in northern Minnesota.
The cold tolerance of larch casebearer changed significantly with season: both lower lethal temperatures and supercooling points were lowest in mid-winter and highest in spring and autumn. For example, 50% survival was estimated after acute exposure to a mean ± SE temperature of −28.9 ± 1.77 °C in October, −40.8 ± 0.77 °C in January and −27.8 ± 1.00 °C in April.
A model predicting survival using supercooling points provided conservative estimates of overwintering survival because it overestimated survival by approximately 4% and 8% in 2016 and 2017, respectively.
Analysis of climate data suggested that overwintering survival could have increased significantly over the previous half century.

Wardlow, B. D., Anderson, M. C., Hain, C., Crow, W. T., Otkin, J., Tadesse, T., & Kouchak, A. A. (2017). Advancements in satellite remote sensing for drought monitoring. In *Drought and Water Crises: Integrating Science, Management, and Policy, Second Edition* (pp. 225-258).
Research Tags: Weather, Research
Abstract: *Drought is a complex, climatic phenomenon of global importance with major, wide-ranging impacts to many sectors of society including agriculture, the economy, energy, health and water and other natural resources. In many regions of the world, drought is a common, recurring natural event that can have significant, detrimental economic and environmental impacts. For example, the annual impact of drought in the United States is estimated to total between $6-8 billion (NCDC, 2014) with even farther-reaching effects in developing regions that can result in famine, malnutrition, loss of life and social and political conflict. Changes in climate and the projected increase in climatic extremes such as drought (Dai, 2012) coupled with increasing demands on finite water supplies and food production capabilities have raised the significance of developing effective drought early warning and mitigation strategies. Drought monitoring is a key component for effective drought preparedness strategies, providing critical information on current conditions that can be used to trigger mitigation actions to lessen the impact of this natural hazard. However, drought can be both complex and challenging to monitor because it lacks a single, universal definition, which makes the detection and assessment of key drought characteristics such as severity, geographic extent and duration difficult (Mishra and Singh, 2010). Three operational, physically based definitions were developed by Wilhite and Glantz (1985) to differentiate and describe different types of drought; namely, meteorological, agricultural, and hydrologic drought. The temporal length of dryness needed to initiate and recover from a drought event and the specific environmental factors affected (e.g., rainfall deficits versus plant health versus reservoir water levels) are primary factors distinguishing among these different types of drought. In general, the time period associated with the manifestation or cessation of drought increases as we progress from meteorological through to hydrologic drought. As a result, a period of dryness may result in the emergence of one type of drought (e.g., meteorological) but not the others, while in the case of more prolonged or more severe dry events, several types of drought may be occurring at the same time. As a result, a number of drought indicators related to precipitation, soil moisture, vegetation health, surface and ground water have been developed to characterize specific types of drought and have been analyzed collectively in efforts such as the U.S. Drought Monitor (USDM; Svoboda et al., 2002) to more fully describe drought conditions.*

Warren, M., Frolking, S., Dai, Z., & Kurnianto, S. (2017). Impacts of land use, restoration, and climate change on tropical

peat carbon stocks in the twenty-first century: implications for climate mitigation. *Mitigation and Adaptation Strategies for Global Change, 22*(7), 1041-1061. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84968677689&doi=10.1007%2fs11027-016-9712-1&partnerID=40&md5=72a7de3ae8112b572018a758aaaac2bc. doi:10.1007/s11027-016-9712-1

Research Tags: Soil, Emissions

Abstract: *The climate mitigation potential of tropical peatlands has gained increased attention as Southeast Asian peatlands are being deforested, drained and burned at very high rates, causing globally significant carbon dioxide (CO_2) emissions to the atmosphere. We used a process-based dynamic tropical peatland model to explore peat carbon (C) dynamics of several management scenarios within the context of simulated twenty-first century climate change. Simulations of all scenarios with land use, including restoration, indicated net C losses over the twenty-first century ranging from 10 to 100 % of pre-disturbance values. Fire can be the dominant C-loss pathway, particularly in the drier climate scenario we tested. Simulated 100 years of oil palm (Elaeis guineensis) cultivation with an initial prescribed burn resulted in 2400–3000 Mg CO_2 ha^{-1} total emissions. Simulated restoration following one 25-year oil palm rotation reduced total emissions to 440–1200 Mg CO_2 ha^{-1}, depending on climate. These results suggest that even under a very optimistic scenario of hydrological and forest restoration and the wettest climate regime, only about one third of the peat C lost to the atmosphere from 25 years of oil palm cultivation can be recovered in the following 75 years if the site is restored. Emissions from a simulated land degradation scenario were most sensitive to climate, with total emissions ranging from 230 to 10,600 Mg CO_2 ha^{-1} over 100 years for the wettest and driest dry season scenarios, respectively. The large difference was driven by increased fire probability. Therefore, peat fire suppression is an effective management tool to maintain tropical peatland C stocks in the near term and should be a high priority for climate mitigation efforts. In total, we estimate emissions from current cleared peatlands and peatlands converted to oil palm in Southeast Asia to be 8.7 Gt CO_2 over 100 years with a moderate twenty-first century climate. These emissions could be minimized by effective fire suppression and hydrological restoration.*

Warren, M., Hergoualc'h, K., Kauffman, J. B., Murdiyarso, D., & Kolka, R. (2017). An appraisal of Indonesia's immense peat carbon stock using national peatland maps: Uncertainties and potential losses from conversion. *Carbon Balance and Management, 12*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019357660&doi=10.1186%2fs13021-017-0080-2&partnerID=40&md5=0dd71bf738b4dc2e955fcaa7b66a5151. doi:10.1186/s13021-017-0080-2

Research Tags: Soil

Abstract: *Background*
A large proportion of the world's tropical peatlands occur in Indonesia where rapid conversion and associated losses of carbon, biodiversity and ecosystem services have brought peatland management to the forefront of Indonesia's climate mitigation efforts. We evaluated peat volume from two commonly referenced maps of peat distribution and depth published by Wetlands International (WI) and the Indonesian Ministry of Agriculture (MoA), and used regionally specific values of carbon density to calculate carbon stocks.
Results
Peatland extent and volume published in the MoA maps are lower than those in the WI maps, resulting in lower estimates of carbon storage. We estimate Indonesia's total peat carbon store to be within 13.6 GtC (the low MoA map estimate) and 40.5 GtC (the high WI map estimate) with a best estimate of 28.1 GtC: the midpoint of medium carbon stock estimates derived from WI (30.8 GtC) and MoA (25.3 GtC) maps. This estimate is about half of previous assessments which used an assumed average value of peat thickness for all Indonesian peatlands, and revises the current global tropical peat carbon pool to 75 GtC. Yet, these results do not diminish the significance of Indonesia's peatlands, which store an estimated 30% more carbon than the biomass of all Indonesian forests. The largest discrepancy between maps is for the Papua province, which accounts for 62–71% of the overall differences in peat area, volume and carbon storage. According to the MoA map, 80% of Indonesian peatlands are <300 cm thick and thus vulnerable to conversion outside of protected areas according to environmental regulations. The carbon contained in these shallower peatlands is conservatively estimated to be 10.6 GtC, equivalent to 42% of Indonesia's total peat carbon and about 12 years of global emissions from land use change at current rates.
Conclusions

Considering the high uncertainties in peatland extent, volume and carbon storage revealed in this assessment of current maps, a systematic revision of Indonesia's peat maps to produce a single geospatial reference that is universally accepted would improve national peat carbon storage estimates and greatly benefit carbon cycle research, land use management and spatial planning.

Warwell, M. V., & Shaw, R. G. (2017). Climate-related genetic variation in a threatened tree species, pinus albicaulis. *American Journal of Botany, 104*(8), 1205-1218. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028340581&doi=10.3732%2fajb.1700139&partnerID=40&md5=063d93ea0a77797a875f00961d3b2863. doi:10.3732/ajb.1700139

Research Tags: Forestry

Abstract: *PREMISE OF THE STUDY:*

With ongoing climate change, understanding of intraspecific adaptive variation is critical for conservation and restoration of plant species. Such information is especially scarce for threatened and endangered tree species, such as Pinus albicaulis Engelm. Therefore, our principal aims were to assess adaptive variation and characterize its relationship with climate of seed origin.

METHODS:

We grew seedlings from 49 P. albicaulis populations representative of the interior northwestern United States in two common garden field experiments under warm-dry conditions that mimic climatic conditions predicted in the current century for areas within the species' range. Differences among populations were assessed for growth and survival. We then used regression to describe clines of apparent adaptive variation in relation to climate variation among the populations' origins.

KEY RESULTS:

We detected genetic divergence for growth and survival among populations of P. albicaulis. These differences corresponded to distinct climatic clines. Populations originating from locations with lower spring precipitation exhibited greater survival in response to natural drought. Populations originating from increasingly milder climates exhibited greater height growth under relatively limited stress in early years and greater fitness after 12 yr.

CONCLUSIONS:

The results suggest that P. albicaulis exhibits adaptive variation for drought tolerance and growth in response to selection pressures associated with variation in moisture availability and temperature, respectively. Even so, clinal variation was relatively gentle. Thus, apparent differences in local adaptation to climate among populations appears to be relatively low.

Warwell, M. V., & Shaw, R. G. (2018). Phenotypic selection on growth rhythm in whitebark pine under climatic conditions warmer than seed origins. *Journal of Evolutionary Biology, 31*(9), 1284-1299. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052433734&doi=10.1111%2fjeb.13301&partnerID=40&md5=2d96a5f755135ec274f486264702e110. doi:10.1111/jeb.13301

Research Tags: Forestry

Abstract: *Growth rhythm that is well synchronized with seasonal changes in local climatic conditions is understood to enhance fitness; however, rapid ongoing climate change threatens to disrupt this synchrony. To evaluate phenotypic selection on growth rhythm under expected warmer and drier future climate, seedlings from 49 populations of whitebark pine (Pinus albicaulis Engelm.) were grown and measured over more than 10 years in two common garden field experiments on sites that approximate the projected future climate of the seed origins. Selection on growth rhythm was assessed by relating individual plant fitness to timing and rate of shoot elongation. Differential survival clearly evidenced selection on growth rhythm. We detected directional and stabilizing selection that varied in magnitude between experimental sites and among years. The observed phenotypic selection supports the interpretation of clinal variation among populations within tree species as reflecting adaptive variation in response to past natural selection mediated by climate. To the extent that growth rhythm is heritable, results of the present study suggest evolution of whitebark pine toward a more distinct timing of shoot elongation and generally more rapid elongation in the immediate next generation under ongoing climate change in environments similar to the study sites.*

Warwell, M. V., & Shaw, R. G. (2019). Phenotypic selection on ponderosa pine seed and seedling traits in the field

under three experimentally manipulated drought treatments. *Evolutionary Applications, 12*(2), 159-174. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058851982&doi=10.1111%2feva.12685&partnerID=40&md5=626308e939dd7640861dda6bc7ded9f7. doi:10.1111/eva.12685
Research Tags: Forestry, Weather
Abstract: *Drought-related selection during seedling emergence and early development may play a strong role in adaptation. Yet this process is poorly understood and particularly so in relation to ongoing climate change. To evaluate drought-induced differences in selection during early life stages, a total of 50 maternal families sampled from three climatically disparate ponderosa pine (Pinus ponderosa Doug.) populations were grown from seed in two common garden field experiments at a location that was warmer and drier than seed origins. Three drought treatments were imposed experimentally. Phenotypic selection was assessed by relating plant fitness measured as survival or unconditional expected height at age 3 to seed density (mass per unit volume), date of emergence, and timing of shoot elongation. In the year of emergence from seed, differential mortality was particularly strong and clearly indicated selection. In contrast, selection in subsequent years was far less pronounced. Phenotypes with high seed density, an intermediate but relatively early emergence date, and high 2nd-year early-season shoot elongation exhibited the greatest estimated fitness under drought. The form of selection varied among seed sources in relation to drought treatment. Selection was generally more acute in the cases of greatest difference between drought treatment and climatic patterns of precipitation at the site of seed origin. These results suggest that populations of ponderosa pine are differentially adapted to drought patterns associated with the climate of their origin. To the extent that the phenotypic traits examined are heritable or correlated with heritable traits, our results provide insight into how tree populations may evolve in response to drought.*

Warziniack, T., Lawson, M., & Karen Dante-Wood, S. (2018) Effects of Climate Change on Ecosystem Services in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 189-208).
Research Tags: Forestry, Economics
Abstract: *In this chapter, we focus on the ecosystem services provided to people who visit, live adjacent to, or otherwise benefit from natural resources on public lands. Communities in the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and the Greater Yellowstone Area (GYA), hereafter called the Northern Rockies region, are highly dependent on ecosystem services from water, soil, and air that will be affected by climate change in a variety of ways. Every community in the region will feel these impacts. We link biophysical effects associated with climate change, as described in previous chapters, with potential effects on the well-being of humans and communities, and identify strategies for adapting to climate-induced changes and prioritizing among competing interests. First, we introduce ecosystem services and how to describe and measure them. Second, we describe how people and communities currently use and benefit from public lands in the Northern Rockies region, as well as existing stressors that may affect the ability of communities to adapt to a changing climate. Third, we discuss climate change effects on specific ecosystem services. Finally, we identify adaptation strategies that can help reduce negative effects on ecosystem services, and discuss the ability of public agencies and communities to respond to climate change (adaptive capacity).*

Wear, D. N., & Prestemon, J. P. (2019). Spatiotemporal downscaling of global population and income scenarios for the United States. *PLoS ONE, 14*(7). Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069695222&doi=10.1371%2fjournal.pone.0219242&partnerID=40&md5=6d62a51bc26a509f500d246a0c3e45a3. doi:10.1371/journal.pone.0219242
Research Tags: Research, Economics
Abstract: *Downscaled climate projections need to be linked to downscaled projections of population and economic growth to fully develop implications for land, natural resources, and ecosystems for future scenarios. We develop an empirical spatiotemporal approach for jointly projecting population and income at the county scale in the United States that is consistent with neoclassical economic growth theory and overlapping labor markets and that accounts for labor migration and spatial spillovers. Downscaled projections generated for the five Shared Socioeconomic Pathways used to support global scenario analysis generally show growth focused around relatively few centers especially in the southeast and western regions, with some areas in the Midwest and northeast experiencing population declines. Results are consistent with economic growth theory and with*

historical trends in population change and convergence of per capita personal income across US counties.

Webb, K. M., Delgrosso, S. J., West, M. S., Freeman, C., & Brenner, T. (2017). Influence of environment, crop age and cultivar on the development and severity of Fusarium yellows in field-grown sugar beet. *Canadian Journal of Plant Pathology, 39*(1), 37-47. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017542117&doi=10.1080%2f07060661.2017.1295402&partnerID=40&md5=0a3f6dd55c2139089d0793110f5e054e. doi:10.1080/07060661.2017.1295402

Research Tags: Crops

Abstract: *Fusarium yellows, caused by multiple Fusarium spp., is an important disease of sugar beet in many production regions and leads to considerable reductions in root yield, sucrose percentage, and juice purity. Due to the increasing incidence of Fusarium yellows and the potential impacts of climate change on plant disease development, a better understanding of how the environment contributes to disease severity would provide additional strategies for managing losses due to Fusarium yellows. However, little is known about what environmental factors are most influential for the development and severity of disease in the field, nor how sugar beet responds to these abiotic stresses. Therefore, the occurrence of Fusarium yellows in a susceptible, moderately susceptible, and a resistant cultivar of field grown sugar beet were monitored and correlated with the environmental conditions during the growing season over a four-year period. While Fusarium yellows gradually increased during the field season with crop age, soil moisture appeared to be the environmental factor most correlated with disease severity throughout the growing season. Higher soil moisture content was associated with higher levels of Fusarium yellows particularly as the growing season progressed. During drier years, disease severity was less, especially for the resistant cultivar. Based on these findings, cultivar-specific prediction models were developed using crop age and soil water content, which explained 57–89% of the observed variability in disease severity.*

Webb, N. P., Marshall, N. A., Stringer, L. C., Reed, M. S., Chappell, A., & Herrick, J. E. (2017). Land degradation and climate change: building climate resilience in agriculture. *Frontiers in Ecology and the Environment, 15*(8), 450-459. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028767653&doi=10.1002%2ffee.1530&partnerID=40&md5=145fd29b0fd50775e98dc409dcefcd1a. doi:10.1002/fee.1530

Research Tags: Crops, Livestock

Abstract: *Land degradation and climate change pose enormous risks to global food security. Land degradation increases the vulnerability of agroecological systems to climate change and reduces the effectiveness of adaptation options. Yet these interactions have largely been omitted from climate impact assessments and adaptation planning. We examine how land degradation can influence climate-change impacts and the adaptive capacity of crop and livestock producers across agroecological systems. We then present novel strategies for climate-resilient agriculture that support opportunities to integrate responses to these challenges. Forward-looking, climate-resilient agriculture requires: (1) incorporation of land degradation processes, and their linkages with adaptive capacity, into adaptation planning; (2) identification of key vulnerabilities to prioritize adaptation responses; (3) improved knowledge exchange across local to global scales to support strategies for developing the adaptive capacity of producers; and (4) innovative management and policy options that provide multiple "wins" for land, climate, and biodiversity, thus enabling global development and food security goals to be achieved.*

Webber, H., White, J. W., Kimball, B. A., Ewert, F., Asseng, S., Eyshi Rezaei, E., . . . Martre, P. (2018). Physical robustness of canopy temperature models for crop heat stress simulation across environments and production conditions. *Field Crops Research, 216*, 75-88. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033721014&doi=10.1016%2fj.fcr.2017.11.005&partnerID=40&md5=d3158c079afcb3abab28e9e328ceac4a. doi:10.1016/j.fcr.2017.11.005

Research Tags: Weather, Crops

Abstract: *Despite widespread application in studying climate change impacts, most crop models ignore complex interactions among air temperature, crop and soil water status, CO2 concentration and atmospheric conditions that influence crop canopy temperature. The current study extended previous studies by evaluating Tc simulations from nine crop models at six locations across environmental and production conditions. Each*

crop model implemented one of an empirical (EMP), an energy balance assuming neutral stability (EBN) or an energy balance correcting for atmospheric stability conditions (EBSC) approach to simulate Tc. Model performance in predicting Tc was evaluated for two experiments in continental North America with various water, nitrogen and CO2 treatments. An empirical model fit to one dataset had the best performance, followed by the EBSC models. Stability conditions explained much of the differences between modeling approaches. More accurate simulation of heat stress will likely require use of energy balance approaches that consider atmospheric stability conditions.

Webster, J. R., Stewart, R. M., Knoepp, J. D., & Jackson, C. R. (2019). Effects of instream processes, discharge, and land cover on nitrogen export from southern Appalachian Mountain catchments. *Hydrological Processes, 33*(2), 283-304. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057498485&doi=10.1002%2fhyp.13325&partnerID=40&md5=f3dbe3a227527181ff01ddf4bc120e16. doi:10.1002/hyp.13325

Research Tags: Water

Abstract: *Catchments with minimal disturbance usually have low dissolved inorganic nitrogen (DIN) export, but disturbances and anthropogenic inputs result in elevated DIN concentration and export and eutrophication of downstream ecosystems. We studied streams in the southern Appalachian Mountains, USA, an area dominated by hardwood deciduous forest but with areas of valley agriculture and increasing residential development. We collected weekly grab samples and storm samples from nine small catchments and three river sites. Most discharge occurred at baseflow, with baseflow indices ranging from 69% to 95%. We identified three seasonal patterns of baseflow DIN concentration. Streams in mostly forested catchments had low DIN with bimodal peaks, and summer peaks were greater than winter peaks. Streams with more agriculture and development also had bimodal peaks; however, winter peaks were the highest. In streams draining catchments with more residential development, DIN concentration had a single peak, greatest in winter and lowest in summer. Three methods for estimating DIN export produced consistent results. Annual DIN export ranged from less than 200 g ha−1 year−1 for the less disturbed catchments to over 2,000 g ha−1 year−1 in the catchments with the least forest area. Land cover was a strong predictor of DIN concentration but less significant for predicting DIN export. The two forested reference catchments appeared supply limited, the most residential catchment appeared transport limited, and export for the other catchments was significantly related to discharge. In all streams, baseflow DIN export exceeded stormflow export. Morphological and climatological variation among watersheds created complexities unexplainable by land cover. Nevertheless, regression models developed using land cover data from the small catchments reasonably predicted concentration and export for receiving rivers. Our results illustrate the complexity of mechanisms involved in DIN export in a region with a mosaic of climate, geology, topography, soils, vegetation, and past and present land use.*

Wedow, J. M., Yendrek, C. R., Mello, T. R., Creste, S., Martinez, C. A., & Ainsworth, E. A. (2019). Metabolite and transcript profiling of Guinea grass (Panicum maximum Jacq) response to elevated [CO <inf>2</inf>] and temperature. *Metabolomics, 15*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063500043&doi=10.1007%2fs11306-019-1511-8&partnerID=40&md5=ce9b14fa56566ce4d8a64e3d010745f7. doi:10.1007/s11306-019-1511-8

Research Tags: Grassland

Abstract: *Introduction*

By mid-century, global atmospheric carbon dioxide concentration ([CO2]) is predicted to reach 600 μmol mol−1 with global temperatures rising by 2 °C. Rising [CO2] and temperature will alter the growth and productivity of major food and forage crops across the globe. Although the impact is expected to be greatest in tropical regions, the impact of climate-change has been poorly studied in those regions.

Objectives

This experiment aimed to understand the effects of elevated [CO2] (600 μmol mol−1) and warming (+ 2 °C), singly and in combination, on Panicum maximum Jacq. (Guinea grass) metabolite and transcript profiles.

Methods

We created a de novo assembly of the Panicum maximum transcriptome. Leaf samples were taken at two time points in the Guinea grass growing season to analyze transcriptional and metabolite profiles in plants grown at ambient and elevated [CO2] and temperature, and statistical analyses were used to integrate the data.

Results

Elevated temperature altered the content of amino acids and secondary metabolites. The transcriptome of Guinea grass shows a clear time point separations, with the changes in the elevated temperature and [CO2] combination plots.

Conclusion

Field transcriptomics and metabolomics revealed that elevated temperature and [CO2] result in alterations in transcript and metabolite profiles associated with environmental response, secondary metabolism and stomatal function. These metabolic responses are consistent with greater growth and leaf area production under elevated temperature and [CO2]. These results show that tropical C4 grasslands may have unpredicted responses to global climate change, and that warming during a cool growing season enhances growth and alleviates stress.

Wegner, B. R., Chalise, K. S., Singh, S., Lai, L., Abagandura, G. O., Kumar, S., . . . Jagadamma, S. (2018). Response of soil surface greenhouse gas fluxes to crop residue removal and cover crops under a corn-soybean rotation. *Journal of Environmental Quality, 47*(5), 1146-1154. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055450662&doi=10.2134%2fjeq2018.03.0093&partnerID=40&md5=0b5c21e6e542b270178d6f0320bd81a5. doi:10.2134/jeq2018.03.0093

Research Tags: Crops, Soil, Emissions

Abstract: *Excessive crop residue returned to the soil hinders farm operations, but residue removal can affect soil quality. In contrast, cover cropping can return additional residue to the soil and improve soils and environmental quality compared with no cover cropping. Residue and cover crop impacts on soil surface greenhouses gas (GHG) emissions are undetermined and site specific. Thus, the present study was conducted to investigate the impacts of corn (Zea mays L.) residue management and cover cropping on GHG fluxes. The fluxes were measured from 2013 to 2015 using static chamber under corn and soybean [Glycine max (L.) Merr.] rotation initiated in 2000 at Brookings, SD. Treatments included two residue management levels (residue returned [RR] and residue not returned [RNR]) and two cover cropping (cover crops [CC] and no cover crops [NCC]). Results showed that RR under corn and soybean phases significantly reduced cumulative CO2 fluxes (2681.3 kg ha−1 in corn and 2419.8 kg ha−1 in soybeans) compared with RNR (3331.0 kg ha−1 in corn and 2755.0 kg ha−1 in soybeans) in 2013. The RR emitted significantly less cumulative N2O fluxes than RNR from both the phases in 2013 and 2014, but not in 2015. The CC treatment had significantly lower cumulative N2O fluxes than the NCC for corn and soybean phases in 2013 and 2014. We conclude that crop residue retention and cover cropping can mitigate the GHG emissions compared with residue removal and no cover cropping.*

Wei, X., Winkler, R., & Sun, G. (2017). Forest cover change, climate variability, and hydrological responses. *Ecohydrology, 10*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85015220675&doi=10.1002%2feco.1847&partnerID=40&md5=bedc8692800d54f92c131b0af9b2c764. doi:10.1002/eco.1847

Research Tags: Forestry, Water

Abstract: *Understanding ecohydrological response to environmental change is critical for protecting watershed functions, sustaining clean water supply, and other ecosystem services, safeguarding public safety, floods mitigation, and drought response. Understanding ecohyhdrological processes and their implications to forest and water management has become increasingly important in the Anthropocene (Li et al., 2017; Sun & Vose, 2016). In forested watersheds or landscapes, the complex relationships between climate and forest cover are commonly viewed as two key drivers of ecohydrological processes. Quantifying these relationships and the ecohydrological response to change is key to improved land-use planning and management in forested watersheds.*

This special issue includes 11 selected papers presented at the 4th IUFRO (International Union of Forest Research Organization) Conference on Forests and Water in a Changing Environment held from July 6–9, 2015, in Kelowna, British Columbia, Canada. This collection represents the most recent studies on forest ecohydrological processes under a wide range of geographic regions and environmental settings.

The first four papers in this special issue examine the relationships between climate and ecohydrological processes. Liu (2017) investigated the response of dead forest fuel moisture to climate change in the continental United States, an area of frequent wildfires and where controlled burning is used to reduce fire hazards. Using the empirical fuel moisture model of the US National Fire Danger Rating System, the study predicted an

overwhelming decrease in fuel moisture across the United States, mainly due to an increase in air temperature, further suggesting future increases in frequency, size, and intensity of wildfires. Liu, Harper, Dell, Liu, and Yu (2017) examined vegetation responses to a long drought period (2002–2010) on the Australian continent and found a dramatic decline in both normalized difference vegetation and leaf area indices particularly in places where rainfall decreased the most. Using the FORECAST-Climate model, de Andrés et al. (2017) simulated the responses of a mixed Scots pine and European beech forest to climate change. They found improved water use efficiency in the mixed species as compared to monoculture beech or pine stands and suggest that plantings of pine and beech mixed forest could be an effective climate change adaptation strategy on drought-prone sites in northern Spain. Zhang, Hickel and Shao (2017a) clearly demonstrated the critical role of climate in changing moisture regime, vegetation dynamics, water use efficiency and, consequently, hydrological response to forest disturbance in six large watersheds located in the interior of British Columbia, Canada.

The five subsequent papers focus on the relationships between ecohydrological processes and forest changes caused by environmental disturbance, logging, and reforestation. Hallema et al. (2017) found that forest cover loss through wildfire greatly enhanced streamflow in their three case watersheds in the conterminous United States. Winkler, Spittlehouse, and Sarah (2017) demonstrated that logging (47%) only caused 5% increase of annual water yield but greatly shifted seasonal flow patterns (e.g., increasing April–May total yield but decreasing June–July water yield). Tschaplinski and Pike (2017) demonstrate that logging-related changes in annual water yield and the seasonal distribution of flow can have important implications for other ecohydrological processes and significant downstream consequences such as increased sedimentation and deterioration of fish habitat. Based on the paired-basin experiments, Perry and Jones (2017) found that Douglas-fir regeneration in the U.S. Pacific Northwest significantly reduced summer flows. Similarly, Zhang, Wei and Li (2017b) showed reductions in monthly streamflow with afforestation in four Australian catchments based on the simulations using a dynamic water balance model.

The importance of understanding the combined effects of changes in both climate and land (or forest) cover on ecohydrologic processes is illustrated in the final two papers. Chen et al. (2017) assessed soil moisture changes in response to both regional climate and land cover changes across China. Their study was able to quantify relative roles of climatic variability and land cover changes in surface soil moisture dynamics. They concluded that climatic factors were the main contributors to the declining trends of cool-season soil moisture in central and south China, and land cover changes were a more dominant control in soil moisture in northwest China. Schüler et al. (2017) assessed hydrological processes and water resources under future climate and forest cover changes in two forested headwater catchments in South-West Germany using the physical based hydrological model ArcAPEX. Their results suggest usefulness of considering "spread the risk" management options and "no-regret" decisions in dealing with the uncertain future. Those two case studies clearly demonstrate importance of including both climate and forest changes in assessing hydrological response. This rather holistic approach is also highlighted in several other studies in this special issue (e.g., Zhang, et al., 2017a; Hallema et al., 2017).

The case studies reported in this special issue clearly demonstrate the critical and individual role of climate and forests in ecohydrological processes. More importantly, this special issue also shows the significance of, and need for, considering the combined effects of both climate variability and forest cover change when assessing hydrological variations in forested watersheds and in future ecohydrological studies.

Weintraub, P. G., Scheffer, S. J., Visser, D., Valladares, G., Correa, A. S., Shepard, B. M., . . . Metzler, H. B. (2017). The invasive liriomyza huidobrensis (Diptera: Agromyzidae): Understanding its pest status and management globally. *Journal of Insect Science, 17*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029668262&doi=10.1093%2fjisesa%2fiew121&partnerID=40&md5=3720a46ade9f815c5d685ac49fde70a6. doi:10.1093/jisesa/iew121

Research Tags: Wildlife

Abstract: *Liriomyza huidobrensis (Blanchard) is native to South America but has expanded its range and invaded many regions of the world, primarily on flowers and to a lesser extent on horticultural product shipments. As a result of initial invasion into an area, damage caused is usually significant but not necessarily sustained. Currently, it is an economic pest in selected native and invaded regions of the world. Adults cause damage by puncturing abaxial and adaxial leaf surfaces for feeding and egg laying sites. Larvae mine the leaf parenchyma tissues which can lead to leaves drying and wilting. We have recorded 365 host plant species from*

49 families and more than 106 parasitoid species. In a subset of the Argentinian data, we found that parasitoid community composition attacking L. huidobrensis differs significantly in cultivated and uncultivated plants. No such effect was found at the world level, probably due to differences in collection methods in the different references. We review the existing knowledge as a means of setting the context for new and unpublished data. The main objective is to provide an update of widely dispersed and until now unpublished data, evaluate dispersion of the leafminer and management strategies in different regions of the world, and highlight the need to consider the possible effects of climate change on further regional invasions or expansions.

Weise, D. R., Fletcher, T. H., Cole, W., Mahalingam, S., Zhou, X., Sun, L., & Li, J. (2018). Fire behavior in chaparral–Evaluating flame models with laboratory data. *Combustion and Flame, 191*, 500-512. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042876719&doi=10.1016%2fj.combustflame.2018.02.012&partnerID=40&md5=161692dfce81b5ac5d466b7c49f78731. doi:10.1016/j.combustflame.2018.02.012

Research Tags: Grassland, Weather

Abstract: *Flame and mass loss data for chaparral, a mixture of shrub plants from the Mediterranean climate zone of southwestern North America, from five previously reported experiments were used to evaluate several published models relating flame characteristics to mass loss and heat release rates. These data are unique with fuel moisture content ranging from 0.36 to 0.94 (dry basis); the study used mass loss rates which included water loss. Fit of the data to Froude number correlations developed by Albini, Byram, Nelson and Thomas and heat release rate—flame length correlations by Heskestad, Zukoski, and Yuan/Cox for axisymmetric and line fires were examined.*

Chaparral fuels configured as circular cribs and burned in this fashion behaved similarly to other "pool fire" configurations. Scaled flame lengths generally agreed with heat release correlations developed for other fuel types; however, limited agreement for line fire data indicated potential for improvements that can be made. A strong relationship between mass loss rate and flame length in these live fuel beds extends this well-established relationship to these fuel types. The fitted exponent lends support to Byram's derivation that flame length is related to Fr0.5 and not Thomas' derivation of Fr2/3. Live foliage particles still retain significant moisture at the time of ignition suggesting that moisture content may be an important parameter to include in these correlations if they are to be applied to live wildland fuels.

Wenninger, A., Hollingsworth, T., & Wagner, D. (2019). Predatory Hymenopteran Assemblages in Boreal Alaska: Associations with Forest Composition and Post-Fire Succession. *Ecoscience, 26*(3), 205-220. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066743297&doi=10.1080%2f11956860.2018.1564484&partnerID=40&md5=8db33df2eee9352b97dc5b46a283b45e. doi:10.1080/11956860.2018.1564484

Research Tags: Forestry, Weather, Wildlife

Abstract: *Changes to the fire regime in boreal Alaska are shifting the ratio of coniferous to deciduous dominance on the landscape. The increase in aspen and birch may have important effects on predatory hymenopteran assemblages by providing a source of extrafloral nectar and increasing prey availability. Furthermore, fire-induced changes in successional age alter habitat structure and microclimate in ways that may favor ants. This study is the first to characterize the influence of fire-related vegetation changes on boreal predatory hymenopteran assemblages. We compare the abundance, species richness, and composition of predatory hymenopteran assemblages among forests at different stages of succession and of varying post-fire tree species compositions. Ant assemblages were weakly related to forest composition, but ants were significantly more abundant and speciose in early-successional forests than in mid-late successional forests. In contrast, macropterous wasp morphospecies richness and abundance, and micropterous wasp abundance, were positively related to the basal area of aspen, but were not related to successional stage. The results suggest that shifts in boreal vegetation related to climate warming will result in changes to the predaceous insect community, with ants responding positively to disturbance and wasps responding positively to an increase in the representation of aspen on the landscape.*

Westbrook, J. K., & Eyster, R. S. (2018). Atmospheric environment associated with animal flight. In *Aeroecology* (pp. 13-45).

Research Tags: Wildlife
Abstract: *The atmospheric environment can assist or restrict flight of animals (insects, birds, and bats), influencing their ability to extend their population range and find new habitats for food, mating, and shelter (Pedgley, Windborne pests and diseases: meteorology of airborne organisms. Ellis Horwood, 1982; Drake and Gatehouse, Insect migration: tracking resources through space and time. Cambridge University Press, 1995; Isard and Gage, Flow of life in the atmosphere: an airscape approach to understanding invasive organisms. Michigan State University Press, 2001; Drake and Reynolds, Radar entomology: observing insect flight and migration. CABI, 2012). Flight initiation may be influenced by air temperature, wind speed, wind direction, barometric pressure change, or other atmospheric variables and may require substantial convective lift for small invertebrates such as wingless insects and spiders. Flight displacement distance and direction largely depends on prevailing wind speed and wind direction at respective flight altitudes, although flying animals can add to their displacement speed and can alter their displacement direction by heading at an angle relative to the wind direction (Wolf et al., Southwestern Entomol Suppl 18:45–61, 1995), including upwind flight. While flying, animals may engage in predatory behaviors and conversely may be preyed upon. Long-distance flight of flying animals may be abruptly terminated by mid-latitude fronts, gust fronts, and precipitation. Ultimately, movement of animal populations in the atmosphere ranges across spatial and temporal scales spanning the microscale to macroscale and is vulnerable to changes in short-term weather and long-term climate patterns.*

Wetherington, M. T., Jennings, D. E., Shrewsbury, P. M., & Duan, J. J. (2017). Climate variation alters the synchrony of host–parasitoid interactions. *Ecology and Evolution, 7*(20), 8578-8587. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85031722006&doi=10.1002%2fece3.3384&partnerID=40&md5=19d24baaf9f5f2cb4d9619f8b4652f75. doi:10.1002/ece3.3384
Research Tags: Weather, Wildlife, Forestry
Abstract: *Observed changes in mean temperature and increased frequency of extreme climate events have already impacted the distributions and phenologies of various organisms, including insects. Although some research has examined how parasitoids will respond to colder temperatures or experimental warming, we know relatively little about how increased variation in temperature and humidity could affect interactions between parasitoids and their hosts. Using a study system consisting of emerald ash borer (EAB), Agrilus planipennis, and its egg parasitoid Oobius agrili, we conducted environmentally controlled laboratory experiments to investigate how increased seasonal climate variation affected the synchrony of host–parasitoid interactions. We hypothesized that increased climate variation would lead to decreases in host and parasitoid survival, host fecundity, and percent parasitism (independent of host density), while also influencing percent diapause in parasitoids. EAB was reared in environmental chambers under four climate variation treatments (standard deviations in temperature of 1.24, 3.00, 3.60, and 4.79°C), while O. agrili experiments were conducted in the same environmental chambers using a 4 × 3 design (four climate variation treatments × 3 EAB egg densities). We found that EAB fecundity was negatively associated with temperature variation and that temperature variation altered the temporal egg laying distribution of EAB. Additionally, even moderate increases in temperature variation affected parasitoid emergence times, while decreasing percent parasitism and survival. Furthermore, percent diapause in parasitoids was positively associated with humidity variation. Our findings indicate that relatively small changes in the frequency and severity of extreme climate events have the potential to phenologically isolate emerging parasitoids from host eggs, which in the absence of alternative hosts could lead to localized extinctions. More broadly, these results indicate how climate change could affect various life history parameters in insects, and have implications for consumer–resource stability and biological control.*

White, M. J., Gambone, M., Haney, E., Arnold, J., & Gao, J. (2017). Development of a station based climate database for SWAT and APEX assessments in the US. *Water (Switzerland), 9*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020869552&doi=10.3390%2fw9060437&partnerID=40&md5=ab2927b5765109fc4a7159bdb3d9f4fa. doi:10.3390/w9060437
Research Tags: Water, Soil, Research
Abstract: *Water quality simulation models such as the Soil and Water Assessment Tool (SWAT) and Agricultural Policy EXtender (APEX) are widely used in the US. These models require large amounts of spatial and tabular data to simulate the natural world. Accurate and seamless daily climatic data are critical for*

accurate depiction of the hydrologic cycle, yet these data are among the most difficult to obtain and process. In this paper we describe the development of a national (US) database of preprocessed climate data derived from monitoring stations applicable to USGS 12-digit watersheds. Various sources and processing methods are explored and discussed. A relatively simple method was employed to choose representative stations for each of the 83,000 12-digit watersheds in the continental US. Fully processed climate data resulting from this research were published online to facilitate other SWAT and APEX modeling efforts in the US.

White, R. R., & Hall, M. B. (2018). Reply to van meerbeek and svenning, emery, and springmann et al.: Clarifying assumptions and objectives in evaluating effects of food system shifts on human diets. *Proceedings of the National Academy of Sciences of the United States of America, 115*(8), E1706-E1708. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042197862&doi=10.1073%2fpnas.1720895115&partnerID=40&md5=737eb5d569557fea6d7a8ef0446a92c8. doi:10.1073/pnas.1720895115
Research Tags: Economics, Crops, Livestock
No Abstract:

Wi, S., Ray, P., Demaria, E. M. C., Steinschneider, S., & Brown, C. (2017). A user-friendly software package for VIC hydrologic model development. *Environmental Modelling and Software, 98*, 35-53. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030482023&doi=10.1016%2fj.envsoft.2017.09.006&partnerID=40&md5=580ba92da68c751308f100346db2b279. doi:10.1016/j.envsoft.2017.09.006
Research Tags: Water
Abstract: *The Variable Infiltration Capacity (VIC) hydrologic and river routing model simulates the water and energy fluxes that occur near the land surface and provides useful information regarding the quantity and timing of available water within a watershed system. However, despite its popularity, wider adoption is hampered by the considerable effort required to prepare model inputs and calibrate the model parameters. This study presents a user-friendly software package, named VIC-Automated Setup Toolkit (VIC-ASSIST), accessible through an intuitive MATLAB graphical user interface. VIC-ASSIST enables users to navigate the model building process through prompts and automation, with the intention to promote the use of the model for practical, educational, and research purposes. The automated processes include watershed delineation, climate and geographical input set-up, model parameter calibration, sensitivity analysis, and graphical output generation. We demonstrate the package's utilities in various case studies.*

Wieczorek, K., Bugaj-Nawrocka, A., Kanturski, M., & Miller, G. L. (2017). Geographical variation in morphology of Chaetosiphella stipae stipae Hille Ris Lambers, 1947 (Hemiptera: Aphididae: Chaitophorinae). *Scientific Reports, 7*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014928343&doi=10.1038%2fsrep43988&partnerID=40&md5=9d424ee6d6041bea91e287728720294a. doi:10.1038/srep43988
Research Tags: Wildlife, Grassland
Abstract: *Chaetosiphella stipae stipae is a xerothermophilous aphid, associated with Palaearctic temperate steppe zones or dry mountain valleys, where there are grasses from the genus Stipa. Its geographical distribution shows several populations that are spread from Spain, across Europe and Asia Minor, to Mongolia and China. Geographical variation in chaetotaxy and other morphological features were the basis to consider whether individuals from different populations are still the same species. Moreover, using Ch. stipae stipae and Stipa species occurrences, as well as climatic variables, we predict potential geographical distributions of the aphid and its steppe habitat. Additionally, for Stipa species we projected current climatic conditions under four climate change scenarios for 2050 and 2070. While highly variable, our results of morphometric analysis demonstrates that all Ch. stipae stipae populations are one very variable subspecies. And in view of predicted climate change, we expect reduction of Stipa grasslands. The disappearance of these ecosystems could result in stronger separation of the East-European and Asian steppes as well as European 'warm-stage' refuges. Therefore, the geographic morphological variability that we see today in the aphid subspecies Ch. stipae stipae may in the future lead to speciation and creation of separate subspecies or species.*

Wienhold, B. J., Jin, V. L., Schmer, M. R., & Varvel, G. E. (2018). Soil carbon response to projected climate change in the US Western Corn Belt. *Journal of Environmental Quality, 47*(4), 704-709. Retrieved from

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049428262&doi=10.2134%2fjeq2017.09.0379&partnerID=40&md5=339b3ea9510f9c2d6af7b6c18f8c758b. doi:10.2134/jeq2017.09.0379
Research Tags: Soil
Abstract: *The western US Corn Belt is projected to experience major changes in growing conditions due to climate change over the next 50 to 100 yr. Projected changes include increases in growing season length, number of high temperature stress days and warm nights, and precipitation, with more heavy rainfall events. The impact these changes will have on soil organic carbon (SOC) needs to be estimated and adaptive changes in management developed to sustain soil health and system services. The process-based model CQESTR was used to model changes in SOC stocks (0–30 cm) of continuous corn (Zea mays L.) and a corn–soybean [Glycine max (L.) Merr.] rotation under disk, chisel, ridge, and no-tillage using projected growing season conditions for the next 50 yr. Input for the model was based on management and harvest records from a long-term tillage study (1986–2015) in eastern Nebraska, and model output was validated using measured changes in SOC from 1999 to 2011 in the study. The validated model was used to estimate changes in SOC over 17 yr under climatic conditions projected for 2065 under two scenarios: (i) crop yields increasing at the observed rate from 1971 to 2016 or (ii) crop yields reduced due to negative effects of increasing temperature. CQESTR estimates of SOC agreed well with measured SOC (R2 = 0.70, P < 0.0001). Validated model simulated changes in SOC under projected climate change differed among the three soil depths (0–7.5, 7.5–15, and 15–30 cm). Summed over the 0- to 30-cm depth, there were significant three-way interactions of year × rotation × yield (p = 0.014) and year × tillage × yield (p < 0.001). As yield increased, SOC increased under no-tillage continuous corn but was unchanged under no-tillage corn–soybean and ridge tillage regardless of cropping system. Under chisel and disk tillage, SOC declined regardless of cropping system. With declining yields SOC decreased regardless of tillage or cropping system. These results highlight the interaction between genetics and management in maintaining yield trends and soil C.*

Wienhold, B. J., Vigil, M. F., Hendrickson, J. R., & Derner, J. D. (2018). Vulnerability of crops and croplands in the US Northern Plains to predicted climate change. *Climatic Change, 146*(1-2), 219-230. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019890848&doi=10.1007%2fs10584-017-1989-x&partnerID=40&md5=d0c2078ad6ddf3682d430d9dbed83663. doi:10.1007/s10584-017-1989-x
Research Tags: Crops
Abstract: *The states of Colorado, Montana, Nebraska, North Dakota, South Dakota, and Wyoming comprise the Northern Great Plains region of the USA. The soil and water resources contained in this region have historically supported highly diverse and productive agriculture enterprises that provide a significant proportion of the food, feed, and oilseed for the nation. The region also provides ecological services that influence air, water, and soil quality along with biological diversity. Combined with livestock production and a biofuel industry, crop production forms an integrated system that can offer producers flexibility in management decisions. Projected climatic changes for this region include increasing atmospheric CO2, a longer, warmer growing season, and increased precipitation, likely received in more frequent extreme events. These changes will impact soil and water resources in the region and create opportunities and challenges for land managers. The objectives of this paper are to describe anticipated impacts of projected mid-(2050) and late-(2085) climatic changes on crop production systems in the Northern Great Plains and provide adaptation strategies that should be developed to take advantage of positive and mitigate negative changes. Projected climatic changes will influence agricultural productivity directly as well as indirectly due to changes in weed pressure, insect populations, and diseases. A warmer, longer growing season will change the crops and distribution of those crops grown within the region. An increase in the number of extreme temperature events (high daytime highs or nighttime lows) will decrease crop yields due to increased plant stress during critical pollination and grain fill periods. Adaptation strategies to reduce vulnerability of soil and water resources to projected climatic changes include increasing cropping intensity, reducing tillage intensity, and use of cover crops to provide surface cover to reduce erosion potential and improve nutrient and water use efficiency. Increased use of perennial forages, crop residue, and failed crops in integrated crop-livestock systems will add biological diversity and provide options for converting vegetation biomass into animal protein. Socio-economic changes will need to be incorporated into adaptation strategies planning to insure that sustaining ecosystem services and meeting desired production and conservation goals is accomplished. Education and extension services will be needed to transfer adaptive knowledge in a timely manner to producers in the field.*

Wigneron, J. P., Jackson, T. J., O'Neill, P., De Lannoy, G., de Rosnay, P., Walker, J. P., . . . Kerr, Y. (2017). Modelling the passive microwave signature from land surfaces: A review of recent results and application to the L-band SMOS & SMAP soil moisture retrieval algorithms. *Remote Sensing of Environment, 192*, 238-262. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014435143&doi=10.1016%2fj.rse.2017.01.024&partnerID=40&md5=862bf5216223b766912339d6f77db424. doi:10.1016/j.rse.2017.01.024

Research Tags: Soil, Research

Abstract: *Two passive microwave missions are currently operating at L-band to monitor surface soil moisture (SM) over continental surfaces. The SMOS sensor, based on an innovative interferometric technology enabling multi-angular signatures of surfaces to be measured, was launched in November 2009. The SMAP sensor, based on a large mesh reflector 6 m in diameter providing a conically scanning antenna beam with a surface incidence angle of 40°, was launched in January of 2015. Over the last decade, an intense scientific activity has focused on the development of the SM retrieval algorithms for the two missions. This activity has relied on many field (mainly tower-based) and airborne experimental campaigns, and since 2010–2011, on the SMOS and Aquarius space-borne L-band observations. It has relied too on the use of numerical, physical and semi-empirical models to simulate the microwave brightness temperature of natural scenes for a variety of scenarios in terms of system configurations (polarization, incidence angle) and soil, vegetation and climate conditions. Key components of the inversion models have been evaluated and new parameterizations of the effects of the surface temperature, soil roughness, soil permittivity, and vegetation extinction and scattering have been developed. Among others, global maps of select radiative transfer parameters have been estimated very recently. Based on this intense activity, improvements of the SMOS and SMAP SM inversion algorithms have been proposed. Some of them have already been implemented, whereas others are currently being investigated. In this paper, we present a review of the significant progress which has been made over the last decade in this field of research with a focus on L-band, and a discussion on possible applications to the SMOS and SMAP soil moisture retrieval approaches.*

Wijewardana, C., Reddy, K. R., Shankle, M. W., Meyers, S., & Gao, W. (2018). Low and high-temperature effects on sweetpotato storage root initiation and early transplant establishment. *Scientia Horticulturae, 240*, 38-48. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047929374&doi=10.1016%2fj.scienta.2018.05.052&partnerID=40&md5=0d9a67595644a91d9ac0828ce3d772cb. doi:10.1016/j.scienta.2018.05.052

Research Tags: Crops, Weather

Abstract: *Temperature is considered as a major environmental factor upon which the storage behavior of sweetpotatoes depends. To quantify shoot and root vigor responses during sweetpotato early transplant establishment, an experiment was conducted using sunlit environmental growth chambers at three day/night temperatures, 22/14 (low), 30/22 (optimum), 38/30 °C (high). Ten sweetpotato cultivars were transplanted in pots for 20 days and several shoot and root morphological and physiological traits were assessed. Sweetpotato cultivars varied significantly for many traits measured particularly root components. High and low temperatures significantly decreased the production of storage root number. Low temperature caused a marked decrease in vine length, node number, leaf area, total biomass, and net photosynthesis causing 95, 70, 78, 66, and 36% reduction compared to the optimum temperature. At high temperature, average leaf area was seven times more than optimum indicating strong temperature effects on leaf number, size, and leaf area development. Principal component analysis was used to classify sweetpotato cultivars to low and high-temperature tolerant, intermediate, and sensitive groups. The sweetpotato cultivars O'henry and Bonita were identified as tolerant, Evangeline, B14, Vardaman, and Covington as intermediate tolerant, and NC05198 and Travis as sensitive to both low and high temperatures. A poor correlation was observed between low and high temperature response indices indicating that cold and heat tolerance mechanisms are different and the selection has to be made independently in developing tolerance to low and high temperatures. The identified low and high temperature tolerant cultivars and their associated morpho-physiological characteristics may be useful for breeders to develop new cultivars that could withstand variable temperatures projected to occur in future climates aiming to increase storage root yield.*

Wilcox, K. R., Shi, Z., Gherardi, L. A., Lemoine, N. P., Koerner, S. E., Hoover, D. L., . . . Luo, Y. (2017). Asymmetric responses of primary productivity to precipitation extremes: A synthesis of grassland precipitation manipulation experiments. *Global Change Biology, 23*(10), 4376-4385. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019027127&doi=10.1111%2fgcb.13706&partnerID=40&md5=b967b0ad7e95efbc41d64dade5828068. doi:10.1111/gcb.13706

Research Tags: Weather, Grassland

Abstract: *Climatic changes are altering Earth's hydrological cycle, resulting in altered precipitation amounts, increased interannual variability of precipitation, and more frequent extreme precipitation events. These trends will likely continue into the future, having substantial impacts on net primary productivity (NPP) and associated ecosystem services such as food production and carbon sequestration. Frequently, experimental manipulations of precipitation have linked altered precipitation regimes to changes in NPP. Yet, findings have been diverse and substantial uncertainty still surrounds generalities describing patterns of ecosystem sensitivity to altered precipitation. Additionally, we do not know whether previously observed correlations between NPP and precipitation remain accurate when precipitation changes become extreme. We synthesized results from 83 case studies of experimental precipitation manipulations in grasslands worldwide. We used meta-analytical techniques to search for generalities and asymmetries of aboveground NPP (ANPP) and belowground NPP (BNPP) responses to both the direction and magnitude of precipitation change. Sensitivity (i.e., productivity response standardized by the amount of precipitation change) of BNPP was similar under precipitation additions and reductions, but ANPP was more sensitive to precipitation additions than reductions; this was especially evident in drier ecosystems. Additionally, overall relationships between the magnitude of productivity responses and the magnitude of precipitation change were saturating in form. The saturating form of this relationship was likely driven by ANPP responses to very extreme precipitation increases, although there were limited studies imposing extreme precipitation change, and there was considerable variation among experiments. This highlights the importance of incorporating gradients of manipulations, ranging from extreme drought to extreme precipitation increases into future climate change experiments. Additionally, policy and land management decisions related to global change scenarios should consider how ANPP and BNPP responses may differ, and that ecosystem responses to extreme events might not be predicted from relationships found under moderate environmental changes.*

Wilcox, T. M., Young, M. K., McKelvey, K. S., Isaak, D. J., Horan, D. L., & Schwartz, M. K. (2018). Fine-scale environmental DNA sampling reveals climate-mediated interactions between native and invasive trout species. *Ecosphere, 9*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058111585&doi=10.1002%2fecs2.2500&partnerID=40&md5=0f5b3c76e4c990deb64ceec5ebdeed2f. doi:10.1002/ecs2.2500

Research Tags: Wildlife

Abstract: *It is widely recognized that biotic interactions may act as important mediators of species responses to climate change. However, collecting the abiotic and biotic covariates at the resolution and extent needed to reveal these interactions from species distribution models is often prohibitively expensive and labor-intensive. Here we used crowd-sourced environmental DNA sampling—the inference of species presence from genetic material in the environment—and high-resolution habitat covariates across 630 sites over an area of nearly 10,000 km2 to build an accurate species distribution model (AUC = 0.96; prediction accuracy = 0.90) for bull trout in cold-water habitats that incorporates fine-scale, context-dependent interactions with invasive brook trout. We then used this model to project possible climate change and brook trout invasion scenarios for bull trout forward in time. Our environmental DNA sampling results were concordant with traditional electrofishing samples in the basin and revealed species patterns that were consistent with previous studies: Bull trout were positively associated with larger stream sizes and negatively associated with high brook trout abundances. However, our modeling also revealed an important nuance: At high abundance, brook trout appear to exclude bull trout from small streams, even those below the thermal optima for brook trout. Climate projections suggest a loss of suitable bull trout habitat as streams warm and summer flows decrease, which could make deleterious interactions with brook trout more common in the future. Where brook trout are invading bull trout habitats, streams that are both large and cold are most likely to provide native bull trout with long-term refuges.*

Wilhelmi, N. P., Shaw, D. C., Harrington, C. A., Clair, J. B. S., & Ganio, L. M. (2017). Climate of seed source affects

susceptibility of coastal Douglas-fir to foliage diseases. *Ecosphere, 8*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039440349&doi=10.1002%2fecs2.2011&partnerID=40&md5=8d8de8cc0bdcafec5f375d8d01184b4e. doi:10.1002/ecs2.2011
Research Tags: Forestry
Abstract: *Seed-source movement trials using common garden experiments are needed to understand climate, tree (host), and pathogen interactions. Douglas-fir (Pseudotsuga menziesii var menziesii) is an important tree species native to western North America influenced by the foliar fungi Phaeocryptopus gaeumannii, a biotroph and causal agent of Swiss needle cast (SNC), and Rhabdocline species, necrotrophs that cause Rhabdocline needle cast. We used the Douglas-fir Seed-Source Movement Trial, a large provenance study of Douglas-fir that consists of populations and test sites chosen to represent the range of climate conditions experienced by Douglas-fir west of the Cascade and northern Sierra Nevada Mountains, USA, to assess disease severity and symptom expression in Douglas-fir in relation to climatic differences between test sites and population sources. Using generalized linear mixed models, probability of disease severity/expression was modeled with respect to the climate variables May through September precipitation (MSP), mean winter temperature (MWT), and continentality. Stark differences in disease expression were observed in trees from different regions, especially in relation to resistance to Rhabdocline spp. and tolerance to P. gaeumannii. There were no major differences across seed-source regions at any particular site in infection levels of P. gaeumannii assessed by fruiting body abundance, yet disease tolerance followed similar geographic patterns as resistance to Rhabdocline spp. Transfers of populations from low to high MSP, and/or cool to warm MWT, increased the probability of moderate to severe Rhabdocline spp. infection and SNC disease symptoms. Our results suggest that local seed sources are adapted to local climate and pathogen pressures and that seed sources from regions with high foliage disease pressure are most resistant/tolerant to those foliage diseases. We also confirm that temperature and precipitation are important epidemiological factors in forest disease and that assisted migration must take into account trophic interactions of trees. Movement of seed sources from dry spring and summer and/or cool winter conditions to mild, mesic environments is likely to lead to increased probability of losses due to these foliage diseases.*

Wilk, R. J., Lesmeister, D. B., & Forsman, E. D. (2018). Nest trees of northern spotted owls (Strix occidentalis caurina) in Washington and Oregon, USA. *PLoS ONE, 13*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048019915&doi=10.1371%2fjournal.pone.0197887&partnerID=40&md5=88b9cdc3edc83b556969ac5c6bc99251. doi:10.1371/journal.pone.0197887
Research Tags: Wildlife
Abstract: *The northern spotted owl (Strix occidentalis caurina) is a federally-threatened subspecies in the United States associated with late-successional forests. In mesic forests it nests primarily in tree cavities, but also uses various types of external platform nests in drier forests. We describe 1717 northern spotted owl nests in 16 different tree species in five study areas in Washington and Oregon in the Pacific Northwest, USA. The vast majority of nests (87%) were in Douglas-fir (Pseudotsuga menziesii) trees, except on the Olympic Peninsula, Washington, where nests were about equally abundant in Douglas-fir, western red cedar (Thuja plicata), and western hemlock (Tsuga heterophylla) trees. Distribution of nests was 57.9% in top cavities of trees with broken tops, 20.3% in side cavities of hollow tree trunks, and 21.8% on external platforms of trees. Platforms were most common in the two driest study areas in the Eastern Cascades Physiographic Province, Washington (89% of nests), and the Klamath Province, Oregon (32%). The vast majority (89%) of nests were in trees with intact or declining crowns. Nests in dead trees were most common on the Olympic Peninsula. Nest trees with top and side cavities were larger and much more prevalent in study areas where annual precipitation was highest (Olympic Peninsula, Oregon Coast Range). Large nest cavities and platforms used by northern spotted owls occur almost exclusively in old forest. Managing for the retention of such forests and for their replacement is a significant challenge for land managers, especially in the face of climate change and an increasing human population, but will likely be required for the persistence of viable populations of northern spotted owls.*

Wilkinson, J. M., & Muck, R. E. (2019). Ensiling in 2050: Some challenges and opportunities. *Grass and Forage Science, 74*(2), 178-187. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063686473&doi=10.1111%2fgfs.12418&partnerID

=40&md5=18c05b19cee0a9e951998080a6800003. doi:10.1111/gfs.12418
Research Tags: Livestock
Abstract: *Challenges to ensiling are coming from a wide spectrum. Faster harvest rates are making it more difficult to achieve target silage densities. Larger harvest equipment is increasing soil compaction and rural road issues. Older silos are too small and are overfilled, creating safety issues, or temporary piles are placed on bare ground permitting soil contamination. Mycotoxins and other pathogens in silages are still a problem. Global warming may affect the forage crops grown and crop characteristics as well as rates of silage fermentation and aerobic deterioration. Silage as an input to bio-refineries has an unclear future. Silage analysis is challenged by sampling and knowing what components truly predict nutritional value. The future holds many opportunities for both ensiling and silage research. Robotic harvesting will release more labour for silo packing, and there are opportunities to develop tools to estimate silage density during filling. Total mixed ration silages should allow more by-products in rations. The development of novel silage additives to improve silage hygiene or increase nutrient availability appears promising. Predicting the onset of aerobic deterioration with quick tests for lactate-assimilating yeasts or silage temperatures seems possible. Metabolomics and metabonomics, in addition to the microbiome tools in development, put us at the cusp of being able to see which microorganisms are active in the silo and rumen and what compounds of significance they are producing. This could lead to many advances in silage quality including reduced microbial toxins, better hygiene and improved utilization by livestock.*

Williams, A., Jordan, N. R., Smith, R. G., Hunter, M. C., Kammerer, M., Kane, D. A., . . . Davis, A. S. (2018). A regionally-adapted implementation of conservation agriculture delivers rapid improvements to soil properties associated with crop yield stability. *Scientific Reports, 8*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048022524&doi=10.1038%2fs41598-018-26896-2&partnerID=40&md5=292d04d6d6beb21d76616ef8df0a6e16. doi:10.1038/s41598-018-26896-2
Research Tags: Soil, Crops, Weather
Abstract: *Climate models predict increasing weather variability, with negative consequences for crop production. Conservation agriculture (CA) may enhance climate resilience by generating certain soil improvements. However, the rate at which these improvements accrue is unclear, and some evidence suggests CA can lower yields relative to conventional systems unless all three CA elements are implemented: reduced tillage, sustained soil cover, and crop rotational diversity. These cost-benefit issues are important considerations for potential adopters of CA. Given that CA can be implemented across a wide variety of regions and cropping systems, more detailed and mechanistic understanding is required on whether and how regionally-adapted CA can improve soil properties while minimizing potential negative crop yield impacts. Across four US states, we assessed short-term impacts of regionally-adapted CA systems on soil properties and explored linkages with maize and soybean yield stability. Structural equation modeling revealed increases in soil organic matter generated by cover cropping increased soil cation exchange capacity, which improved soybean yield stability. Cover cropping also enhanced maize minimum yield potential. Our results demonstrate individual CA elements can deliver rapid improvements in soil properties associated with crop yield stability, suggesting that regionally-adapted CA may play an important role in developing high-yielding, climate-resilient agricultural systems.*

Williams, C. J., Snyder, K. A., & Pierson, F. B. (2018). Spatial and temporal variability of the impacts of pinyon and juniper reduction on hydrologic and erosion processes across climatic gradients in the western US: A regional synthesis. *Water (Switzerland), 10*(11). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056238221&doi=10.3390%2fw10111607&partnerID=40&md5=564a3187a9e756ced8e9b469cb551224. doi:10.3390/w10111607
Research Tags: Forestry, Water
Abstract: *Pinyon (Pinus spp.) and juniper (Juniperus spp.) woodlands are an important vegetation type in the Great Basin, Colorado Plateau, and southwestern desert regions of the western US that is undergoing substantial changes associated with land management, altered disturbance regimes, and climate change. We synthesized literature on the ecohydrologic impacts of pinyon and juniper tree reductions across plot to watershed scales, short- and long-term periods, and regional climatic gradients. We found that the initial plot- to hillslope-scale ecohydrologic and erosion impacts of tree reduction on pinyon and juniper woodlands by fire,*

mechanical tree removal, or drought depend largely on: (1) the degree to which these perturbations alter vegetation and ground cover structure, (2) initial conditions, and (3) inherent site attributes. Fire commonly imparts an initial increased risk for hillslope runoff and erosion that degrades over time with vegetation and ground cover recovery whereas tree reductions by mechanical means pose fewer initial negative ecohydrologic impacts. Tree reduction by either approach can enhance understory vegetation and improve site-level ecohydrologic function over time, particularly on sites with an initially favorable cover of native herbaceous vegetation and a cool-season precipitation regime. Understory vegetation and ground cover enhancements appear to increase ecohydrologic resilience of some woodland communities to disturbances such as drought, fire, and insect infestations. In contrast, intensive land use, prolonged drought or repeated burning associated with invasions of fire-prone grasses can propagate long-term site degradation through persistent elevated runoff and erosion rates. Our synthesis suggests the annual precipitation requirement for increases in plot- to hillslope-scale soil water availability for herbaceous enhancement through tree removal likely ranges from 200–400 mm for sites in the Great Basin and northern Colorado Plateau (cool-season precipitation regimes), and, although suggested with great uncertainty, likely exceeds 400 mm for woodlands with rain-dominated precipitation regimes in the southwestern US. Overall, literature is inconclusive regarding tree reduction impacts on watershed-scale changes in groundwater and streamflow. To date, there is little evidence that drought-related changes to vegetation in pinyon and juniper woodlands substantially affect watershed-scale water availability and streamflow at the annual time scale. Our synthesis identifies key knowledge gaps to overcome in improving understanding of the ecohydrologic and erosion impacts of broadly occurring pinyon and juniper tree reductions in the western US.

Will-Wolf, S., Jovan, S., Nelsen, M. P., Trest, M. T., Rolih, K. M., & Reis, A. H. (2018). Lichen indices assess local climate and air quality status in the Mid-Atlantic Region, U.S.A. *Bryologist, 121*(4), 461-479. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056400154&doi=10.1639%2f0007-2745-121.4.461&partnerID=40&md5=7eb8b60507910befe88a17dfca0eaa14. doi:10.1639/0007-2745-121.4.461

Research Tags: Research

Abstract: *Lichen-based indices were developed for monitoring local climate and air quality impacts in the United States of America (U.S.A.) Mid-Atlantic states (MidA). The U.S.A. Forest Service Forest Inventory and Analysis Program (FIA) uses such biological indicators to monitor forest environments. Index development used a unique combination of recommended analysis techniques. The Climate Index (Axis 1 of nonmetric multidimensional scaling [NMS] ordination of 189 plots, 80 lichen species) accounted for 44.7% of data variation, and was correlated with latitude, temperature and humidity (r2 = 0.5 to 0.7). The Pollution Index was based on abundances of 10 tolerant and 27 sensitive lichen species selected from Indicator Species Analysis and other techniques (210 plots, 180 species). Strong quantitative support guided careful selection of pollution indicator species. The Pollution Index was strongly correlated with Al, Cu, Fe, N and S measured in lichen samples (51 plots; maximum r2=0.796), and with 51-plot NMS Axis 1 (r2=0.694; 41.7% of information) correlated with pollution. Indices were uncorrelated with each other or with nearby forest cover, another important factor. From within-site repeatability, Climate Index changes of 13–21% of full range and Pollution Index changes of 18–24% will be detectable. These indices fill a gap to complete FIA index coverage for much of eastern U.S.A. Both indices are suitable for application in other MidA studies. Comparisons with similar FIA studies supported guidelines for use of our indicator selection process and evaluation of environmental interactions to improve other studies.*

Wilson, C. G., Abban, B., Keefer, L. L., Wacha, K., Dermisis, D., Giannopoulos, C., . . . Papanicolaou, A. N. (2018). The intensively managed landscape critical zone observatory: A scientific testbed for understanding critical zone processes in agroecosystems. *Vadose Zone Journal, 17*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058986988&doi=10.2136%2fvzj2018.04.0088&partnerID=40&md5=bc4c846172a1795f299311b6350ba700. doi:10.2136/vzj2018.04.0088

Research Tags: Research

Abstract: *In intensively managed landscapes, interactions between surface (tillage) and subsurface (tile drainage) management with prevailing climate/weather alter landscape characteristics, transport pathways, and transformation rates of surface/subsurface water, soil/sediment, and particulate/dissolved nutrients. To capture the high spatial and temporal variability of constituent transport and residence times in the critical* *zone (between the bedrock and canopy) of these altered landscapes, both storm event and continuous measurements are needed. The Intensively Managed Landscapes Critical Zone Observatory (IML-CZO) is comprised of three highly characterized, well instrumented, and representative watersheds (i.e., Clear Creek, Iowa; Upper Sangamon River, Illinois; and Minnesota River, Minnesota). It is organized to quantify the heterogeneity in structure and dynamic response of critical zone processes to human activities in the context of the glacial and management (anthropogenic) legacies. Observations of water, sediment, and nutrients are made at nested points of the landscape in the vertical and lateral directions during and between storm events (i.e., continuously). The measurements and corresponding observational strategy are organized as follows. First, reference measurements from surface soil and deep core extractions, geophysical surveys, lidar, and hyperspectral data, which are common across all Critical Zone Observatories, are available. The reference measurements include continuous quantification of energy, water, solutes, and sediment fluxes. The reference measurements are complemented with event-based measurements unique to IML-CZO. These measurements include water table fluctuations, enrichment ratios, and roughness as well as bank erosion, hysteresis, sediment sources, and lake/floodplain sedimentation. The coupling of reference and event-based measurements support testing of the central hypothesis (i.e., system shifts from transformer to transporter in IML-CZO due to the interplay between management and weather/climate). Data collected since 2014 are available through a data repository and through the Geodashboard interface, which can be used for process-based model simulations.*

Wilson, G., Green, M., & Mack, K. (2018). Historical climate warming in the white mountains of New Hampshire (USA): Implications for snowmaking water needs at Ski Areas. *Mountain Research and Development, 38*(2), 164-171. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050190236&doi=10.1659%2fMRD-JOURNAL-D-17-00117&partnerID=40&md5=37cbbb4dd7aaac63a30fedc5d7778aac. doi:10.1659/MRD-JOURNAL-D-17-00117

Research Tags: Weather, Economics

Abstract: *The objectives of this study were to examine changing snowmaking conditions in the New Hampshire White Mountains and how changes in snowmaking operations have compared with winter warming. We analyzed three 50-year high-quality daily temperature records representing different elevations and aspects to assess changes in snowmaking conditions during important snowmaking periods. The analysis provides context for discussing the historical relationships between temperatures, water, and snowmaking infrastructure. There was significant warming of winter temperatures over the 50-year record, notably strongest at the early portion of the snowmaking season, especially in the weeks between 1 December and 25 December. While the rates of warming were comparable on both north- and south-facing aspects, the implied reduction in days suitable for snowmaking in each period was always lowest on the north-facing aspect as the mean temperatures on this aspect were farther below the snowmaking threshold. Daily average temperatures of –2°C and –5°C were both explored as thresholds for snowmaking. The implied reduction in snowmaking opportunity during the 1 November to 25 December period using a –2°C snowmaking threshold at the north-facing site was 20%, while the implied reduction for the entire season for that site was 8.5%.This decrease in opportunity for snowmaking, especially in the economically important early season, suggests an increasing need for large volumes of water to make snow in less time, given that holiday vacations are fixed in time. Analysis of snowmaking operations at Loon Mountain Resort suggest that modern snowmaking investments there have outpaced the pressure from climate warming to date, but this has concentrated demand for water into smaller time frames.*

Wilson, P. B., Streich, J. C., Murray, K. D., Eichten, S. R., Cheng, R., Aitken, N. C., . . . Mur, L. (2019). Global diversity of the Brachypodium species complex as a resource for genome-wide association studies demonstrated for agronomic traits in response to climate. *Genetics, 211*(1), 317-331. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059797325&doi=10.1534%2fgenetics.118.301589&partnerID=40&md5=0e9321a94712503224e2a0eaf735365b. doi:10.1534/genetics.118.301589

Research Tags: Research

Abstract: *The development of model systems requires a detailed assessment of standing genetic variation across natural populations. The Brachypodium species complex has been promoted as a plant model for grass genomics with translation to small grain and biomass crops. To capture the genetic diversity within this species* *complex, thousands of Brachypodium accessions from around the globe were collected and genotyped by sequencing. Overall, 1897 samples were classified into two diploid or allopolyploid species, and then further grouped into distinct inbred genotypes. A core set of diverse B. distachyon diploid lines was selected for whole genome sequencing and high resolution phenotyping. Genome-wide association studies across simulated seasonal environments was used to identify candidate genes and pathways tied to key life history and agronomic traits under current and future climatic conditions. A total of 8, 22, and 47 QTL were identified for flowering time, early vigor, and energy traits, respectively. The results highlight the genomic structure of the Brachypodium species complex, and the diploid lines provided a resource that allows complex trait dissection within this grass model species.*

Winkler, D. E., Backer, D. M., Belnap, J., Bradford, J. B., Butterfield, B. J., Copeland, S. M., . . . Reed, S. C. (2018). Beyond traditional ecological restoration on the Colorado Plateau. *Restoration Ecology, 26*(6), 1055-1060. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053450387&doi=10.1111%2frec.12876&partnerID=40&md5=a300461d7beff3ce73aa767071bcd568. doi:10.1111/rec.12876

Research Tags: Grassland

Abstract: *The Colorado Plateau is one of North America's five major deserts, encompassing 340,000 km2 of the western United States, and offering many opportunities for restoration relevant to researchers and land managers in drylands around the globe. The Colorado Plateau is comprised of vast tracts of public land managed by local, state, and federal agencies that oversee a wide range of activities (e.g., mineral and energy extraction, livestock grazing, and recreation). About 75% of the Plateau is managed by federal and tribal agencies and tens of millions of people visit the Plateau's public lands each year. However, even in the face of this diverse use, our knowledge of effective ways to restore Plateau ecosystems remains relatively poor. Further, the multiple agencies on the Plateau have mandates that differ greatly in allowable practices, restoration needs, and desired outcomes. The Colorado Plateau is also expected to undergo ecosystem shifts in the face of climate change, further complicating management decisions and potentially limiting some options while creating others. Here, we explore the current state of Colorado Plateau restoration science and underscore key challenges and opportunities for improving our capacity to maintain the myriad of services provided by these desert ecosystems. We highlight past research efforts and future needs related to restoration concepts, including consideration and design of novel ecosystems, mitigation for and adaptation to climate change, use of genetically diverse seed adapted for current and future conditions, and the value of strong multi-agency and stakeholder collaborations in restoring systems on the Colorado Plateau and beyond.*

Winkler, D. E., Belnap, J., Hoover, D., Reed, S. C., & Duniway, M. C. (2019). Shrub persistence and increased grass mortality in response to drought in dryland systems. *Global Change Biology, 25*(9), 3121-3135. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066898238&doi=10.1111%2fgcb.14667&partnerID=40&md5=f69dfd18d0fe5ce4f390081170a12ab3. doi:10.1111/gcb.14667

Research Tags: Weather, Grassland

Abstract: *Droughts in the southwest United States have led to major forest and grassland die-off events in recent decades, suggesting plant community and ecosystem shifts are imminent as native perennial grass populations are replaced by shrub- and invasive plant-dominated systems. These patterns are similar to those observed in arid and semiarid systems around the globe, but our ability to predict which species will experience increased drought-induced mortality in response to climate change remains limited. We investigated meteorological drought-induced mortality of nine dominant plant species in the Colorado Plateau Desert by experimentally imposing a year-round 35% precipitation reduction for eight continuous years. We distributed experimental plots across numerous plant, soil, and parent material types, resulting in 40 distinct sites across a 4,500 km2 region of the Colorado Plateau Desert. For all 8 years, we tracked c. 400 individual plants and evaluated mortality responses to treatments within and across species, and through time. We also examined the influence of abiotic and biotic site factors in driving mortality responses. Overall, high mortality trends were driven by dominant grass species, including Achnatherum hymenoides, Pleuraphis jamesii, and Sporobolus cryptandrus. Responses varied widely from year to year and dominant shrub species were generally resistant to meteorological drought, likely due to their ability to access deeper soil water. Importantly, mortality increased* *in the presence of invasive species regardless of treatment, and native plant die-off occurred even under ambient conditions, suggesting that recent climate changes are already negatively impacting dominant species in these systems. Results from this long-term drought experiment suggest major shifts in community composition and, as a result, ecosystem function. Patterns also show that, across multiple soil and plant community types, native perennial grass species may be replaced by shrubs and invasive annuals in the Colorado Plateau Desert.*

Winsome, T., Silva, L. C. R., Scow, K. M., Doane, T. A., Powers, R. F., & Horwath, W. R. (2017). Plant-microbe interactions regulate carbon and nitrogen accumulation in forest soils. *Forest Ecology and Management, 384*, 415-423. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84999636313&doi=10.1016%2fj.foreco.2016.10.036&partnerID=40&md5=72645086d2c42799597f0a83a6c6c3c2. doi:10.1016/j.foreco.2016.10.036
Research Tags: Soil
Abstract: *Understory removal is a common practice in forest plantations, which is aimed at reducing competition for resources and increasing the productivity of target tree species. Recent studies have shown, however, that the presence of understory vegetation can increase soil carbon and nutrient content, especially where N-fixing species are present. To investigate whether this response can be attributed to changes in soil microbial communities, we conducted experiments with isotopically-labeled litter in Pinus ponderosa stands where N-fixing understory species were present (UP) or absent (UA). We measured carbon and nutrient stocks and monitored changes in soil microbial biomass and composition. Field and laboratory experiments strongly suggest that understory suppression and relatively small changes in litter quality can yield significant changes in soil C and N stocks, which are critical to maintaining forest productivity. We detected a greater accumulation of carbon and nitrogen (relative to controls) when mixtures of pine and N-rich litter were applied to the soil. In contrast, soils amended only with pine litter showed a net loss of carbon and nitrogen stocks. Soil microbial biomass was significantly higher in UP than in UA stands and microbial community composition varied with type of litter inputs and incubation time (0–180 days), but not as a function of understory management. Similar results were obtained from field experiments, in which mesocosms were incubated for ~2.5 years with pine and N-rich understory litter mixtures. The suppression of understory species caused a decline in litter-derived carbon and nitrogen in the soil, even when the microbial community was resilient to the imposed treatments.*

Winter, P. L., Padgett, P. E., Milburn, L. A. S., & Li, W. (2019). Neighborhood Parks and Recreationists' Exposure to Ozone: A Comparison of Disadvantaged and Affluent Communities in Los Angeles, California. *Environmental Management, 63*(3), 379-395. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061234700&doi=10.1007%2fs00267-019-01140-3&partnerID=40&md5=8f8ad62e3fbd55ddb1b86bbaa1487e37. doi:10.1007/s00267-019-01140-3
Research Tags: Emissions, Economics
Abstract: *Urban parks are valued for their benefits to ecological and human systems, likely to increase in importance as climate change effects continue to unfold. However, the ability of parks to provide those myriad benefits hinges on equitable provision of and access to green spaces and their environmental quality. A social–ecological approach was adopted in a study of urban park use by recreationists in the City of Los Angeles, contrasting two affluent and two disadvantaged communities situated in coastal and inland zones. Twenty-four days of observations distributed across morning and afternoon time blocks were gathered, with observations in each day drawn from a pair of affluent and disadvantaged community parks. Observers noted location, gender, age, ethnicity/race, and level of physical activity of each visitor encountered during four scheduled observation sweeps on each day of field work. In addition, ozone dose exposure was measured through passive monitoring. Ozone dose exposure was calculated using average hourly ozone in ppb multiplied by METS (metabolic expenditures). Dose exposure was significantly higher in the disadvantaged community parks (with majority Latino use). Findings suggest that additional monitoring in disadvantaged communities, especially inland, may be prudent to facilitate community-based information as well as to assess the degree of potential impact over time. Additionally, mitigative strategies placed in urban parks, such as increased tree canopy may help to reduce the degree of risk and improve community resilience. Future research examining the positive outcomes from physically active use of urban parks may benefit from adopting a nuanced approach in light of the present findings.*

Wisniewski, M., Nassuth, A., & Arora, R. (2018). Cold hardiness in trees: a mini-review. *Frontiers in Plant Science, 9*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054545565&doi=10.3389%2ffpls.2018.01394&partnerID=40&md5=647b7a75ebf1e5f82b2e827c46497b08. doi:10.3389/fpls.2018.01394

Research Tags: Weather, Forestry

Abstract: *Significant advances have been made in our understanding of the regulation of cold hardiness. The existence of numerous biophysical and biochemical adaptive mechanisms in perennial woody plants and the complexity their regulation has made the development of methods for managing and improving cold hardiness in perennial woody plants has been very difficult. This may be partially attributed to viewing cold hardiness as a single dimensional response, rather than as a complex phenomenon, involving different mechanisms (avoidance and tolerance), different stages (mid-winter vs. late winter), and having an intimate overlap with the genetic regulation of dormancy. In particular separating the molecular regulation of cold hardiness from growth processes has been challenging. ICE and C-repeat binding factor (CBF), transcription factors (Inducer of CBF expression and CRT-binding factor) have been shown to be an important aspect in the regulation of cold-induced gene expression. Evidence has emerged, however, that they are also intimately involved in the regulation of growth, flowering, dormancy, and stomatal development. This evidence includes the presence of CBF binding motifs in genes regulating these processes, or through cross-talk between the pathways that regulate them. Recent changes in climate that have resulted in erratic episodes of unseasonal warming followed by more seasonal patterns of low temperatures has also highlighted the need to better understand the genetic and molecular regulation of deacclimation, a topic of research that is only more recently being addressed. Environmentally-induced epigenetic regulation of stress responses and seasonal processes such as cold acclimation, deacclimation, and dormancy have been documented but are still poorly understood. Advances in the ability to efficiently generate large DNA and RNA datasets and genetic transformation technologies have greatly increased our ability to explore the regulation of gene expression and explore genetic diversity. Greater knowledge of the interplay between epigenetic and genetic regulation of cold hardiness, along with the application of advanced genetic analyses, such as genome-wide-association-studies (GWAS), are needed to develop strategies for addressing the complex processes associated with cold hardiness in woody plants. A cautionary note is also indicated regarding the time-scale needed to examine and interpret plant response to freezing temperatures if progress is to be made in developing effective approaches for manipulating and improving cold hardiness.*

Wolf, J., Asrar, G. R., & West, T. O. (2017). Revised methane emissions factors and spatially distributed annual carbon fluxes for global livestock. *Carbon Balance and Management, 12*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030149421&doi=10.1186%2fs13021-017-0084-y&partnerID=40&md5=61e023c02221a2565801b92243f8210c. doi:10.1186/s13021-017-0084-y

Research Tags: Livestock, Emissions

Abstract: *Background*

Livestock play an important role in carbon cycling through consumption of biomass and emissions of methane. Recent research suggests that existing bottom-up inventories of livestock methane emissions in the US, such as those made using 2006 IPCC Tier 1 livestock emissions factors, are too low. This may be due to outdated information used to develop these emissions factors. In this study, we update information for cattle and swine by region, based on reported recent changes in animal body mass, feed quality and quantity, milk productivity, and management of animals and manure. We then use this updated information to calculate new livestock methane emissions factors for enteric fermentation in cattle, and for manure management in cattle and swine.

Results

Using the new emissions factors, we estimate global livestock emissions of 119.1 ± 18.2 Tg methane in 2011; this quantity is 11% greater than that obtained using the IPCC 2006 emissions factors, encompassing an 8.4% increase in enteric fermentation methane, a 36.7% increase in manure management methane, and notable variability among regions and sources. For example, revised manure management methane emissions for 2011 in the US increased by 71.8%. For years through 2013, we present (a) annual livestock methane emissions, (b) complete annual livestock carbon budgets, including carbon dioxide emissions, and (c) spatial distributions of livestock methane and other carbon fluxes, downscaled to 0.05 × 0.05 degree resolution.

Conclusions
Our revised bottom-up estimates of global livestock methane emissions are comparable to recently reported top-down global estimates for recent years, and account for a significant part of the increase in annual methane emissions since 2007. Our results suggest that livestock methane emissions, while not the dominant overall source of global methane emissions, may be a major contributor to the observed annual emissions increases over the 2000s to 2010s. Differences at regional and local scales may help distinguish livestock methane emissions from those of other sectors in future top-down studies. The revised estimates allow improved reconciliation of top-down and bottom-up estimates of methane emissions, will facilitate the development and evaluation of Earth system models, and provide consistent regional and global Tier 1 estimates for environmental assessments.

Wolfe, D. W., DeGaetano, A. T., Peck, G. M., Carey, M., Ziska, L. H., Lea-Cox, J., . . . Hollinger, D. Y. (2018). Unique challenges and opportunities for northeastern US crop production in a changing climate. *Climatic Change, 146*(1-2), 231-245. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033589217&doi=10.1007%2fs10584-017-2109-7&partnerID=40&md5=009acb5a1de9043244bf76219b22e4a0. doi:10.1007/s10584-017-2109-7
Research Tags: Crops, Water
Abstract: *Climate change may both exacerbate the vulnerabilities and open up new opportunities for farming in the Northeastern USA. Among the opportunities are double-cropping and new crop options that may come with warmer temperatures and a longer frost-free period. However, prolonged periods of spring rains in recent years have delayed planting and offset the potentially beneficial longer frost-free period. Water management will be a serious challenge for Northeast farmers in the future, with projections for increased frequency of heavy rainfall events, as well as projections for more frequent summer water deficits than this historically humid region has experienced in the past. Adaptations to increase resilience to such changes include expanded irrigation capacity, modernized water monitoring and irrigation scheduling, farm drainage systems that collect excess rain into ponds for use as a water source during dry periods, and improved soil water holding capacity and drainage. Among the greatest vulnerabilities over the next several decades for the economically important perennial fruit crop industry of the region is an extended period of spring frost risk associated with warmer winter and early spring temperatures. Improved real-time frost warning systems, careful site selection for new plantings, and use of misting, wind machine, or other frost protection measures will be important adaptation strategies. Increased weed and pest pressure associated with longer growing seasons and warmer winters is another increasingly important challenge. Pro-active development of non-chemical control strategies, improved regional monitoring, and rapid-response plans for targeted control of invasive weeds and pests will be necessary.*

Wolfe, J. D., Ralph, C. J., & Wiegardt, A. (2017). Bottom-up processes influence the demography and life-cycle phenology of Hawaiian bird communities. *Ecology, 98*(11), 2885-2894. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85030481549&doi=10.1002%2fecy.1981&partnerID=40&md5=f89081077eb18d0318c04c05cecbd82f. doi:10.1002/ecy.1981
Research Tags: Wildlife
Abstract: *Changes in climate can indirectly regulate populations at higher trophic levels by influencing the availability of food resources in the lower reaches of the food web. As such, species that rely on fruit and nectar food resources may be particularly sensitive to these bottom-up perturbations due to the strength of their trophic linkages with climatically-influenced plants. To measure the influence of climatically-mediated, bottom-up processes, we used climate, bird capture, bird count, and plant phenology data from the Big Island of Hawaii to construct a series of structural equation and abundance models. Our results suggest that fruit and nectar-eating birds arrange life cycle events around climatically-influenced food resources, while some of these same food resources also influence seasonal patterns of abundance. This trend was particularly strong for two native nectarivores, 'I'iwi and 'Apapane, where we found that the dissimilar timing of molting and breeding activity was associated with peak abundance of the two most common flowers at our study site which, in turn, were each driven by dissimilar climatic cues. Given the rapidly changing Hawaiian climate, we suggest that determining behavioral plasticity, or evolutionary capacity of birds to mitigate changes in climatically-influenced food resources, should be recognized as a future research priority.*

Wondzell, S. M., Diabat, M., & Haggerty, R. (2019). What Matters Most: Are Future Stream Temperatures More Sensitive to Changing Air Temperatures, Discharge, or Riparian Vegetation? *Journal of the American Water Resources Association, 55*(1), 116-132. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058050610&doi=10.1111%2f1752-1688.12707&partnerID=40&md5=bf71634dd6f672e718b3786529ab63a2. doi:10.1111/1752-1688.12707

Research Tags: Water, Weather

Abstract: *Simulations of stream temperatures showed a wide range of future thermal regimes under a warming climate — from 2.9°C warmer to 7.6°C cooler than current conditions — depending primarily on shade from riparian vegetation. We used the stream temperature model, Heat Source, to analyze a 37-km study segment of the upper Middle Fork John Day River, located in northeast Oregon, USA. We developed alternative future scenarios based on downscaled projections from climate change models and the composition and structure of native riparian forests. We examined 36 scenarios combining future changes in air temperature (ΔTair = 0°C, +2°C, and +4°C), stream discharge (ΔQ = −30%, 0%, and +30%), and riparian vegetation (post-wildfire with 7% shade, current vegetation with 19% shade, a young-open forest with 34% shade, and a mature riparian forest with 79% effective shade). Shade from riparian vegetation had the largest influence on stream temperatures, changing the seven-day average daily maximum temperature (7DADM) from +1°C to −7°C. In comparison, the 7DADM increased by 1.4°C with a 4°C increase in air temperature and by 0.7°C with a 30% change in discharge. Many streams throughout the interior western United States have been altered in ways that have substantially reduced shade. The effect of restoring shade could result in future stream temperatures that are colder than today, even under a warmer climate with substantially lower late-summer streamflow.*

Wood, J. D., Griffis, T. J., Baker, J. M., Frankenberg, C., Verma, M., & Yuen, K. (2017). Multiscale analyses of solar-induced florescence and gross primary production. *Geophysical Research Letters, 44*(1), 533-541. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85010705171&doi=10.1002%2f2016GL070775&partnerID=40&md5=b1de629d139d982604fc3e6f63f2a870. doi:10.1002/2016GL070775

Research Tags: Research

Abstract: *Solar-induced fluorescence (SIF) has shown great promise for probing spatiotemporal variations in terrestrial gross primary production (GPP), the largest component flux of the global carbon cycle. However, scale mismatches between SIF and ground-based GPP have posed challenges toward fully exploiting these data. We used SIF obtained at high spatial sampling rates and resolution by NASA's Orbiting Carbon Observatory-2 satellite to elucidate GPP-SIF relationships across space and time in the U.S. Corn Belt. Strong linear scaling functions (R2 ≥ 0.79) that were consistent across instantaneous to monthly time scales were obtained for corn ecosystems and for a heterogeneous landscape based on tall tower observations. Although the slope of the corn function was ~56% higher than for the landscape, SIF was similar for corn (C4) and soybean (C3). Taken together, there is strong observational evidence showing robust linear GPP-SIF scaling that is sensitive to plant physiology but insensitive to the spatial or temporal scale.*

Wood, T. E., González, G., Silver, W. L., Reed, S. C., & Cavaleri, M. A. (2019). On the shoulders of giants: Continuing the legacy of large-scale ecosystem manipulation experiments in Puerto Rico. *Forests, 10*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063881145&doi=10.3390%2ff10030210&partnerID=40&md5=92aa5ee60124e732a527e9d520807e7a. doi:10.3390/f10030210

Research Tags: Forestry

Abstract: *There is a long history of experimental research in the Luquillo Experimental Forest in Puerto Rico. These experiments have addressed questions about biotic thresholds, assessed why communities vary along natural gradients, and have explored forest responses to a range of both anthropogenic and non-anthropogenic disturbances. Combined, these studies cover many of the major disturbances that affect tropical forests around the world and span a wide range of topics, including the effects of forest thinning, ionizing radiation, hurricane disturbance, nitrogen deposition, drought, and global warming. These invaluable studies have greatly enhanced our understanding of tropical forest function under different disturbance regimes and informed the development of management strategies. Here we summarize the major field experiments that have occurred* *within the Luquillo Experimental Forest. Taken together, results from the major experiments conducted in the Luquillo Experimental Forest demonstrate a high resilience of Puerto Rico's tropical forests to a variety of stressors*

Woodall, C. W., Westfall, J. A., D'Amato, A. W., Foster, J. R., & Walters, B. F. (2018). Decadal changes in tree range stability across forests of the eastern U.S. *Forest Ecology and Management, 429*, 503-510. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050658863&doi=10.1016%2fj.foreco.2018.07.049&partnerID=40&md5=c559dade14f09a2d9f64ec648f5418bf. doi:10.1016/j.foreco.2018.07.049

Research Tags: Forestry

Abstract: *The monitoring of tree range dynamics has emerged as an important component of adaptive responses of forest management to global change scenarios such as extreme precipitation events and/or invasive species. Comparisons between the locations of adults versus seedlings of individual tree species using contemporary forest inventories is one tool widely used to assess the status of tree ranges in light of these changing conditions. With the consistent remeasurement of standard forest inventory plots across the entire eastern US occurring since the 2000s, the opportunity exists to evaluate the stability of tree ranges of focal species across a decade. Using said inventory, the northern range margins of tree distributions were examined by comparing differences (Holm-Sidak adjusted p-value = 0.2) in the 95th percentile locations of seedlings to adults (i.e., trees) by 0.5 degree longitudinal bands over nearly 10 years and by categories of canopy disturbance (i.e., canopy gap formation) for 20 study species. Our results suggest that range margins are stable for 85% of study species at both time one and at remeasurement regardless of canopy disturbance. For the very few species that had a significant difference in seedlings and adults at their range margins, there was nearly a 0.4 degree difference in latitude with seedlings being farther south irrespective of disturbance. Our findings of tree range stability across forests of the eastern US indicate a general propensity towards range contraction, especially for study species forecasted to lose range and located on disturbed sites, which may present substantial hurdles for adaptive management strategies focused on maintaining and enhancing forest ecosystem resilience in the context of global change and associated rapid climate change.*

Woodbury, B. L., Gilley, J. E., Parker, D. B., & Stromer, B. S. (2018). Greenhouse gas emissions from beef feedlot surface materials as affected by diet, moisture, temperature, and time. *Transactions of the ASABE, 61*(2), 571-582. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046073784&doi=10.13031%2ftrans.12483&partnerID=40&md5=e92933d589e6f6c2d22861a02f43c885. doi:10.13031/trans.12483

Research Tags: Emissions, Livestock

Abstract: *A laboratory study was conducted to measure the effects of diet, moisture, temperature, and time on greenhouse gas (GHG) emissions from feedlot surface materials (FSM). The FSM were collected from open-lot pens where beef cattle were fed either a dry-rolled corn (DRC) diet containing no wet distillers grains with solubles (WDGS) or a DRC diet containing 35% WDGS. The FSM were collected, air-dried or mixed with 3.0 L of water to represent dry or wet conditions, and then incubated at temperatures of 5°C, 15°C, 25°C, or 35°C. Static flux chambers were used to quantify GHG emissions over a 14-day period. Flux data for each diet x moisture combination were analyzed using repeated measures in time. The largest GHG emissions occurred under wet conditions at temperatures of 25°C and 35°C. Flux values for these conditions typically were significantly greater than measurements obtained on the same day at 5°C and 15°C. Mean emissions under wet conditions for CO2, CH4, and N2O were 35, 121, and 278 times greater, respectively, than emissions from dry FSM. The 0% WDGS diet produced mean CO2 and N2O flux measurements that were 1.8 and 1.5 times greater, respectively, than those obtained for the 35% WDGS diet. The 35% WDGS diet, in contrast, produced a mean CH4 emission rate that was 6 times greater than the 0% WDGS diet. Management for GHG mitigation should include design and/or maintenance of pen drainage to speed drying as well as the use of modified animal diets.*

Worqlul, A. W., Yen, H., Collick, A. S., Tilahun, S. A., Langan, S., & Steenhuis, T. S. (2017). Evaluation of CFSR, TMPA 3B42 and ground-based rainfall data as input for hydrological models, in data-scarce regions: The upper Blue Nile Basin, Ethiopia. *Catena, 152*, 242-251. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85010441723&doi=10.1016%2fj.catena.2017.01.019&partnerID=40&md5=cc52ec670247550665a6b14ef88f0cca. doi:10.1016/j.catena.2017.01.019

Research Tags: Water, Research
Abstract: *Accurate prediction of hydrological models requires accurate spatial and temporal distribution of rainfall. In developing countries, the network of observation stations for rainfall is sparse and unevenly distributed. Satellite-based products have the potential to overcome this shortcoming. The objective of this study is to compare the advantages and the limitation of commonly used high-resolution satellite rainfall products (Climate Forecast System Reanalysis (CFSR) and Tropical Rainfall Measuring Mission (TRMM) Multisatellite Precipitation Analysis (TMPA) 3B42 version 7) as input to hydrological models as compared to sparsely and densely populated network of rain gauges. We used two (semi-distributed) hydrological models that performed well in the Ethiopian highlands: Hydrologiska Byråns Vattenbalansavdelning (HBV) and Parameter Efficient Distributed (PED). The rainfall products were tested in two watersheds: Gilgel Abay with a relatively dense network of rain gauge stations and Main Beles with a relatively scarce network, both are located in the Upper Blue Nile Basin. The results indicated that TMPA 3B42 was not be able to capture the gauged rainfall temporal variation in both watersheds and was not tested further. CFSR over predicted the rainfall pattern slightly. Both the gauged and the CFSR reanalysis data were able to reproduce the streamflow well for both models and both watershed when calibrated separately to the discharge data. Using the calibrated model parameters of gauged rainfall dataset together with the CFSR rainfall, the stream discharge for the Gilgel Abay was reproduced well but the discharge of the Main Beles was captured poorly partly because of the poor accuracy of the gauged rainfall dataset with none of the rainfall stations located inside the watershed. HBV model performed slightly better than the PED model, but the parameter values of the PED could be identified with the features of the landscape.*

Wu, Z., He, H. S., Fang, L., Liang, Y., & Parsons, R. A. (2018). Wind speed and relative humidity influence spatial patterns of burn severity in boreal forests of northeastern China. *Annals of Forest Science, 75*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049143585&doi=10.1007%2fs13595-018-0749-z&partnerID=40&md5=080821d5a461edaeb2351a60e54b9c0c. doi:10.1007/s13595-018-0749-z
Research Tags: Weather, Forest
Abstract: *Key message*
We investigated relationships between the spatial patterns of burn severity in Chinese boreal forests and weather parameters. Patch size, shape and arrangement differed between high-severity and low/moderate-severity patches. Wind speed and relative humidity were dominant weather parameters of spatial variation in burn severity. Patch size negatively correlated with relative humidity; patch complexity and aggregation positively correlated with wind speed.
Context
Spatial patterns of burn severity strongly control post-fire succession and numerous ecological processes in fire-prone boreal forests. Burn-severity patterns are strongly tied to weather conditions. Understanding how weather influences spatial patterns of burn severity is critical for predicting burn severity and fire management strategies.
Aims
We investigated relationships between spatial patterns of burn severity and weather variables in the Chinese boreal forests.
Methods
Using satellite imagery, we mapped burn severity for 22 fires that occurred between 2000 and 2005. For each fire, we calculated metrics of spatial pattern. Using Random Forest models, we quantified the relative importance of weather variables in determining spatial patterns of burn severity.
Results
High-severity fire patch, averaged 570.5 ha (SD = 1530.6), was the dominant outcome, occupying 67.8% of all area burned across the 22 fires. High-severity patches were larger, more aggregated, and simpler in shape than low- and moderate-severity patches. Patch size of high-severity fires increased in drier and less humid conditions, and patches were more complex and aggregated with higher wind speeds.
Conclusion
With drier conditions predicted with climate change, spatial patterns of burn severity in Chinese boreal forests may become increasingly homogeneous, possibly affecting long term ecological functions.

Wulder, M. A., Loveland, T. R., Roy, D. P., Crawford, C. J., Masek, J. G., Woodcock, C. E., . . . Zhu, Z. (2019). Current status of Landsat program, science, and applications. *Remote Sensing of Environment, 225*, 127-147. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062046213&doi=10.1016%2fj.rse.2019.02.015&partnerID=40&md5=c74de9112add127161456fb22bb2f405. doi:10.1016/j.rse.2019.02.015

Research Tags: Research

Abstract: *Formal planning and development of what became the first Landsat satellite commenced over 50 years ago in 1967. Now, having collected earth observation data for well over four decades since the 1972 launch of Landsat-1, the Landsat program is increasingly complex and vibrant. Critical programmatic elements are ensuring the continuity of high quality measurements for scientific and operational investigations, including ground systems, acquisition planning, data archiving and management, and provision of analysis ready data products. Free and open access to archival and new imagery has resulted in a myriad of innovative applications and novel scientific insights. The planning of future compatible satellites in the Landsat series, which maintain continuity while incorporating technological advancements, has resulted in an increased operational use of Landsat data. Governments and international agencies, among others, can now build an expectation of Landsat data into a given operational data stream. International programs and conventions (e.g., deforestation monitoring, climate change mitigation) are empowered by access to systematically collected and calibrated data with expected future continuity further contributing to the existing multi-decadal record. The increased breadth and depth of Landsat science and applications have accelerated following the launch of Landsat-8, with significant improvements in data quality.*

Herein, we describe the programmatic developments and institutional context for the Landsat program and the unique ability of Landsat to meet the needs of national and international programs. We then present the key trends in Landsat science that underpin many of the recent scientific and application developments and follow-up with more detailed thematically organized summaries. The historical context offered by archival imagery combined with new imagery allows for the development of time series algorithms that can produce information on trends and dynamics. Landsat-8 has figured prominently in these recent developments, as has the improved understanding and calibration of historical data. Following the communication of the state of Landsat science, an outlook for future launches and envisioned programmatic developments are presented. Increased linkages between satellite programs are also made possible through an expectation of future mission continuity, such as developing a virtual constellation with Sentinel-2. Successful science and applications developments create a positive feedback loop—justifying and encouraging current and future programmatic support for Landsat.

Wunderle, J. M., & Arendt, W. J. (2017). The plight of migrant birds wintering in the caribbean: Rainfall effects in the annual cycle. *Forests, 8*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017371653&doi=10.3390%2ff8040115&partnerID=40&md5=04f0f0323eb4930f027a75ecefa42698. doi:10.3390/f8040115

Research Tags: Wildlife, Weather

Abstract: *Here, we summarize results of migrant bird research in the Caribbean as part of a 75th Anniversary Symposium on research of the United States Department of Agriculture Forest Service, International Institute of Tropical Forestry (IITF). The fate of migratory birds has been a concern stimulating research over the past 40 years in response to population declines documented in long-term studies including those of the IITF and collaborators in Puerto Rico's Guánica dry forest. Various studies indicate that in addition to forest loss or fragmentation, some migrant declines may be due to rainfall variation, the consequences of which may carry over from one stage of a migrant's annual cycle to another. For example, the Guánica studies indicate that rainfall extremes on either the temperate breeding or tropical wintering grounds affect migrant abundance and survival differently depending on the species. In contrast, IITF's collaborative studies of the migrant Kirtland's Warbler (Setophaga kirtlandii) in the Bahamas found that late winter droughts affect its annual survival and breeding success in Michigan. We review these IITF migrant studies and relate them to other studies, which have improved our understanding of migrant ecology of relevance to conservation. Particularly important is the advent of the full annual cycle (FAC) approach. The FAC will facilitate future identification and mitigation of limiting factors contributing to migrant population declines, which for some species, may be exacerbated by global climate change.*

Wyka, S. A., McIntire, C. D., Smith, C., Munck, I. A., Rock, B. N., Asbjornsen, H., & Broders, K. D. (2018). Effect of climatic variables on abundance and dispersal of lecanosticta acicola spores and their impact on defoliation on eastern white pine. *Phytopathology, 108*(3), 374-383. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042149659&doi=10.1094%2fPHYTO-02-17-0065-R&partnerID=40&md5=95dd6f4ee50bd6cdfddd3862fab8139b. doi:10.1094/PHYTO-02-17-0065-R

Research Tags: Forestry, Weather

Abstract: *The disease complex white pine needle damage (WPND), first reported in 2006, has now escalated to an epidemic state across the northeastern United States. Although this complex is composed of several fungal species, Lecanosticta acicola is considered to be the primary causal agent. Knowledge regarding the epidemiology, specific climatic factors that affect the spread of L. acicola on eastern white pine (Pinus strobus) in natural forest settings, and potential risks repeated defoliation may have on tree health is limited. Therefore, this study examined how climatic variables affect the abundance and distance of spore dispersal of L. acicola and compared litterfall caused by defoliation versus natural needle abscission. Conidia were observed on spore traps from May through August, with a peak in abundance occurring in June, corresponding to the defoliation of second- and third-year foliage measured in litter traps. During peak spore production, relative humidity and the occurrence of rainfall was found to have the greatest influence on spore abundance. Our results will aid managers in determining how far from infected trees natural regeneration will likely be affected and predicting future disease severity based on climatic conditions.*

Wyka, S. A., Munck, I. A., Brazee, N. J., & Broders, K. D. (2018). Response of eastern white pine and associated foliar, blister rust, canker and root rot pathogens to climate change. *Forest Ecology and Management, 423*, 18-26. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044282770&doi=10.1016%2fj.foreco.2018.03.011&partnerID=40&md5=fc41310a3ab3a91cae42dd3728a04d2b. doi:10.1016/j.foreco.2018.03.011

Research Tags: Forestry, Weather

Abstract: *Climate model predictions for the northeastern U.S. forecast a warmer and wetter climate, which favors the survival, reproduction and dispersal of foliar diseases of eastern white pine, collectively called White Pine Needle Damage (WPND). Foliar diseases cause defoliation of white pine, leading to growth reductions, canopy dieback and predisposing trees to other pathogens and insects. This situation is very similar to other conifer foliar diseases, such as Dothistroma needle blight (DNB) in British Columbia and Swiss needle cast (SNC) in Oregon, where the climate is also becoming warmer and wetter. The purpose of this review is to summarize recent WPND findings of the impact climate change, particularly increased spring precipitation and annual warming has on the emergence of this disease complex. These findings will then be related to what is currently known about climatic factors affecting DNB and SNC and their role as native foliar pathogens affecting their natural forest ecosystems. We also discuss other eastern white pine diseases such as blister rust, cankers, and root rots in relation to climate change.*

Wyka, S. A., Smith, C., Munck, I. A., Rock, B. N., Ziniti, B. L., & Broders, K. (2017). Emergence of white pine needle damage in the northeastern United States is associated with changes in pathogen pressure in response to climate change. *Global Change Biology, 23*(1), 394-405. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84977487411&doi=10.1111%2fgcb.13359&partnerID=40&md5=b51e17fbad1b20729d2cf73a3a63d993. doi:10.1111/gcb.13359

Research Tags: Forestry

Abstract: *The defoliation of the eastern white pine (Pinus strobus) across the northeastern United States is an escalating concern threatening the ecological health of northern forests and economic vitality of the region's lumber industry. First documented in the spring of 2010 affecting 24 328 hectares in the state of Maine, white pine needle damage (WPND) has continued to spread and is now well established in all New England states. While causal agents of WPND are known, current research is lacking in both sampling distribution and the specific environmental factor(s) that affect the development and spread of this disease complex. This study aims to construct a more detailed distribution map of the four primary causal agents within the region, as well as utilize long-term WPND monitoring plots and data collected from land-based weather stations to develop a climatic model to predict the severity of defoliation events in the proceeding year. Sampling results showed a greater distribution of WPND than previously reported. WPND was generally found in forest stands that* *compromised >50% eastern white pine by basal area. No single species, nor a specific combination of species had a dominating presence in particular states or regions, thus supporting the disease complex theory that WPND is neither caused by an individual species nor by a specific combination of species. In addition, regional weather data confirmed the trend of increasing temperature and precipitation observed in this region with the previous year's May, June, and July rainfall being the best predictor of defoliation events in the following year. Climatic models were developed to aid land managers in predicting disease severity and accordingly adjust their management decisions. Our results clearly demonstrate the role changing climate patterns have on the health of eastern white pine in the northeastern United States.*

Xia, H., Li, A., Feng, G., Li, Y., Qin, Y., Lei, G., & Cui, Y. (2018). The effects of asymmetric diurnal warming on vegetation growth of the tibetan plateau over the past three decades. *Sustainability (Switzerland), 10*(4). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045087634&doi=10.3390%2fsu10041103&partnerID=40&md5=c105de2918878d8854a136f5015265f9. doi:10.3390/su10041103

Research Tags: Grassland, Weather

Abstract: *Temperatures over the past three decades have exhibited an asymmetric warming pattern between night and day throughout the Tibetan Plateau. However, the implications of such diurnally heterogeneous warming on vegetation growth is still poorly understood. In this paper, we evaluate how vegetation growth has responded to daytime and night-time warming at the regional, biome, and pixel scales based on normalized difference vegetation index (NDVI) and meteorological data from 1982 to 2015. We found a persistent increase in the growing seasonal minimum temperature (Tmin) and maximum temperature (Tmax) over the Tibetan Plateau between 1982–2015, whereas the rate of increase of Tmin was 1.7 times that of Tmax. After removing the correlations between Tmin, precipitation, and solar radiation, we found that the partial correlation between Tmax and NDVI was positive in wetter and colder areas and negative in semi-arid and arid regions. In contrast, the partial correlation between Tmin and NDVI was positive in high-cold steppe and meadow steppe and negative in montane steppe or wet forest. We also found diverse responses of vegetation type to daytime and night-time warming across the Tibetan Plateau. Our results provide a demonstration for studying regional responses of vegetation to climate extremes under global climate change.*

Xia, P. F., Zhang, G. C., Walker, B., Seo, S. O., Kwak, S., Liu, J. J., . . . Jin, Y. S. (2017). Recycling Carbon Dioxide during Xylose Fermentation by Engineered Saccharomyces cerevisiae. *ACS Synthetic Biology, 6*(2), 276-283. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013157598&doi=10.1021%2facssynbio.6b00167&partnerID=40&md5=94fbae48a6df5797d8136e0ba2bf71c2. doi:10.1021/acssynbio.6b00167

Research Tags: Emissions

Abstract: *Global climate change caused by the emission of anthropogenic greenhouse gases (GHGs) is a grand challenge to humanity. To alleviate the trend, the consumption of fossil fuels needs to be largely reduced and alternative energy technologies capable of controlling GHG emissions are anticipated. In this study, we introduced a synthetic reductive pentose phosphate pathway (rPPP) into a xylose-fermenting Saccharomyces cerevisiae strain SR8 to achieve simultaneous lignocellulosic bioethanol production and carbon dioxide recycling. Specifically, ribulose-1,5-bisphosphate carboxylase/oxygenase from Rhodospirillum rubrum and phosphoribulokinase from Spinacia oleracea were introduced into the SR8 strain. The resulting strain with the synthetic rPPP was able to exhibit a higher yield of ethanol and lower yields of byproducts (xylitol and glycerol) than a control strain. In addition, the reduced release of carbon dioxide by the engineered strain was observed during xylose fermentation, suggesting that the carbon dioxide generated by pyruvate decarboxylase was partially reassimilated through the synthetic rPPP. These results demonstrated that recycling of carbon dioxide from the ethanol fermentation pathway in yeast can be achieved during lignocellulosic bioethanol production through a synthetic carbon conservative metabolic pathway. This strategy has a great potential to alleviate GHG emissions during the production of second-generation ethanol.*

Xiao, K., Griffis, T. J., Baker, J. M., Bolstad, P. V., Erickson, M. D., Lee, X., . . . Nieber, J. L. (2018). Evaporation from a temperate closed-basin lake and its impact on present, past, and future water level. *Journal of Hydrology, 561*, 59-75. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044601579&doi=10.1016%2fj.jhydrol.2018.03.059

&partnerID=40&md5=23294ddabcdfb9cc5cfd5c380d1d9051. doi:10.1016/j.jhydrol.2018.03.059
Research Tags: Water
Abstract: *Lakes provide enormous economic, recreational, and aesthetic benefits to citizens. These ecosystem services may be adversely impacted by climate change. In the Twin Cities Metropolitan Area of Minnesota, USA, many lakes have been at historic low levels and water augmentation strategies have been proposed to alleviate the problem. White Bear Lake (WBL) is a notable example. Its water level declined 1.5 m during 2003–2013 for reasons that are not fully understood. This study examined current, past, and future lake evaporation to better understand how climate will impact the water balance of lakes within this region. Evaporation from WBL was measured from July 2014 to February 2017 using two eddy covariance (EC) systems to provide better constraints on the water budget and to investigate the impact of evaporation on lake level. The estimated annual evaporation losses for years 2014 through 2016 were 559 ± 22 mm, 779 ± 81 mm, and 766 ± 11 mm, respectively. The higher evaporation in 2015 and 2016 was caused by the combined effects of larger average daily evaporation and a longer ice-free season. The EC measurements were used to tune the Community Land Model 4 – Lake, Ice, Snow and Sediment Simulator (CLM4-LISSS) to estimate lake evaporation over the period 1979–2016. Retrospective analyses indicate that WBL evaporation increased during this time by about 3.8 mm year−1, which was driven by increased wind speed and lake-surface vapor pressure gradient. Using a business-as-usual greenhouse gas emission scenario (RCP8.5), lake evaporation was modeled forward in time from 2017 to 2100. Annual evaporation is expected to increase by 1.4 mm year−1 over this century, largely driven by lengthening ice-free periods. These changes in ice phenology and evaporation will have important implications for the regional water balance, and water management and water augmentation strategies that are being proposed for these Metropolitan lakes.*

Xu, B., Pan, Y., Plante, A. F., McCullough, K., & Birdsey, R. (2017). Modeling forest carbon cycle using long-term carbon stock field measurement in the Delaware River Basin. *Ecosphere, 8*(5). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019898300&doi=10.1002%2fecs2.1802&partnerID=40&md5=f2ce534af90db9a2dc46f6b48782ed02. doi:10.1002/ecs2.1802
Research Tags: Forestry
Abstract: *Process-based models are a powerful approach to test our understanding of biogeochemical processes, to extrapolate ground survey data from limited plots to the landscape scale, and to simulate the effects of climate change, nitrogen deposition, elevated atmospheric CO2, increasing natural disturbances, and land-use change on ecological processes. However, in most studies, the models are calibrated using ground measurements from only a few sites, though they may be extrapolated to much larger areas. Estimation accuracy can be improved if the models are parameterized using long-term carbon (C) stock data from multiple sites representative of the simulated region. In this study, forest biomass C stocks measured in 61 forested plots located in three research sites in the Delaware River Basin (DRB) were used to modify the PnET-CN model in three ways: (1) Field-measured mortality rates in each forest type were used to parameterize the wood turnover rate; (2) a numerical approach was used to calibrate the relationship between foliage N and maximum photosynthesis rate; and (3) stand age was incorporated into the model as an input variable, which determines the year of the last disturbance. The results showed that these model modifications improved model performance in capturing the spatial variation of forest C dynamics in the DRB forests. The spatial distribution of forest C pools and fluxes in the three sites was mapped using the modified model. The modified model was also used in experimental scenarios, which predicted that 39% of forest C sequestered over the past decade could be attributed to the combined effects of elevated CO2 and N deposition. This study demonstrated an effective method for using long-term biometric measurements of forest biomass C stocks to constrain and improve a process-based ecosystem model at a regional scale. Further research should target improving model parameters that are sensitive to the spatial variation of forest C dynamics.*

Xu, J., Zhao, B., Li, Z., Chu, W., Mao, J., Olk, D. C., . . . Wei, W. (2019). Demonstration of chemical distinction among soil humic fractions using quantitative solid-state 13C NMR. *Journal Of Agricultural And Food Chemistry, 67*(29), 8107-8118. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070485662&doi=10.1021%2facs.jafc.9b02269&partnerID=40&md5=64d71dc85fc52e61590c86d4d05445f3. doi:10.1021/acs.jafc.9b02269
Research Tags: Soil

Abstract: *Humic substances (HS) are vital to soil fertility and carbon sequestration. Using multiple cross-polarization/magic-angle spinning (multiCP/MAS) NMR combined with dipolar dephasing, we quantitatively characterized humic fractions, i.e., fulvic acid (FA), humic acid (HA), and humin (HM), isolated from two representative soils (upland and paddy soils) in China under six long-term (>20 years) fertilizer treatments. Results indicate that each humic fraction showed chemical distinction between the upland and paddy soils, especially with much greater aromaticity of upland HMs than of paddy HMs. Fertilizer treatment exerted greater influence on chemical natures of upland HS than of paddy HS, although the effect was less than that of soil type. Organic manure application especially decreased the percentages of aromatic C in the upland HAs and HMs compared with the control. We concluded that humic fractions responded in chemical nature to environmental conditions, i.e., soil type/cropping system/soil aeration and fertilizer treatments.*

Xu, R., Tian, H., Pan, S., Prior, S. A., Feng, Y., Batchelor, W. D., . . . Yang, J. (2019). Global ammonia emissions from synthetic nitrogen fertilizer applications in agricultural systems: Empirical and process-based estimates and uncertainty. *Global Change Biology, 25*(1), 314-326. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056669247&doi=10.1111%2fgcb.14499&partnerID=40&md5=87e570453c55adc2950f4cffdfbd8c8b. doi:10.1111/gcb.14499

Research Tags: Emissions

Abstract: *Excessive ammonia (NH3) emitted from nitrogen (N) fertilizer applications in global croplands plays an important role in atmospheric aerosol production, resulting in visibility reduction and regional haze. However, large uncertainty exists in the estimates of NH3 emissions from global and regional croplands, which utilize different data and methods. In this study, we have coupled a process-based Dynamic Land Ecosystem Model (DLEM) with the bidirectional NH3 exchange module in the Community Multiscale Air-Quality (CMAQ) model (DLEM-Bi-NH3) to quantify NH3 emissions at the global and regional scale, and crop-specific NH3 emissions globally at a spatial resolution of 0.5° × 0.5° during 1961–2010. Results indicate that global NH3 emissions from N fertilizer use have increased from 1.9 ± 0.03 to 16.7 ± 0.5 Tg N/year between 1961 and 2010. The annual increase of NH3 emissions shows large spatial variations across the global land surface. Southern Asia, including China and India, has accounted for more than 50% of total global NH3 emissions since the 1980s, followed by North America and Europe. Rice cultivation has been the largest contributor to total global NH3 emissions since the 1990s, followed by corn and wheat. In addition, results show that empirical methods without considering environmental factors (constant emission factor in the IPCC Tier 1 guideline) could underestimate NH3 emissions in context of climate change, with the highest difference (i.e., 6.9 Tg N/year) occurring in 2010. This study provides a robust estimate on global and regional NH3 emissions over the past 50 years, which offers a reference for assessing air quality consequences of future nitrogen enrichment as well as nitrogen use efficiency improvement.*

Yan, D., Scott, R. L., Moore, D. J. P., Biederman, J. A., & Smith, W. K. (2019). Understanding the relationship between vegetation greenness and productivity across dryland ecosystems through the integration of PhenoCam, satellite, and eddy covariance data. *Remote Sensing of Environment, 223*, 50-62. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060175953&doi=10.1016%2fj.rse.2018.12.029&partnerID=40&md5=6bb3a6d4950b6a8f2c00a1180babda54. doi:10.1016/j.rse.2018.12.029

Research Tags: Grassland, Research

Abstract: *Drylands account for approximately 40% of the global land surface and play a dominant role in the trend and variability of terrestrial carbon uptake and storage. Gross ecosystem photosynthesis – termed gross primary productivity (GPP) – is a critical driver of terrestrial carbon uptake and remains challenging to be observed directly. Currently, vegetation indices that largely capture changes in greenness are the most commonly used datasets in satellite-based GPP modeling. However, there remains significant uncertainty in the spatiotemporal relationship between greenness indices and GPP, especially for relatively heterogeneous dryland ecosystems. In this paper, we compared vegetation greenness indices from PhenoCam and satellite (Landsat and MODIS) observations against GPP estimates from the eddy covariance technique, across three representative ecosystem types of the southwestern United States. We systematically evaluated the changes in the relationship between vegetation greenness indices and GPP: i) across spatial scales of canopy-level, 30-meter, and 500-meter resolution; and ii) across temporal scale of daily, 8-day, 16-day, and monthly resolution. We found that greenness-GPP relationships were independent of spatial scales as long as land cover*

type and composition remained relatively constant. We also found that the greenness-GPP relationships became stronger as the time interval increased, with the strongest relationships observed at the monthly resolution. We posit that the greenness-GPP relationship breaks down at short timescales because greenness changes more slowly than plant physiological function, which responds rapidly to changes in key biophysical drivers. These findings provide insights into the potential for and limitations of modeling GPP using remotely sensed greenness indices across dryland ecosystem types.

Yang, J., Ren, W., Ouyang, Y., Feng, G., Tao, B., Granger, J. J., & Poudel, K. P. (2019). Projection of 21st century irrigation water requirement across the Lower Mississippi Alluvial Valley. *Agricultural Water Management, 217*, 60-72. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062011898&doi=10.1016%2fj.agwat.2019.02.033&partnerID=40&md5=d20b883565141993bdf822d5231dd529. doi:10.1016/j.agwat.2019.02.033

Research Tags: Crops, Water

Abstract: *Lower Mississippi Alluvial Valley (LMAV) is the largest floodplain and one of the most productive agricultural regions in the United States. Irrigation is widely used in this region to improve crop production and resource use efficiency due to a mismatch between crop water requirements and precipitation timing and quantity during the growing season. In the recent decades, aquifer decline caused by groundwater withdrawals for irrigation has been recognized as a critical environmental issue threatening water security and agricultural sustainability in the LMAV. To improve agricultural water use efficiency and reduce groundwater withdrawals, it is pivotal to understand the spatiotemporal patterns of crop irrigation water requirements (IWR). In this study, we analyzed future climate changes over the LMAV cropland areas and estimated future IWR changes for major crops in the 21st century using two climate scenarios (i.e. RCP45 and RCP85) and two crop growth duration length (GDL) scenarios [i.e. Fixed GDL (GDL does not change with time) and Varied GDL (GDL changes with time)]. Results show that croplands in the LMAV would experience continuous warming, and either no significant change or a decreasing level of precipitation under the RCP45 and the RCP85. If keeping current cropland areas and cropping systems unchanged, average crop IWR by the end of the 21st century would increase by 4.2% under the RCP45 + Varied GDL scenario, 14.5% under the RCP45 + Fixed GDL scenario, 9.2% under the RCP85 + Varied GDL scenario, and 29.4% under the RCP85 + Fixed GDL scenario. The greatest increases would occur in the summer months. Aquifer levels in the LMAV, therefore, are expected to decline at an accelerated pace if no effective mitigation strategies are implemented. This study made the first attempt to reveal the spatially-explicit crop IWR and its future changes in the LMAV, which provides a scientific basis for developing management strategies that can enhance water use efficiency and improve agriculture sustainability.*

Yang, Q., Zhang, X., Abraha, M., Del grosso, S., Robertson, G. P., & Chen, J. (2017). Enhancing the soil and water assessment tool model for simulating N<inf>2</inf>O emissions of three agricultural systems. *Ecosystem Health and Sustainability, 3*(2). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042935684&doi=10.1002%2fehs2.1259&partnerID=40&md5=0c9dfe5bd2043461a5a52502e36ab238. doi:10.1002/ehs2.1259

Research Tags: Emissions

Abstract: *Nitrous oxide (N2O) is a potent greenhouse gas (GHG) contributing to global warming, with the agriculture sector as the major source of anthropogenic N2O emissions due to excessive fertilizer use. There is an urgent need to enhance regional-/watershed-scale models, such as Soil and Water Assessment Tool (SWAT), to credibly simulate N2O emissions to improve assessment of environmental impacts of cropping practices. Here, we integrated the DayCent model's N2O emission algorithms with the existing widely tested crop growth, hydrology, and nitrogen cycling algorithms in SWAT and evaluated this new tool for simulating N2O emissions in three agricultural systems (i.e., a continuous corn site, a switchgrass site, and a smooth brome grass site which was used as a reference site) located at the Great Lakes Bioenergy Research Center (GLBRC) scale-up fields in southwestern Michigan. These three systems represent different levels of management intensity, with corn, switchgrass, and smooth brome grass (reference site) receiving high, medium, and zero fertilizer application, respectively. Results indicate that the enhanced SWAT model with default parameterization reproduced well the relative magnitudes of N2O emissions across the three sites, indicating the usefulness of the new tool (SWAT-N2O) to estimate long-term N2O emissions of diverse cropping systems. Notably,*

parameter calibration can significantly improve model simulations of seasonality of N2O fluxes, and explained up to 22.5%–49.7% of the variability in field observations. Further sensitivity analysis indicates that climate change (e.g., changes in precipitation and temperature) influences N2O emissions, highlighting the importance of optimizing crop management under a changing climate in order to achieve agricultural sustainability goals.

Yang, W., Feng, G., Tewolde, H., & Li, P. F. (2019). CO<inf>2</inf> emission and soil carbon sequestration from spring- and fall-applied poultry litter in corn production as simulated with RZWQM2. *Journal of Cleaner Production, 209*, 1285-1293. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057205363&doi=10.1016%2fj.jclepro.2018.10.251&partnerID=40&md5=2c4a25416e294bf2f3bcd37587b5c0c5. doi:10.1016/j.jclepro.2018.10.251
Research Tags: Emissions, Soil, Crops
Abstract: *Poultry litter has increasingly been used as fertilizer in row crop production systems in the southeastern USA, leading to potential improvement of soil carbon (C) stocks. However, this improvement is accompanied by substantial losses of litter-derived C as CO2 emission, the balance of which has not been well investigated. A calibrated and validated Root Zone Water Quality Model (RZWQM2) with continuous 3-yr comprehensive field data was used to simulate and quantify soil CO2 emission and gain and loss of litter-derived C in a corn (Zea mays L.) production system in northern Mississippi USA. The corn field was fertilized with poultry litter (18,000 kg ha−1 yr−1) or NO3NH4 (202 kg ha−1 N yr−1) applied in the spring or fall over 3-yr. The results showed that simulated CO2 emissions from soil fertilized with litter averaged across years was approximately 0.8 times higher than soil fertilized with NH4NO3. Simulated CO2 emission loss from fall-applied litter was 16% higher than spring-applied litter when averaged across three years. The emission 59% of added litter C was lost as CO2 over the 3 yr course of the experiment, with an average loss rate of 7.53 kg C ha−1 d−1, implying 41% of C added remained in the soil profile. Relative to NH4NO3, litter increased soil total C by an average 1882 kg C ha−1 yr−1. The results overall show that, although the majority C applied to corn soil in the form of poultry litter may be lost as CO2, about 41% of it is stored in the soil in the short term may be contributing to the soil organic matter pool.*

Yang, X., McMaster, G. S., & Yu, Q. (2018). Spatial Patterns of Relationship Between Wheat Yield and Yield Components in China. *International Journal of Plant Production, 12*(1), 61-71. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85044329448&doi=10.1007%2fs42106-017-0007-6&partnerID=40&md5=afbcbe3c80f6b6b116e028f23e5cabe1. doi:10.1007/s42106-017-0007-6
Research Tags: Crops
Abstract: *The considerable plasticity of wheat (Triticum aestivum L.) in reaching final yield is dynamically determined by three yield components: spike number m−2 (SN), kernel number spike−1 (KN) and 1000-kernel weight (KW). Understanding the contribution of yield components to the variation of grain yield under different production environments is essential for designing breeding programs and increasing grain production. This study analyzed 2 years of experimental data from the Chinese Variety Evaluation Program to explore the relationship between grain yield and yield components in four main winter wheat production regions. Correlation and path analysis were the main methods used in this paper. Yield and yield components were restricted by high temperature and lower sunshine hours at southern regions (Upper Yangtze Valleys, UY and Middle and Lower Yangtze Valleys, MLY). No relationship between yield and climate elements was found at northern region (Yellow and Huai Valleys, YH and Northern Land, NL). Yield in the YH region was the greatest with both higher SN and KN, and SN had strong negative relationships with KN and KW. SN was the main factor correlated the variation of yield, especially in low yielding regions (UY and NL), suggesting breeding efforts should emphasize increasing SN in these environments. The role of KW and KN became increasingly important in high yielding region (YH), indicating that all yield components should be considered in breeding for high yielding environments.*

Yang, Y., Anderson, M. C., Gao, F., Hain, C. R., Semmens, K. A., Kustas, W. P., . . . Sun, G. (2017). Daily Landsat-scale evapotranspiration estimation over a forested landscape in North Carolina, USA, using multi-satellite data fusion. *Hydrology and Earth System Sciences, 21*(2), 1017-1037. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013082960&doi=10.5194%2fhess-21-1017-2017&partnerID=40&md5=a1d39bfb35f4737ca16d6dcbf755482d. doi:10.5194/hess-21-1017-2017

Research Tags: Water, Forestry, Crops
Abstract: *As a primary flux in the global water cycle, evapotranspiration (ET) connects hydrologic and biological processes and is directly affected by water and land management, land use change and climate variability. Satellite remote sensing provides an effective means for diagnosing ET patterns over heterogeneous landscapes; however, limitations on the spatial and temporal resolution of satellite data, combined with the effects of cloud contamination, constrain the amount of detail that a single satellite can provide. In this study, we describe an application of a multi-sensor ET data fusion system over a mixed forested/agricultural landscape in North Carolina, USA, during the growing season of 2013. The fusion system ingests ET estimates from the Two-Source Energy Balance Model (TSEB) applied to thermal infrared remote sensing retrievals of land surface temperature from multiple satellite platforms: hourly geostationary satellite data at 4 km resolution, daily 1 km imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS) and biweekly Landsat thermal data sharpened to 30 m. These multiple ET data streams are combined using the Spatial and Temporal Adaptive Reflectance Fusion Model (STARFM) to estimate daily ET at 30 m resolution to investigate seasonal water use behavior at the level of individual forest stands and land cover patches. A new method, also exploiting the STARFM algorithm, is used to fill gaps in the Landsat ET retrievals due to cloud cover and/or the scan-line corrector (SLC) failure on Landsat 7. The retrieved daily ET time series agree well with observations at two AmeriFlux eddy covariance flux tower sites in a managed pine plantation within the modeling domain: US-NC2 located in a mid-rotation (20-year-old) loblolly pine stand and US-NC3 located in a recently clear-cut and replanted field site. Root mean square errors (RMSEs) for NC2 and NC3 were 0.99 and 1.02 mm day−1, respectively, with mean absolute errors of approximately 29 % at the daily time step, 12 % at the monthly time step and 0.7 % over the full study period at the two flux tower sites. Analyses of water use patterns over the plantation indicate increasing seasonal ET with stand age for young to mid-rotation stands up to 20 years, but little dependence on age for older stands. An accounting of consumptive water use by major land cover classes representative of the modeling domain is presented, as well as relative partitioning of ET between evaporation (E) and transpiration (T) components obtained with the TSEB. The study provides new insights about the effects of management and land use change on water yield over forested landscapes.*

Yang, Y., Saatchi, S. S., Xu, L., Yu, Y., Choi, S., Phillips, N., . . . Myneni, R. B. (2018). Post-drought decline of the Amazon carbon sink. *Nature Communications, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051552701&doi=10.1038%2fs41467-018-05668-6&partnerID=40&md5=577872dba55569d097faa5e9896d2a84. doi:10.1038/s41467-018-05668-6
Research Tags: Weather, Forestry
Abstract: *Amazon forests have experienced frequent and severe droughts in the past two decades. However, little is known about the large-scale legacy of droughts on carbon stocks and dynamics of forests. Using systematic sampling of forest structure measured by LiDAR waveforms from 2003 to 2008, here we show a significant loss of carbon over the entire Amazon basin at a rate of 0.3 ± 0.2 (95% CI) PgC yr−1 after the 2005 mega-drought, which continued persistently over the next 3 years (2005–2008). The changes in forest structure, captured by average LiDAR forest height and converted to above ground biomass carbon density, show an average loss of 2.35 ± 1.80 MgC ha−1 a year after (2006) in the epicenter of the drought. With more frequent droughts expected in future, forests of Amazon may lose their role as a robust sink of carbon, leading to a significant positive climate feedback and exacerbating warming trends.*

Yasarer, L. M. W., Bingner, R. L., Garbrecht, J. D., Locke, M. A., Lizotte, R. E., Momm, H. G., & Busteed, P. R. (2017). Climate change impacts on runoff, sediment, and nutrient loads in an agricultural watershed in the lower Mississippi river basin. *Applied Engineering in Agriculture, 33*(3), 379-392. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021784987&doi=10.13031%2faea.12047&partnerID=40&md5=0231ca473fbafa14f2144aed628b15d3. doi:10.13031/aea.12047
Research Tags: Water
Abstract: *Projected climate change can impact various aspects of agricultural systems, including the nutrient and sediment loads exported from agricultural fields. This study evaluated the potential changes in runoff, sediment, nitrogen, and phosphorus loads using projected climate estimates from 2041-2070 in the Beasley Lake watershed in Mississippi, USA, using the Annualized Agricultural Non-Point Source (AnnAGNPS) pollution watershed model. For baseline conditions and model inputs an earlier validated simulation of the watershed*

was used with an event-based NSE of 0.81 for runoff and 0.54 for sediment without calibration. Fifteen global climate models (GCMs) for the climate change scenario RCP8.5 in Western Mississippi were used. Daily precipitation and air temperature were generated with the weather generator SYNTOR. Daily climate data derived from all 15 GCMS were used in AnnAGNPS simulations to generate ensemble projected loads, and climate data from four GCMs were used in simulations to assess the effectiveness of five different conservation practices for reducing projected loads. Predicted median annual-average pollutant loads increased by 9% to 12% with ensemble projected climate change. However, no-tillage and cover crop conservation practices were predicted to reduce pollutant loads from 20% to 75% below historical levels despite the impacts of climate change. This study suggests that greater implementation of conservation practices can be effective at mitigating water quality degradation associated with projected climate change.

Yatskov, M. A., Harmon, M. E., Barrett, T. M., & Dobelbower, K. R. (2019). Carbon pools and biomass stores in the forests of Coastal Alaska: Uncertainty of estimates and impact of disturbance. *Forest Ecology and Management, 434*, 303-317. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058687161&doi=10.1016%2fj.foreco.2018.12.014&partnerID=40&md5=ab1ad2a72e9ff9fe6b494cbaee5be273. doi:10.1016/j.foreco.2018.12.014

Research Tags: Forestry

Abstract: *Forests provide significant long-term carbon (C) storage, but have the potential to increase future C emissions with a changing climate. Aboveground biomass, C stores, and the effect of disturbance were examined using forest inventory data collected across all ownerships on 6.2 million ha in Coastal Alaska. We modelled six C pools using empirical data, estimated two others using the literature, and quantified estimate uncertainty. The average (±SE) aboveground live (218.9 ± 4.6 Mg/ha) and log (28.1 ± 1.8 Mg/ha) biomass in the Alaskan Temperate ecoregion were among the lowest in the Pacific Northwest, whereas snag biomass (30.5 ± 1.0 Mg/ha) was among the highest. In the Alaskan Boreal ecoregion, on the Kenai Peninsula, coarse woody debris (CWD) biomass comprised almost 50% of the regional average of aboveground woody biomass (76.7 ± 3.8 Mg/ha) with bark beetle damaged stands containing 82% of the total CWD biomass. In contrast, in the Temperate ecoregion, CWD comprised 20% of the regional aboveground woody average (277.5 ± 5.4 Mg/ha) with 76% of total CWD biomass in undisturbed stands. Total C stores estimates in Coastal Alaska forests ranged between 1523.6 and 1892.8 Tg with the highest contribution from soils. The largest potential reductions in uncertainty are related to the tree and soils C pools. Disturbance determined total biomass amounts in the system and controlled the ratio between live and dead biomass pools and thus has the ability to shift forest stands into a C source to the atmosphere.*

Yeager, C. M., Gallegos-Graves, L. V., Dunbar, J., Hesse, C. N., Daligault, H., & Kuske, C. R. (2017). Polysaccharide degradation capability of Actinomycetales soil isolates from a semiarid grassland of the Colorado Plateau. *Applied and Environmental Microbiology, 83*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014599450&doi=10.1128%2fAEM.03020-16&partnerID=40&md5=f9a359b610b8228c717947dac688acbe. doi:10.1128/AEM.03020-16

Research Tags: Grassland

Abstract: *Among the bacteria, members of the order Actinomycetales are considered quintessential degraders of complex polysaccharides in soils. However, studies examining complex polysaccharide degradation by Actinomycetales (other than Streptomyces spp.) in soils are limited. Here, we examine the lignocellulolytic and chitinolytic potential of 112 Actinomycetales strains, encompassing 13 families, isolated from a semiarid grassland of the Colorado Plateau in Utah. Members of the Streptomycetaceae, Pseudonocardiaceae, Micromonosporaceae, and Promicromonosporaceae families exhibited robust activity against carboxymethyl cellulose, xylan, chitin, and pectin substrates (except for low/no pectinase activity by the Micromonosporaceae). When incubated in a hydrated mixture of blended Stipa and Hilaria grass biomass over a 5-week period, Streptomyces and Saccharothrix (a member of the Pseudonocardiaceae) isolates produced high levels of extracellular enzyme activity, such as endo- and exocellulase, glucosidase, endo- and exoxylosidase, and arabinofuranosidase. These characteristics make them well suited to degrade the cellulose and hemicellulose components of grass cell walls. On the basis of the polysaccharide degradation profiles of the isolates, relative abundance of Actinomycetales sequences in 16S rRNA gene surveys of Colorado Plateau soils, and analysis of genes coding for polysaccharide-degrading enzymes among 237 Actinomycetales genomes in the CAZy*

database and 5 genomes from our isolates, we posit that Streptomyces spp. and select members of the Pseudonocardiaceae and Micromonosporaceae likely play an important role in the degradation of hemicellulose, cellulose, and chitin substances in dryland soils.
IMPORTANCE Shifts in the relative abundance of Actinomycetales taxa have been observed in soil microbial community surveys during large, manipulated climate change field studies. However, our limited understanding of the ecophysiology of diverse Actinomycetales taxa in soil systems undermines attempts to determine the underlying causes of the population shifts or their impact on carbon cycling in soil. This study combines a systematic analysis of the polysaccharide degradation potential of a diverse collection of Actinomycetales isolates from surface soils of a semiarid grassland with analysis of genomes from five of these isolates and publicly available Actinomycetales genomes for genes encoding polysaccharide-active enzymes. The results address an important gap in knowledge of Actinomycetales ecophysiology—identification of key taxa capable of facilitating lignocellulose degradation in dryland soils. Information from this study will benefit future metagenomic studies related to carbon cycling in dryland soils by providing a baseline linkage of Actinomycetales phylogeny with lignocellulolytic functional potential.

Yeo, I. Y., Lee, S., Lang, M. W., Yetemen, O., McCarty, G. W., Sadeghi, A. M., & Evenson, G. (2019). Mapping landscape-level hydrological connectivity of headwater wetlands to downstream waters: A catchment modeling approach - Part 2. *Science of the Total Environment, 653*, 1557-1570. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057610082&doi=10.1016%2fj.scitotenv.2018.11.237&partnerID=40&md5=f532e4f12effe0c5968fa7ddb61d09ec. doi:10.1016/j.scitotenv.2018.11.237
Research Tags: Water
Abstract: *In Part 1 of this two-part manuscript series, we presented an effective assessment method for mapping inundation of geographically isolated wetlands (GIWs) and quantifying their cumulative landscape-scale hydrological connectivity with downstream waters using time series remotely sensed data (Yeo et al., 2018). This study suggested strong hydrological coupling between GIWs and downstream waters at the seasonal timescale via groundwater. This follow-on paper investigates the hydrological connectivity of GIWs with downstream waters and cumulative watershed-scale hydrological impacts over multiple time scales. Modifications were made to the representation of wetland processes within the Soil and Water Assessment Tool (SWAT). A version of SWAT with improved wetland function, SWAT-WET, was applied to Greensboro Watershed, which is located in the Mid-Atlantic Region of USA, to simulate hydrological processes over 1985–2015 under two contrasting land use scenarios (i.e., presence and absence of GIWs). Comparative analysis of simulation outputs elucidated how GIWs could influence partitioning of precipitation between evapotranspiration (ET) and terrestrial water storage, and affect water transport mechanisms and routing processes that generate streamflow. Model results showed that GIWs influenced the watershed water budget and stream flow generation processes over the long-term (30 year), inter-annual, and monthly time scales. GIWs in the study watershed increased terrestrial water storage during the wet season, and buffered the dynamics of shallow groundwater during the dry season. The inter-annual modeling analysis illustrated that densely distributed GIWs can exert strong hydrological influence on downstream waters by regulating surface water runoff, while maintaining groundwater recharge and ET under changing (wetter) climate conditions. The study findings highlight the hydrological connectivity of GIWs with downstream waters and the cumulative hydrological influence of GIWs as hydrologic sources to downstream ecosystems through different runoff processes over multiple time scales.*

Yi, K., Maxwell, J. T., Wenzel, M. K., Roman, D. T., Sauer, P. E., Phillips, R. P., & Novick, K. A. (2019). Linking variation in intrinsic water-use efficiency to isohydricity: a comparison at multiple spatiotemporal scales. *New Phytologist, 221*(1), 195-208. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052692558&doi=10.1111%2fnph.15384&partnerID=40&md5=2508c984ca018e6063fd45ec7409c430. doi:10.1111/nph.15384
Research Tags: Forestry
Abstract: *Species-specific responses of plant intrinsic water-use efficiency (iWUE) to multiple environmental drivers associated with climate change, including soil moisture (θ), vapor pressure deficit (D), and atmospheric CO2 concentration (ca), are poorly understood.*
We assessed how the iWUE and growth of several species of deciduous trees that span a gradient of isohydric to

anisohydric water-use strategies respond to key environmental drivers (θ, D and ca). iWUE was calculated for individual tree species using leaf-level gas exchange and tree-ring δ13C in wood measurements, and for the whole forest using the eddy covariance method.
The iWUE of the isohydric species was generally more sensitive to environmental change than the anisohydric species was, and increased significantly with rising D during the periods of water stress. At longer timescales, the influence of ca was pronounced for isohydric tulip poplar but not for others.
Trees' physiological responses to changing environmental drivers can be interpreted differently depending on the observational scale. Care should be also taken in interpreting observed or modeled trends in iWUE that do not explicitly account for the influence of D.

Yorgey, G. G., Hall, S. A., Allen, E. R., Whitefield, E. M., Embertson, N. M., Jones, V. P., . . . Kruger, C. E. (2017). Northwest U.S. agriculture in a changing climate: Collaboratively defined research and extension priorities. *Frontiers in Environmental Science, 5*(AUG). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029667515&doi=10.3389%2ffenvs.2017.00052&partnerID=40&md5=cf25d9bc5ded00a4cfb20c44bcb241ea. doi:10.3389/fenvs.2017.00052
Research Tags: Research
Abstract: *In order for agricultural systems to successfully mitigate and adapt to climate change there is a need to coordinate and prioritize next steps for research and extension. This includes focusing on "win-win" management practices that simultaneously provide short-term benefits to farmers and improve the sustainability and resiliency of agricultural systems with respect to climate change. In the Northwest U.S., a collaborative process has been used to engage individuals spanning the research-practice continuum. This collaborative approach was utilized at a 2016 workshop titled "Agriculture in a Changing Climate," that included a broad range of participants including university faculty and students, crop and livestock producers, and individuals representing state, tribal and federal government agencies, industry, nonprofit organizations, and conservation districts. The Northwest U.S. encompasses a range of agro-ecological systems and diverse geographic and climatic contexts. Regional research and science communication efforts for climate change and agriculture have a strong history of engaging diverse stakeholders. These features of the Northwest U.S. provide a foundation for the collaborative research and extension prioritization presented here. We focus on identifying research and extension actions that can be taken over the next 5 years in four areas identified as important areas by conference organizers and participants: (1) cropping systems, (2) livestock systems, (3) decision support systems to support consideration of climate change in agricultural management decisions; and (4) partnerships among researchers and stakeholders. We couple insights from the workshop and a review of current literature to articulate current scientific understanding, and priorities recommended by workshop participants that target existing knowledge gaps, challenges, and opportunities. Priorities defined at the Agriculture in a Changing Climate workshop highlight the need for ongoing investment in interdisciplinary research integrating social, economic, and biophysical sciences, strategic collaborations, and knowledge sharing to develop actionable science that can support informed decision-making in the agriculture sector as the climate changes.*

Youkhana, A. H., Ogoshi, R. M., Kiniry, J. R., Meki, M. N., Nakahata, M. H., & Crow, S. E. (2017). Allometric models for predicting aboveground biomass and carbon stock of tropical perennial C<inf>4</inf> grasses in Hawaii. *Frontiers in Plant Science, 8*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018915473&doi=10.3389%2ffpls.2017.00650&partnerID=40&md5=03691e3cdad356f1794e50cbc9b915a9. doi:10.3389/fpls.2017.00650
Research Tags: Grassland, Energy, Emissions
Abstract: *Biomass is a promising renewable energy option that provides a more environmentally sustainable alternative to fossil resources by reducing the net flux of greenhouse gasses to the atmosphere. Yet, allometric models that allow the prediction of aboveground biomass (AGB), biomass carbon (C) stock non-destructively have not yet been developed for tropical perennial C4 grasses currently under consideration as potential bioenergy feedstock in Hawaii and other subtropical and tropical locations. The objectives of this study were to develop optimal allometric relationships and site-specific models to predict AGB, biomass C stock of napiergrass, energycane, and sugarcane under cultivation practices for renewable energy and validate these site-specific models against independent data sets generated from sites with widely different environments. Several allometric models were developed for each species from data at a low elevation field on the island of*

Maui, Hawaii. A simple power model with stalk diameter (D) was best related to AGB and biomass C stock for napiergrass, energycane, and sugarcane, (R2 = 0.98, 0.96, and 0.97, respectively). The models were then tested against data collected from independent fields across an environmental gradient. For all crops, the models over-predicted AGB in plants with lower stalk D, but AGB was under-predicted in plants with higher stalk D. The models using stalk D were better for biomass prediction compared to dewlap H (Height from the base cut to most recently exposed leaf dewlap) models, which showed weak validation performance. Although stalk D model performed better, however, the mean square error (MSE)-systematic was ranged from 23 to 43 % of MSE for all crops. A strong relationship between model coefficient and rainfall was existed, although these were irrigated systems; suggesting a simple site-specific coefficient modulator for rainfall to reduce systematic errors in water-limited areas. These allometric equations provide a tool for farmers in the tropics to estimate perennial C4 grass biomass and C stock during decision-making for land management and as an environmental sustainability indicator within a renewable energy system.

Young, D. J. N., Stevens, J. T., Earles, J. M., Moore, J., Ellis, A., Jirka, A. L., & Latimer, A. M. (2017). Long-term climate and competition explain forest mortality patterns under extreme drought. *Ecology Letters, 20*(1), 78-86. Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006341254&doi=10.1111%2fele.12711&partnerID=40&md5=f959e7545e5e1d2f0a77c558cb0d5797. doi:10.1111/ele.12711
Research Tags: Forestry, Weather
Abstract: *Rising temperatures are amplifying drought-induced stress and mortality in forests globally. It remains uncertain, however, whether tree mortality across drought-stricken landscapes will be concentrated in particular climatic and competitive environments. We investigated the effects of long-term average climate [i.e. 35-year mean annual climatic water deficit (CWD)] and competition (i.e. tree basal area) on tree mortality patterns, using extensive aerial mortality surveys conducted throughout the forests of California during a 4-year statewide extreme drought lasting from 2012 to 2015. During this period, tree mortality increased by an order of magnitude, typically from tens to hundreds of dead trees per km2, rising dramatically during the fourth year of drought. Mortality rates increased independently with average CWD and with basal area, and they increased disproportionately in areas that were both dry and dense. These results can assist forest managers and policy-makers in identifying the most drought-vulnerable forests across broad geographic areas.*

Young, D. J. N., Werner, C. M., Welch, K. R., Young, T. P., Safford, H. D., & Latimer, A. M. (2019). Post-fire forest regeneration shows limited climate tracking and potential for drought-induced type conversion. *Ecology, 100*(2). Retrieved from
https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059957113&doi=10.1002%2fecy.2571&partnerID=40&md5=28b3370f80df4cf2e9a04182b60543c5. doi:10.1002/ecy.2571
Research Tags: Weather, Forestry
Abstract: *Disturbance such as wildfire may create opportunities for plant communities to reorganize in response to climate change. The interaction between climate change and disturbance may be particularly important in forests, where many of the foundational plant species (trees) are long-lived and where poor initial tree establishment can result in conversion to shrub- or graminoid-dominated systems. The response of post-disturbance vegetation establishment to post-disturbance weather conditions, particularly to extreme weather, could therefore provide useful information about how forest communities will respond to climate change. We examined the effect of post-fire weather conditions on post-fire tree, shrub, and graminoid recruitment in fire-adapted forests in northern California, USA, by surveying regenerating vegetation in severely burned areas 4–5 yr after 14 different wildfires that burned between 2004 and 2012. This time period (2004–2016) encompassed a wide range of post-fire weather conditions, including a period of extreme drought. For the most common tree species, we observed little evidence of disturbance-mediated community reorganization or range shifts but instead either (1) low sensitivity of recruitment to post-fire weather or (2) weak but widespread decreases in recruitment under unusually dry post-fire conditions, depending on the species. The occurrence of a single strong drought year following fire was more important than a series of moderately dry years in explaining tree recruitment declines. Overall, however, post-fire tree recruitment patterns were explained more strongly by long-term climate and topography and local adult tree species abundance than by post-fire weather conditions. This observation suggests that surviving adult trees can*

contribute to a "biological inertia" that restricts the extent to which tree community composition will track changes in climate through post-disturbance recruitment. In contrast to our observations in trees, we observed substantial increases in shrub and graminoid establishment under post-fire drought, suggesting that shifts in dominance between functional groups may become more likely in a future with more frequent and intense drought.

Young, M. K., Isaak, D. J., McKelvey, K. S., Wilcox, T. M., Campbell, M. R., Corsi, M. P., . . . Schwartz, M. K. (2017). Ecological segregation moderates a climactic conclusion to trout hybridization. *Global Change Biology, 23*(12), 5021-5023. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033977222&doi=10.1111%2fgcb.13828&partnerID=40&md5=2767687e294ea3b800b34c1fde2c8292. doi:10.1111/gcb.13828
Research Tags: Wildlife
Abstract: *For decades, it has been assumed that introgressive hybridization between introduced rainbow trout and native cutthroat trout in western North America will lead to genomic extinction of the latter. A broad-scale re-examination of their interaction indicates that ecological differences between these species and demographic processes are dictating the location and extent of their hybrid zones, and that runaway introgression between these taxa is unlikely.*

Young, M. K., Isaak, D. J., Spaulding, S., Thomas, C. A., Barndt, S. A., Groce, M. C., . . . Nagel, D. E. (2018) Effects of Climate Change on Cold-Water Fish in the Northern Rockies. In*: Vol. 63. Advances in Global Change Research* (pp. 37-58).
Research Tags: Weather, Water, Wildlife
Abstract: *Decreased snowpack with climate warming will shift the timing of peak streamflows, decrease summer low flows, and in combination with higher air temperature, increase stream temperatures, all of which will reduce the vigor of cold-water fish species. Abundance and distribution of cutthroat trout and especially bull trout will be greatly reduced, although effects will differ by location as a function of both stream temperature and competition from non-native fish species. Increased wildfire will add sediment to streams, increase peak flows and channel scouring, and raise stream temperature by removing vegetation.*
Primary strategies to address climate change threats to cold-water fish species include maintaining or restoring functionality of channels and floodplains to retain (cool) water and buffer against future changes, decreasing fragmentation of stream networks so aquatic organisms can access similar habitats, and developing wildfire use plans that address sediment inputs and road failures. Adaptation tactics include using watershed analysis to develop integrated actions for vegetation and hydrology, protecting groundwater and springs, restoring riparian areas and American beaver populations to maintain summer baseflows, reconnecting and increasing off-channel habitat and refugia, identifying and improving stream crossings that impede fish movement, decreasing road connectivity, and revegetating burned areas to store sediment and maintain channel geomorphology. Removing non-native fish species and reducing their access to cold-water habitat reduces competition with native fish species.

Youssef, M. A., Abdelbaki, A. M., Negm, L. M., Skaggs, R. W., Thorp, K. R., & Jaynes, D. B. (2018). DRAINMOD-simulated performance of controlled drainage across the U.S. Midwest. *Agricultural Water Management, 197*, 54-66. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034811249&doi=10.1016%2fj.agwat.2017.11.012&partnerID=40&md5=e2d586201f6dd13dbd2963e850b30274. doi:10.1016/j.agwat.2017.11.012
Research Tags: Water
Abstract: *Controlled drainage (CD) has recently been proposed as a best management practice for reducing nutrient export from drained cropland in the U.S. Midwest to the Mississippi River and the Gulf of Mexico. We conducted a 25-year simulation study using the hydrological model, DRAINMOD, and the carbon and nitrogen (N) model, DRAINMOD-NII, to evaluate the performance of CD at 48 locations across the U.S. Midwest. Hydrological and Nitrogen predictions of this simulation study were compared to RZWQM-DSSAT predictions by Thorp et al. (2008). Simulation results showed that CD reduced annual subsurface drainage by 86 mm (30%) and annual N drainage losses by 10.9 kg N ha−1 (32%), on average over the 48 sites. DRAINMOD predicted highest reductions in drain flow at the south and southeast locations and lowest reductions at the northwest*

locations. The large reductions in drain flow in the south and southeast locations resulted in a large increase in surface runoff, which could increase soil erosion and sediment transport to surface water. In the north and northwest locations, the smaller amount of water that did not pass through the drainage system because of CD was primarily lost as evapotranspiration. DRAINMOD-NII predictions of annual reductions in N drainage loss followed the same trend of annual reductions in drainage flow. DRAINMOD-NII predictions show that reductions in N drainage loss under CD were mainly attributed to increase in denitrification. The declining trend in predicted annual denitrification from the southern to the northern locations of the Midwest region is most likely attributed to the lower temperature and less precipitation at the northern locations. RZWQM-DSSAT predicted reductions in annual drainage and N loss under CD conditions showed a similar trend to DRAINMOD/DRAINMOD-NII predictions. RZWQM-DSSAT, however, predicted substantially higher reductions in both drain flow (regional average of 151 mm yr^{-1}, 53%) and N drainage losses (regional average of 18.9 kg N ha^{-1} yr^{-1}, 51%). The discrepancies between DRAINMOD/DRAINMOD-NII and RZWQM-DSSAT predictions of annual reductions in drain flow and N loss under CD conditions were caused by differences in model predictions of individual components of the water and nitrogen balances under both free drainage and controlled drainage scenarios. Overall, this simulation study showed that climate variation across the region has a substantial impact on CD efficacy for reducing N drainage loss.

Yu, M., Rivera-Ocasio, E., Heartsill-Scalley, T., Davila-Casanova, D., Rios-López, N., & Gao, Q. (2019). Landscape-Level Consequences of Rising Sea-Level on Coastal Wetlands: Saltwater Intrusion Drives Displacement and Mortality in the Twenty-First Century. *Wetlands*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068192689&doi=10.1007%2fs13157-019-01138-x&partnerID=40&md5=419780b2da2f87b43a2af89a3969863e. doi:10.1007/s13157-019-01138-x

Research Tags: Water

Abstract: *Coastal wetlands are shrinking rapidly due to land-use activities. Accelerated sea-level rise (SLR) associated to the warming climate is also affecting coastal wetlands, particularly in islands with limited coastal plains. We analyzed coastal wetland changes in Puerto Rico by applying the Sea Level Affecting Marshes Model under two scenarios by 2100. We also analyzed mortality and recruitment in a freshwater swamp dominated by the tree Pterocarpus officinalis Jacq. in the context of landscape saltwater-intrusion and drought. Our results indicate mangroves and estuarine water would replace the areas currently covered by other saltwater and freshwater wetlands, and saltmarsh would encounter the most relative loss among wetland types. A moderate SLR of 1 m by 2100 allows expansion of mangroves but would decrease saltmarsh and freshwater wetlands. A 2-m SLR would decrease the distributions of all vegetated wetlands, mostly replaced by estuarine water. In the P. officinalis forest, saltwater-intrusion and drought increased tree mortality during 2003–2015 compared to 1994–2003. Saltwater intrusion had a more significant negative effect on tree recruitment than on mortality in this Pterocarpus forest. Coastal wetlands are facing challenges to their persistence at current locations due to accelerated SLR, limited coastal lands, and a modified hydrological regime.*

Yu, O. T., Greenhut, R. F., O'geen, A. T., Mackey, B., Horwath, W. R., & Steenwerth, K. L. (2019). Precipitation events, soil type, and vineyard management practices influence soil carbon dynamics in a Mediterranean climate (Lodi, California). *Soil Science Society of America Journal, 83*(3), 772-779. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068612883&doi=10.2136%2fsssaj2018.09.0345&partnerID=40&md5=f1f2a6c88977a627d468275623a1b2e9. doi:10.2136/sssaj2018.09.0345

Research Tags: Weather, Soil, Crops

Abstract: *To characterize the effect of precipitation events, management practices, and soil type on vineyard carbon (C) dynamics, we monitored CO_2 emissions and labile C pools from nine vineyards in Lodi Wine Grape District, California, from April 2011 to December 2012. These commercial vineyards are replicates of three soil series (Redding, San Joaquin, and Tokay), representing a spectrum of soil texture and degree of soil development. We hypothesized that soil characteristics would influence the magnitude of CO_2 efflux occurring in response to precipitation and management events in a Mediterranean climate. During each field visit—bimonthly (April–October) and monthly (November–March)—we measured CO_2, soil temperature, and gravimetric water content (GWC) from vine and intervine (alleys) rows. Monthly, we collected soil samples for dissolved organic C (DOC), which tended to be greater in the alleys of San Joaquin and Redding than Tokay in summer but decreased after the onset of precipitation. In mid-May and mid-October 2012, CO_2 efflux was*

higher in Tokay than in San Joaquin or Redding. Carbon dioxide efflux across all soils increased as a result of seasonal management practices (i.e., tillage and mowing of cover crops). Management practices distinguished soil DOC between vine rows and alleys from June to October 2012. Soil type or clay content influenced CO2 efflux across these vineyards, as did GWC and soil temperature. This 20-mo study indicated that CO2 efflux responded to soil disturbance from management practices, precipitation, and irrigation.

Yu, O. T., Greenhut, R. F., O'Geen, A. T., Mackey, B., Horwath, W. R., & Steenwerth, K. L. (2017). Precipitation events and management practices affect greenhouse gas emissions from vineyards in a mediterranean climate. *Soil Science Society of America Journal, 81*(1), 138-152. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85014562478&doi=10.2136%2fsssaj2016.04.0098&partnerID=40&md5=3d290c877029bf7b1ce50f4401f1732f. doi:10.2136/sssaj2016.04.0098

Research Tags: Weather, Emissions, Crops

Abstract: *To evaluate the effect of precipitation events, management practices, and soil type in wine grape (Vitis vinifera L. ssp. vinifera) vineyard systems and provide data for greenhouse gas (GHG) emissions calculators, we monitored nine vineyards in the Lodi wine grape district, California, from April 2011 to December 2012. These commercial vineyards exist on three soil series (Redding, San Joaquin, and Tokay), representing a spectrum of soil textures and degrees of soil development. We hypothesized that soil characteristics would be a dominating factor affecting GHG fluxes, but the magnitude of fluxes would be influenced by precipitation and management events. We measured N2O fluxes, soil NO3–N and NH4–N, and gravimetric water content (GWC) from vine and intervine (alleys) rows bimonthly (April–October) and monthly (November–March). Monthly, we collected soil samples for dissolved organic C (DOC) and dissolved organic N (DON) determination. Path analysis revealed that the effects of soil type and vineyard zone on N2O emissions were influenced by soil texture (i.e., gravel and clay contents) but that this effect was mediated by GWC through soil temperature and soil inorganic N content. Management practices such as irrigation, fertigation, cover cropping, and tillage affected differences between vine rows and alleys for soil inorganic pools, DOC, and DON from June to October 2012. This 20-mo study indicated that precipitation events strongly influenced N2O fluxes.*

Yu, Z., Sun, G., Cai, T., Hallema, D. W., & Duan, L. (2019). Water yield responses to gradual changes in forest structure and species composition in a subboreal watershed in Northeastern China. *Forests, 10*(3). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063865455&doi=10.3390%2ff10030211&partnerID=40&md5=8141a7bba616717ef2cf22c99410ded9. doi:10.3390/f10030211

Research Tags: Water, Forestry

Abstract: *Relationships between forest cover and streamflow have been studied worldwide, but only a few studies have examined how gradual changes in forest structure and species composition due to logging and climate change affect watershed water yield (Q) and flow regimes. In this study, we analyzed long-term (45 years) hydrologic, climate and forest dynamics data from the subboreal Tahe watershed in northeastern China. Our purpose was to evaluate the effects of forest logging and regeneration on changes in forest biomass and species and to quantify the subsequent impact on mean annual streamflow and flow regime under a changing climate. The study watershed was dominated by old-growth larch (Larix gmelinii Rupr.) during the 1970s, but gradually transformed into young deciduous larch mixed with deciduous broad-leaved birch (Betula platyphylla Sukaczev) during the 2010s. During the same period, the watershed experienced climate change with a significant increase in air temperature of 0.028 ℃/year. We applied eight sensitivity-based techniques to separate the effects of climate change on water yield from those due to forest changes. We used flow duration curves (FDCs) to characterize flow regimes by dividing the study into four key periods based on the proportional change of larch and birch trees. We found that the mean annual streamflow decreased by 10 mm (−16 mm attributed to forest change and +6 mm to climate change) between the 1984–1994 period and the 2006–2016 period when the proportion of birch increased by 20% with a similar total forest volume in the later period. The mean annual streamflow increased from 216 mm to 270 mm (+35.5 mm due to forest change vs +17.7 mm due to climate change) when forest volume decreased by 18.7% (17 m3/ha) between the 1970s and 1984–1994. Water yield changed only slightly (3.5 mm) when forest volume increased by 8.7% (6 m3/ha) from 2000 to 2011. In addition, the magnitude of high flow and low flow increased following deforestation and a shift in species composition from a period (1984–1994) with 70% larch with 30% birch to a later period*

(2006–2016) with 50% larch with 50% birch. Both high flow and low flow decreased coinciding with a reforestation period (2006–2016). Our results highlight complex interactions among climate, forest structure, total biomass, and plant diversity (trees species composition) in influencing watershed hydrology. Further study is needed to examine the effects of ecohydrological processes such as evapotranspiration in larch and birch forests on hydrologic changes across multiple scales.

Yun, K., Hsiao, J., Jung, M. P., Choi, I. T., Glenn, D. M., Shim, K. M., & Kim, S. H. (2017). Can a multi-model ensemble improve phenology predictions for climate change studies? *Ecological Modelling, 362*, 54-64. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028499873&doi=10.1016%2fj.ecolmodel.2017.08.003&partnerID=40&md5=73612f405abe6791864fe9c28fb854ef. doi:10.1016/j.ecolmodel.2017.08.003

Research Tags: Research, Weather

Abstract: *Predicting phenology, the timing of developmental events, is critical for understanding how plants respond to the changing climate. Many prediction models have been developed during the last decades, but their use has been limited because of incomplete understanding of internal processes and lack of observation datasets needed for calibration and validation. Dependency on species and locations further complicates the model selection procedure which is an essential part of phenology predictions. To overcome the limitations raised by using a single model, we propose a multi-model ensemble that simplifies model selection and provides competitive performance. We hypothesize that 1) no single individual model consistently outperforms the others and 2) an ensemble model performs equally as or better than any individual models. Nine individual models based on the concept of thermal-time accumulation and their ensembles were cross-validated with 137 datasets of four species collected from multiple locations and years in the United States and South Korea. Non-parametric tests concluded that the performance of a simple mean ensemble model was as good as the best individual model and outperformed the others. Differences between individual models were not statistically significant. The use of ensemble, however, does not preclude any bias in the interpretation caused by characteristics of the underlying models. When the ensemble was classified into groups: 1) with and 2) without chilling components, to assess spring phenology of flowering cherry species in the long-term projections, the predictions of two ensemble groups diverged considerably under RCP8.5 scenario. Our results suggest that a simple ensemble model can be a good phenology prediction tool for avoiding the pitfalls of model selection and reducing inherent uncertainties in climate change studies, but also highlight the importance of implementing the underlying mechanisms of key physiological processes into individual models used in an ensemble.*

Zalesny, R. S., Headlee, W. L., Gopalakrishnan, G., Bauer, E. O., Hall, R. B., Hazel, D. W., . . . Wiese, A. H. (2019). Ecosystem services of poplar at long-term phytoremediation sites in the Midwest and Southeast, United States. *Wiley Interdisciplinary Reviews: Energy and Environment*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067451278&doi=10.1002%2fwene.349&partnerID=40&md5=b010f23bd77e2ef41c4245d34fd03ce8. doi:10.1002/wene.349

Research Tags: Forestry

Abstract: *Short rotation woody crops (SRWCs) including Populus species and their hybrids (i.e., poplars) are ideal for incorporating biomass production with phytotechnologies such as phytoremediation. To integrate these applications, 15 poplar plantings from nine long-term phytoremediation installations were sampled from 2012 to 2013 in the Midwest (Illinois, Iowa, Wisconsin) and Southeast (Alabama, Florida, North Carolina) United States. In this review, we report summary results of this sampling and how performance at each site compared with comparable phytoremediation systems in the literature. We review significant genotypic differences from each planting within the context of provisioning (i.e., biomass production) and regulating (i.e., carbon sequestration) ecosystem services and how they relate to the need for a cleaner environment during times of accelerated ecological degradation. Overall, the contaminated poplar sites provided these ecosystem services comparable to noncontaminated poplar sites used for bioenergy and biofuels feedstock production. For example, phytoremediation trees at the Midwestern sites had biomass values ranging from 4.4 to 15.5 Mg ha−1 y−1, which was ~20% less relative to bioenergy trees (p = .0938). Results were similar for diameter and carbon, with some genotype × environment interactions resulting in phytoremediation trees exhibiting substantially greater growth and productivity (i.e., +131% at one site). As illustrated in the current review, phytoremediation success can be increased with the identification and deployment of genotypes tailored to grow well and tolerate a broad diversity of contaminants (generalists) (i.e., 'DN34', 'NM6', '7300501') versus those that significantly* *outperform their counterparts under unique site conditions (specialists) (i.e., '220-5', '51-5', 'S13C20').*

Zecca, K., Allen, R. J., & Anderson, R. G. (2018). Importance of the El Niño Teleconnection to the 21st Century California Wintertime Extreme Precipitation Increase. *Geophysical Research Letters, 45*(19), 10,648-"610,655". Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85054686192&doi=10.1029%2f2018GL079714&partnerID=40&md5=74dafd9a6b23cddec87a7f83c0e53dcb. doi:10.1029/2018GL079714

Research Tags: Weather

Abstract: *In a warmer world, future California hydrological changes remain uncertain. Here we analyze state-of-the-art model simulations and find an increase in California precipitation during the winter. Nearly all of this increase is due to an increase in extreme precipitation, associated with moistening of the warmer atmosphere. Moreover, models that better simulate the El Niño-California precipitation teleconnection yield larger increases in extreme precipitation. This is related to better simulation of the dynamical and thermodynamical atmospheric responses associated with extreme California precipitation.*

Zettlemoyer, M. A., Prendeville, H. R., & Galloway, L. F. (2017). The effect of a latitudinal temperature gradient on germination patterns. *International Journal of Plant Sciences, 178*(9), 673-679. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85033580651&doi=10.1086%2f694185&partnerID=40&md5=d0c8e3c7d809a1ee3c10d2ea444f92d6. doi:10.1086/694185

Research Tags: Grassland, Weather

Abstract: *Premise of research. Germination timing determines a plant's exposure to environmental factors and has strong impacts on fitness. Despite this key role in the life cycle, relatively little is known about variation in germination within species. This study examines whether geographic variation in local environmental conditions affects germination in populations of Campanula americana throughout eastern North America.*
Methodology. We determined the temperature of spring and fall germination through a survey of 16 natural populations along a latitudinal transect over 4 yr. We then examined germination propensity and rate in a subset of these populations under controlled temperature conditions.
Pivotal results. Northern populations germinated at cooler temperatures than southern populations regardless of season, and fall germination occurred at warmer temperatures than spring germination across all populations. Northern populations germinated later in the spring than southern populations. Under controlled conditions, northern populations germinated more rapidly than southern populations, while warm temperatures accelerated germination, with all populations germinating at similar rates. However, under controlled conditions fewer seeds germinated from northern populations in comparison to southern populations, and the decrease in propensity to germinate at higher latitudes was pronounced under cool conditions.
Conclusions. Temperature influences germination timing in C. americana. In the field, germination occurs at a consistent time across a wide range of climates, but populations spanning the latitudinal gradient germinate under different temperatures. Under controlled conditions, warmer temperatures accelerate germination. Populations differ in plasticity of germination propensity to temperature. This reduced germination of northern populations, especially under cooler temperatures, may serve as an adaptive plastic response to the later arrival of suitable temperatures for growth. The influence of environmental variation on germination in natural populations and under ecologically relevant experimental conditions indicates that novel environmental conditions imposed by climate change may alter life-history patterns.

Zhang, B., Feng, G., Ahuja, L. R., Kong, X., Ouyang, Y., Adeli, A., & Jenkins, J. N. (2018). Soybean crop-water production functions in a humid region across years and soils determined with APEX model. *Agricultural Water Management, 204*, 180-191. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85045535285&doi=10.1016%2fj.agwat.2018.03.024&partnerID=40&md5=795560946df5974807c68063f6ac0ed3. doi:10.1016/j.agwat.2018.03.024

Research Tags: Crops, Water, Soil

Abstract: *Crop production as a function of water use or water applied, called the crop water production function (CWPF), is a useful tool for irrigation planning, design and management. However, these functions are not only crop and variety specific they also vary with soil types and climatic conditions (locations). Derivation of* *multi-year average CWPFs through field experiments for different locations and soils is time-consuming and expensive, as it requires careful long-term and multi-location field experiments to obtain them. Process based crop system models provide a useful tool for determining CWPFs using short-term field experimental data for calibration and validation. The aim of this study was to determine soybean CWPFs using the Agricultural Policy/Environmental eXtender (APEX) model across three soil types (Vaiden-silty clay, Cahaba-sandy loam, and Demopolis-clay loam) and three weather conditions (14-year average from 2002 to 2015, dry, and wet) of a humid irrigated region in Mississippi, USA. The results showed that the relationship between simulated soybean grain yield (GY) and the seasonal crop evapotranspiration (ET) for each soil under 14-year average weather condition was linear. Compared with the Vaiden soil, the Cahaba and Demopolis soils had slightly higher water use efficiency (WUE) over 14-year average weather conditions. The CWPFs for GY vs supplemental irrigation were cubic polynomials for all soil types and weather conditions, with varying coefficients. The maximum values of irrigation water use efficiency (IWUEmax) derived from these cubic CWPFs varied from 2.58 to 9.89 kg ha−1 mm−1 across soils and weather conditions. The irrigation amount during the growing season required (Imax) to achieve the maximum GY for soybean also had a wide range of values, from 110 to 405 mm. The IWUE and Imax were related to available water holding capacity of soils. The relationship between GY and total plant available water supply (TWS) was also a cubic function, with coefficients varying with soil types and climatic conditions. The yield response factor (Ky) was 1.24 (greater than 1.00) when averaged over 14 years' weather data, indicating that soybean was very sensitive to water stress even in a humid region like Mississippi. Thus, supplemental irrigation is necessary to increase GY and ensure stability in yields.*

Zhang, F., Pan, Y., Birdsey, R. A., Chen, J. M., & Dugan, A. (2017). Seeking potential contributions to future carbon budget in conterminous US forests considering disturbances. *Theoretical and Applied Climatology, 130*(3-4), 971-978. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84988329662&doi=10.1007%2fs00704-016-1936-1&partnerID=40&md5=337537f8fc1fb51aa350bba00a113fe6. doi:10.1007/s00704-016-1936-1

Research Tags: Forestry

Abstract: *Currently, US forests constitute a large carbon sink, comprising about 9 % of the global terrestrial carbon sink. Wildfire is the most significant disturbance influencing carbon dynamics in US forests. Our objective is to estimate impacts of climate change, CO2 concentration, and nitrogen deposition on the future net biome productivity (NBP) of US forests until the end of twenty-first century under a range of disturbance conditions. We designate three forest disturbance scenarios under one future climate scenario to evaluate factor impacts for the future period (2011–2100): (1) no wildfires occur but forests continue to age (Saging), (2) no wildfires occur and forest ages are fixed in 2010 (Sfixed_nodis), and (3) wildfires occur according to a historical pattern, consequently changing forest age (Sdis_age_change). Results indicate that US forests remain a large carbon sink in the late twenty-first century under the Sfixed_nodis scenario; however, they become a carbon source under the Saging and Sdis_age_change scenarios. During the period of 2011 to 2100, climate is projected to have a small direct effect on NBP, while atmospheric CO2 concentration and nitrogen deposition have large positive effects on NBP regardless of the future climate and disturbance scenarios. Meanwhile, responses to past disturbances under the Sfixed_nodis scenario increase NBP regardless of the future climate scenarios. Although disturbance effects on NBP under the Saging and Sdis_age_change scenarios decrease with time, both scenarios experience an increase in NBP prior to the 2050s and then a decrease in NBP until the end of the twenty-first century. This study indicates that there is potential to increase or at least maintain the carbon sink of conterminous US forests at the current level if future wildfires are reduced and age structures are maintained at a productive mix. The effects of CO2 on the future carbon sink may overwhelm effects of other factors at the end of the twenty-first century. Although our model in conjunction with multiple disturbance scenarios may not reflect the true conditions of future forests, it provides a range of potential conditions as well as a useful guide to both current and future forest carbon management.*

Zhang, F., Quan, Q., Ma, F., Tian, D., Hoover, D. L., Zhou, Q., & Niu, S. (2019). When does extreme drought elicit extreme ecological responses? *Journal of Ecology*. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068531052&doi=10.1111%2f1365-2745.13226&partnerID=40&md5=92d24d32b0dd060d92bd7c05d2957710. doi:10.1111/1365-2745.13226

Research Tags: Weather

Abstract: *Global climate change models predict an increase in the frequency and intensity of extreme droughts, with uncertain ecological impacts across ecosystems. In particular, it is not clear when extreme droughts will elicit extreme ecological responses.*
For this study, we employed three complementary approaches to explore the relationships between extreme drought and ecosystem responses. First, we used global data mining to evaluate the relationship between extreme gross primary productivity and extreme precipitation from 1980 to 2013. Second, we conducted a meta-analysis using 132 drought experiments across the globe to assess the response ratios (RRs) of above-ground net primary productivity (ANPP) to extreme versus non-extreme drought treatments. Third, we examined community and ecosystem responses in an alpine meadow to a drought gradient experiment, which included five precipitation treatment levels (1/12 P, 1/4 P, 1/2 P, 3/4 P, and P, where P is the growing season precipitation).
This study had three key results. In our historical data mining, we found that extreme droughts elicited extreme ecological responses only 15.1% of the time. The meta-analysis results indicated that there were no significant differences in the RRs of ANPP between the extreme versus non-extreme drought treatments. The drought gradient experiment results revealed that although the four drought treatments were statistically extreme, only the most extreme drought treatment (1/12 P) significantly reduced ANPP over the 3 years. Meanwhile, species richness and asynchrony were significantly reduced under the 1/12 P treatment, which led to a significant reduction in productivity.
Synthesis. These results suggest that extreme ecological responses to extreme drought may be less frequent than previously thought. But when they do occur, extreme ecological responses may be driven by plant community changes such as species asynchrony, species loss or species reordering. Our experimental results highlight the key role of community dynamics in determining the resistance of ecosystem productivity to extreme drought, which should be assessed when predicting ecological responses to climate change.

Zhang, G., Feng, G., Li, X., Xie, C., & Pi, X. (2017). Flood effect on groundwater recharge on a typical silt loam soil. *Water (Switzerland), 9*(7). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85025457165&doi=10.3390%2fw9070523&partnerID=40&md5=f30d40abdf9a25ef5f6c2899c7248a17. doi:10.3390/w9070523
Research Tags: Water, Soil
Abstract: *Floods are of great concern as the global climate changes, and investigations of flood water infiltration and groundwater recharge are important for water resource management worldwide, especially under conditions of global climate changes. However, information on the relationship between the flood water and groundwater recharge is limited. The objective of this study was to determine the relationship between the flood water depth and the height of groundwater rise using lysimeters and numerical modeling in the floodplain of the Tarim River in northwestern China. The experimental results suggested that the rise in height of the groundwater table was closely related to the flood water ponding depth, and the groundwater depth decreased quickly after flooding due to the high infiltration rate of water originating at the Tarim River. The water table falling velocity was significantly less than the water table rising velocity. If the initial groundwater table was deeper, the variation in the water table rise depth was smaller and the water table falling velocity was slower. The numerical simulation results showed good agreement with the observed data, with a determination coefficient (R2) of 0.87 and a root mean square error (RMSE) of 63.91 cm. A good relationship (R2 = 0.789) between the initial groundwater table depth (H0), initial soil water content (W0), flood water depth (h), and height of the water table rise (H) was established. Considering that natural and artificial flood frequencies are related to flood time interval (dt), a relationship (R2 = 0.892) was developed between them. These results can enhance the understanding of flood recharge characteristics in the floodplains of inland rivers.*

Zhang, J., Zhang, D., Wei, J., Shi, X., Ding, H., Qiu, S., . . . Xia, Y. (2019). Annual growth cycle observation, hybridization and forcing culture for improving the ornamental application of Paeonia lactiflora Pall.In the low-latitude regions. *PLoS ONE, 14*(6). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067513830&doi=10.1371%2fjournal.pone.0218164&partnerID=40&md5=a8aedc0766cdb8b59abf911d125c6755. doi:10.1371/journal.pone.0218164
Research Tags: Crops, Weather
Abstract: *Expanding the southern range of herbaceous peony (Paeonia lactiflora Pall.) is a meaningful and*

worthwhile horticultural endeavor in the Northern Hemisphere. However, high temperatures in winter seriously hinder the bud dormancy release and flowering of peony in the more southern areas of subtropical and tropical regions. Resource introduction and hybridization can contribute to creating new cultivars with high adaptability in a warmer winter climate. In this study, three representative cultivars of P. lactiflora were screened for flowering capabilities and their annual growth cycles were observed to provide information needed for hybridization. Among these three cultivars, 'Hang Baishao' is the best adapted cultivar for southern growing regions and is unique in its ability to thrive in southern areas of N 30°00'. Pollen viability of 'Hang Baishao' was 55.60% based on five measuring methods, which makes it an excellent male parent in hybridization. Hybrid plants among these three cultivars grew well, but all of their flower buds aborted. Additionally, the ability of three growth regulators that advance the flowering of 'Hang Baishao' to promote an indoor cultivation strategy for improving peony application as a potted or cut-flower plant was tested. 5-azacytidine could impact the growth of 'Hang Baishao' and induce dwarfism and small flowers but not advance the flowering time. Gibberellin A3 promoted the sprouting and growth significantly, but all plants eventually withered. Chilling at 0–4°C for four weeks and irrigation with 300 mg/L humic acid was the optimal combination used to hasten flowering and ensure flowering quality simultaneously. These results can lay the foundation for future studies on the chilling requirement trait, bud dormancy release and key functional gene exploration of herbaceous peony. Additionally, this study can also provide guidance for expanding the range of economically important plants with the winter dormancy trait to the low-latitude regions.

Zhang, L., Qiu, Y., Cheng, L., Wang, Y., Liu, L., Tu, C., . . . Hu, S. (2018). Atmospheric CO<inf>2</inf> Enrichment and Reactive Nitrogen Inputs Interactively Stimulate Soil Cation Losses and Acidification. *Environmental Science and Technology, 52*(12), 6895-6902. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047390422&doi=10.1021%2facs.est.8b00495&partnerID=40&md5=fd7c5dbb56612ebb3b3e44cafba40d1d. doi:10.1021/acs.est.8b00495

Research Tags: Soil

Abstract: *Reactive N inputs (Nr) may alleviate N-limitation of plant growth and are assumed to help sustain plant responses to the rising atmospheric CO2 (eCO2). However, Nr and eCO2 may elicit a cascade reaction that alters soil chemistry and nutrient availability, shifting the limiting factors of plant growth, particularly in acidic tropical and subtropical croplands with low organic matter and low nutrient cations. Yet, few have so far examined the interactive effects of Nr and eCO2 on the dynamics of soil cation nutrients and soil acidity. We investigated the cation dynamics in the plant–soil system with exposure to eCO2 and different N sources in a subtropical, acidic agricultural soil. eCO2 and Nr, alone and interactively, increased Ca2+ and Mg2+ in soil solutions or leachates in aerobic agroecosystems. eCO2 significantly reduced soil pH, and NH4+-N inputs amplified this effect, suggesting that eCO2-induced plant preference of NH4+-N and plant growth may facilitate soil acidification. This is, to our knowledge, the first direct demonstration of eCO2 enhancement of soil acidity, although other studies have previously shown that eCO2 can increase cation release into soil solutions. Together, these findings provide new insights into the dynamics of cation nutrients and soil acidity under future climatic scenarios, highlighting the urgency for more studies on plant–soil responses to climate change in acidic tropical and subtropical ecosystems.*

Zhang, T. Q., Zheng, Z. M., Lal, R., Lin, Z. Q., Sharpley, A. N., Shober, A. L., . . . Van Cappellen, P. (2018). Environmental indicator principium with case references to agricultural soil, water, and air quality and model-derived indicators. *Journal of Environmental Quality, 47*(2), 191-202. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043310198&doi=10.2134%2fjeq2017.10.0398&partnerID=40&md5=8b8348102717e4b29f3f6b56f7f69ee4. doi:10.2134/jeq2017.10.0398

Research Tags: Soil, Water, Research

Abstract: *Environmental indicators are powerful tools for tracking environmental changes, measuring environmental performance, and informing policymakers. Many diverse environmental indicators, including agricultural environmental indicators, are currently in use or being developed. This special collection of technical papers expands on the peer-reviewed literature on environmental indicators and their application to important current issues in the following areas: (i) model-derived indicators to indicate phosphorus losses from arable land to surface runoff and subsurface drainage, (ii) glutathione–ascorbate cycle-related antioxidants as early-warning bioindicators of polybrominated diphenyl ether toxicity in mangroves, and (iii) assessing the*

effectiveness of using organic matrix biobeds to limit herbicide dissipation from agricultural fields, thereby controlling on-farm point-source pollution. This introductory review also provides an overview of environmental indicators, mainly for agriculture, with examples related to the quality of the agricultural soil–water–air continuum and the application of model-derived indicators. Current knowledge gaps and future lines of investigation are also discussed. It appears that environmental indicators, particularly those for agriculture, work efficiently at the field, catchment, and local scales and serve as valuable metrics of system functioning and response; however, these indicators need to be refined or further developed to comprehensively meet community expectations in terms of providing a consistent picture of relevant issues and/or allowing comparisons to be made nationally or internationally.

Zhang, X. X., Sharratt, B., Lei, J. Q., Wu, C. L., Zhang, J., Zhao, C., . . . Hao, J. Q. (2019). Parameterization schemes on dust deposition in northwest China: Model validation and implications for the global dust cycle. *Atmospheric Environment*, 1-13. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064249703&doi=10.1016%2fj.atmosenv.2019.04.017&partnerID=40&md5=fb3f1e7ba94e1cfa3ec806f8d27f84a1. doi:10.1016/j.atmosenv.2019.04.017

Research Tags: Soil

Abstract: *Accurate estimation of dust deposition is of significance for modelling global radiation and the biochemical carbon cycle in the earth system. However, the paucity of dust deposition data precludes our ability to adequately verify estimations of dust deposition. Based on the environmental monitoring records in Xinjiang Province, northwest China, we conducted a numerical simulation of dust deposition using the Weather Research and Forecasting model coupled with Chemistry (WRF-Chem) and compared observed and modelled deposition during the spring dust season (March–May). The performance of WRF-Chem on modelling dust deposition was tested and evaluated with adoption of Georgia Tech/Goddard Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) and Shao et al. (2011a) dust emission schemes. Our results indicate that the dry deposition schemes have the capability to predict size-resolved dust deposition. However, modelled and measured dust deposition differed by more than one order of magnitude. The modelled dust dry deposition does not satisfactorily agree well with field measurements. This study suggests significant distinctions exist among these two dust emission schemes when simulating mineral dust dry deposition in northwest China. Uncertainties in estimating the dry dust deposition are in a range of 77–96%. These uncertainties imply that parameterization in the current dust deposition schemes need to be further improved. We found that the estimation of dust deposition is highly underestimated by the Global Climate Model and Regional Climate Model (GCM/RCM). Thus global dust cycles and dust deposition may exceed our current estimates.*

Zhang, X. X., Sharratt, B., Liu, L. Y., Wang, Z. F., Pan, X. L., Lei, J. Q., . . . Lyu, Y. L. (2018). East Asian dust storm in May 2017: Observations, modelling, and its influence on the Asia-Pacific region. *Atmospheric Chemistry and Physics, 18*(11), 8353-8371. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048811266&doi=10.5194%2facp-18-8353-2018&partnerID=40&md5=1509ed71c1345584a80d10fe20ee21e1. doi:10.5194/acp-18-8353-2018

Research Tags: Soil

Abstract: *A severe dust storm event originated from the Gobi Desert in Central and East Asia during 2–7 May 2017. Based on Moderate Resolution Imaging Spectroradiometer (MODIS) satellite products, hourly environmental monitoring measurements from Chinese cities and East Asian meteorological observation stations, and numerical simulations, we analysed the spatial and temporal characteristics of this dust event as well as its associated impact on the Asia-Pacific region. The maximum observed hourly PM10 (particulate matter with an aerodynamic diameter ≤ 10 µm) concentration was above 1000 µg m−3 in Beijing, Tianjin, Shijiazhuang, Baoding, and Langfang and above 2000 µg m−3 in Erdos, Hohhot, Baotou, and Alxa in northern China. This dust event affected over 8.35 million km2, or 87 % of the Chinese mainland, and significantly deteriorated air quality in 316 cities of the 367 cities examined across China. The maximum surface wind speed during the dust storm was 23–24 m s−1 in the Mongolian Gobi Desert and 20–22 m s−1 in central Inner Mongolia, indicating the potential source regions of this dust event. Lidar-derived vertical dust profiles in Beijing, Seoul, and Tokyo indicated dust aerosols were uplifted to an altitude of 1.5–3.5 km, whereas simulations by the Weather Research and Forecasting with Chemistry (WRF-Chem) model indicated 20.4 and 5.3 Tg of aeolian dust being deposited respectively across continental Asia and the North Pacific Ocean.*

According to forward trajectory analysis by the FLEXible PARTicle dispersion (FLEXPART) model, the East Asian dust plume moved across the North Pacific within a week. Dust concentrations decreased from the East Asian continent across the Pacific Ocean from a magnitude of 103 to 10−5 μg m−3, while dust deposition intensity ranged from 104 to 10−1 mg m−2. This dust event was unusual due to its impact on continental China, the Korean Peninsula, Japan, and the North Pacific Ocean. Asian dust storms such as those observed in early May 2017 may lead to wider climate forcing on a global scale.

Zhang, Y., Cheng, G., Li, X., Jin, H., Yang, D., Flerchinger, G. N., . . . Liang, J. (2017). Influences of Frozen Ground and Climate Change on Hydrological Processes in an Alpine Watershed: A Case Study in the Upstream Area of the Hei'he River, Northwest China. *Permafrost and Periglacial Processes, 28*(2), 420-432. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85002568462&doi=10.1002%2fppp.1928&partnerID=40&md5=d8a41e252d7e7e2f20bea19d19b0478d. doi:10.1002/ppp.1928

Research Tags: Water

Abstract: *In cold regions, the occurrence of frozen ground has a fundamental control over the character of the water cycle. To investigate the impact of changing ground temperature conditions on hydrological processes in the context of climate change, a distributed hydrological model with an explicit frozen ground module was applied to an alpine watershed in the upstream area of the Hei'he River in the Qilian Mountains, northwest China. After evaluating the base model, we considered scenarios of frost-free ground and climate change. Results showed that the base model with a frozen ground module successfully captured the water balance and thermal regimes in the basin. When the frozen ground module was turned off, the simulated groundwater recharge and base flow increased by a factor of two to three because surface runoff caused by exceeding infiltration capacities at high elevations, which occurred in the base model, was eliminated. Consequently, the river hydrograph became smoother and flatter, with summer flood peaks delayed and reduced in volume. The annual mean depth where subsurface runoff was generated, was about 2.4 m compared to 1.1 m in the base model. For a warming climate, a combination of increasing evapotranspiration and reducing permafrost area results in smoother and flatter hydrographs, and a reduction in total river discharge. Although our analysis using numerical models has its limitations, it still provides new quantitative understanding of the influences of frozen ground and climate change on hydrological processes in an alpine watershed.*

Zhang, Y., Li, W., Sun, G., & King, J. S. (2019). Coastal wetland resilience to climate variability: A hydrologic perspective. *Journal of Hydrology, 568*, 275-284. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056271627&doi=10.1016%2fj.jhydrol.2018.10.048&partnerID=40&md5=d4ba58848a026e19272c8b571698a4d9. doi:10.1016/j.jhydrol.2018.10.048

Research Tags: Water

Abstract: *Climate-induced disturbances are expected to increase in frequency and intensity and affect wetland ecology by altering its hydrology. Investigating how wetland hydrology responds to climate disturbances is an important first step to understand the ecological response of coastal wetlands to these disturbances. Wetland hydrologic resilience, the ability of wetland in absorbing disturbances and restoring to pre-disturbance conditions in hydrological function, is a critical measure of wetland hydrological response to climate disturbances. However, a practical methodology for quantifying wetland hydrologic resilience (HR) is still lacking. This study aimed to improve the approach for quantifying the hydrologic resilience of wetland ecosystems to climate variability and climate change. A set of quantitative metrics was developed including the variations of groundwater table, overland flow, and saltwater table. This approach was then applied to a coastal landscape that includes coastal-forested and herbaceous wetlands in North Carolina, USA. We investigated the threshold behaviors of groundwater table, overland flow, and saltwater table for a 20-year period (1995–2014) by applying a regional scale wetland hydrological model, Penn State Integrated Hydrological Model for wetland hydrology (PIHM-Wetland). We found that the multiscale variations of groundwater table under dry climatic conditions is a good indicator of wetland HR to drought. The variation of overland flow during rainfall events effectively quantified HR to wet periods. We also found that the variation of the water level of saltwater is an important metric of wetland HR to sea level rise. This study improves the methodology of quantifying wetland hydrologic resilience at a regional scale, representing an important first step towards understanding the wetland hydrological and ecological resilience to future intensified climate disturbances in coastal regions and beyond.*

Zhang, Y., Li, W., Sun, G., Miao, G., Noormets, A., Emanuel, R., & King, J. S. (2018). Understanding coastal wetland hydrology with a new regional-scale, process-based hydrological model. *Hydrological Processes, 32*(20), 3158-3173. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85052844950&doi=10.1002%2fhyp.13247&partnerID=40&md5=002b18f27a808a3af8aacffa4f114708. doi:10.1002/hyp.13247

Research Tags: Water

Abstract: *Coastal wetlands represent an ecotone between ocean and terrestrial ecosystems, providing important services, including flood mitigation, fresh water supply, erosion control, carbon sequestration, and wildlife habitat. The environmental setting of a wetland and the hydrological connectivity between a wetland and adjacent terrestrial and aquatic systems together determine wetland hydrology. Yet little is known about regional-scale hydrological interactions among uplands, coastal wetlands, and coastal processes, such as tides, sea level rise, and saltwater intrusion, which together control the dynamics of wetland hydrology. This study presents a new regional-scale, physically based, distributed wetland hydrological model, PIHM-Wetland, which integrates the surface and subsurface hydrology with coastal processes and accounts for the influence of wetland inundation on energy budgets and evapotranspiration (ET). The model was validated using in situ hydro-meteorological measurements and Moderate Resolution Imaging Spectroradiometer (MODIS) ET data for a forested and herbaceous wetland in North Carolina, USA, which confirmed that the model accurately represents the major wetland hydrological behaviours. Modelling results indicate that topographic gradient is a primary control of groundwater flow direction in adjacent uplands. However, seasonal climate patterns become the dominant control of groundwater flow at lower coastal plain and land–ocean interface. We found that coastal processes largely influence groundwater table (GWT) dynamics in the coastal zone, 300 to 800 m from the coastline in our study area. Among all the coastal processes, tides are the dominant control on GWT variation. Because of inundation, forested and herbaceous wetlands absorb an additional 6% and 10%, respectively, of shortwave radiation annually, resulting in a significant increase in ET. Inundation alters ET partitioning through canopy evaporation, transpiration, and soil evaporation, the effect of which is stronger in cool seasons than in warm seasons. The PIHM-Wetland model provides a new tool that improves the understanding of wetland hydrological processes on a regional scale. Insights from this modelling study provide benchmarks for future research on the effects of sea level rise and climate change on coastal wetland functions and services.*

Zhang, Y., Song, C., Band, L. E., Sun, G., & Li, J. (2017). Reanalysis of global terrestrial vegetation trends from MODIS products: Browning or greening? *Remote Sensing of Environment, 191*, 145-155. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85010281688&doi=10.1016%2fj.rse.2016.12.018&partnerID=40&md5=8b406a1dba8ebd252576c01dfc68cb4e. doi:10.1016/j.rse.2016.12.018

Research Tags: Research

Abstract: *Accurately monitoring global vegetation dynamics with modern remote sensing is critical for understanding the functions and processes of the biosphere and its interactions with the planetary climate. The MODerate resolution Imaging Spectroradiometer (MODIS) vegetation index (VI) product has been a primary data source for this purpose. To date, the MODIS team had released several versions of VI products that have widely used in global change studies and practical applications. In this study, we re-examined the global vegetation activity by comparing the recent MODIS Collection 6 (C6) VIs with Collection 5 (C5) VIs including Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) from Terra (2001–2015) and Aqua Satellites (2003–2015). We found substantial differences in global vegetation trends betweenTerra-C5 and -C6 VIs, especially EVI. From 2001 to 2015, global vegetation showed a remarkable greening trend in annual EVI from the Terra-C6 (0.28% year− 1; P < 0.001), in contrast to the decreasing EVI trend from the Terra-C5 (− 0.14% year− 1, P < 0.01). Spatially, large portions of the browning areas in tropical regions identified by Terra-C5 VIs were not evident in Terra-C6 VIs. In contrast, the widespread greening areas in Terra-C6 VIs were consistent with Aqua-C6 VIs and GIMMS3g NDVI. Our finding of a greening Earth supports the recent studies suggesting an enhanced land carbon sink. Our study suggests that most of the vegetation browning trends detected by MODIS Terra-C5 VIs were likely caused by sensor degradation, particularly for the period after 2007. Therefore, previous studies of temporal vegetation trends based solely on Terra-C5 VIs may need to be reevaluated. Our new analysis offers the most updated understanding of the*

global vegetation dynamics during the past 15 years and contributes to accurately understanding the role of vegetation played in the Earth's biogeochemical and climatic systems.

Zhang, Y. L., Li, L. J., Yao, S. H., Mao, J. D., Schmidt-Rohr, K., Olk, D. C., . . . Zhang, B. (2018). Distinct changes in composition of soil organic matter with length of cropping time in subsoils of a Phaeozem and Chernozem. *European Journal of Soil Science, 69*(5), 868-878. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050954174&doi=10.1111%2fejss.12688&partnerID=40&md5=dced07397b61f40b1b8ca16a1a7da31c. doi:10.1111/ejss.12688

Research Tags: Soil, Crops

Abstract: *Deeper soil horizons might provide an opportunity to enhance C sequestration because soil organic matter (SOM) at depth is assumed to be stable. However, it is unknown whether the stable composition of organic carbon in subsoils changes with the length of cropping time and the type of soil. The objectives of this study were to determine the effects on the chemical structures of SOM of cropping time after conversion from grassland to arable land under a Phaeozem and Chernozem in northeast China. Near-quantitative multiple cross-polarization (multiCP) 13C nuclear magnetic resonance (NMR) spectroscopy was applied, and 11 types of carbon (C) functional groups were identified. Principal component analysis of these functional groups showed that the chemical composition of SOM was differentiated by soil type and depth. The Phaeozem and Chernozem profiles differed mainly in their relative proportions of aromatic C–C and (CH2)n groups: the Phaeozem contained relatively more aromatic C–C, whereas the Chernozem contained relatively more (CH2)n groups. The fused-ring aromatic C–C carbon was probably derived from char-like organic matter generated by burning of plant litter or from SOM humification, whereas the (CH2)n groups were likely to be from plant- or microbially-derived residues. The main differences between top- and sub-soils were the occurrence of more protonated C in the topsoils and more non-protonated C in the subsoils. With increasing length of cropping time, aromatic C–C and C–O groups and COO/N–C=O groups increased, but (CH2)n groups decreased in the Phaeozem subsoils and increased in the Chernozem subsoils. Our findings suggested that leaching and soil moisture might influence the origin, redistribution and transformation of the recalcitrant components of SOM in the soil profile, resulting in changes in SOM composition under different climates and soil types.*

Zhang, Y. L., Yao, S. H., Cao, X. Y., Schmidt-Rohr, K., Olk, D. C., Mao, J. D., & Zhang, B. (2018). Structural evidence for soil organic matter turnover following glucose addition and microbial controls over soil carbon change at different horizons of a Mollisol. *Soil Biology and Biochemistry, 119*, 63-73. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85041437345&doi=10.1016%2fj.soilbio.2018.01.009&partnerID=40&md5=9ad1687a1a1cf8937b8716335eb3ff4b. doi:10.1016/j.soilbio.2018.01.009

Research Tags: Soil

Abstract: *Soil organic matter (SOM) in subsoils stores more than half of terrestrial organic carbon (C), and may sequestrate more C with increasing organic input due to its low C content (or high mineral reactivity) and high chemical stability. Organic inputs can stimulate microbial decomposition of native SOM (known as the priming effect), while being microbially decomposed and transformed into SOM. Yet, microbial controls over these processes and their influence on soil carbon change in soil profile remain elusive because of technical challenge to separate them. We overcame this challenge by employing a novel approach of combining 13C and 12C isotopes with quantitative solid-state 13C nuclear magnetic resonance (NMR). We used soil samples taken from three soil horizons in a Mollisol profile that dominated with fused-ring aromatics for a 43-day incubation. The signal intensities of the most dominant fused-ring aromatics and nonpolar alkyl groups were reduced due to the priming effect following the addition of 12C enriched glucose. Those signal intensities of O-alkyl and nonpolar alkyl groups increased in SOM spectra following the addition of 13C-labeld glucose, demonstrating accumulation of glucose and microbial residues. With the increasing glucose concentration, priming effect estimated using isotopic method and the magnitudes of signal loss estimated using 13C NMR both increased as exemplified for the Ap horizon soil. However, soil organic C content increased only when the added glucose concentration was beyond a previously non-quantified priming saturation threshold (between 36.0 and 100.0 g glucose-C kg−1 SOM-C). The increase of soil organic C was larger in the subsoils than in the topsoil due to lower microbial biomass, higher microbial growth efficiency (MGE) and mineral reactivity, which were related to the reduced priming effect and enhanced accumulation of microbial and glucose residues in the subsoils. The higher MGE in the subsoils agreed with stronger shifts of microbial community composition, characterized by*

phosphorous lipid fatty acid profiling, with changing glucose concentration during the incubation. Our findings highlighted the importance of priming saturation threshold, microbial mediation and mineral reactivity, but not SOM recalcitrance, in controlling the dynamics of SOM. Our study provided a novel approach to quantify these parameters and understand the controlling factors in relation to different plant types and soil types.

Zhao, F., Healey, S. P., Huang, C., McCarter, J. B., Garrard, C., Goeking, S. A., & Zhu, Z. (2018). Assessing the Effects of Fire Disturbances and Timber Management on Carbon Storage in the Greater Yellowstone Ecosystem. *Environmental Management, 62*(4), 766-776. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85048539852&doi=10.1007%2fs00267-018-1073-y&partnerID=40&md5=b7e9faae748faf5d80010a5a0bf8a798. doi:10.1007/s00267-018-1073-y

Research Tags: Weather, Forestry

Abstract: *Accurate characterization of Carbon (C) consequences of forest disturbances and management is critical for informed climate mitigation and adaptation strategies. While research into generalized properties of the forest C cycle informs policy and provides abstract guidance to managers, most management occurs at local scales and relies upon monitoring systems that can consistently provide C cycle assessments that explicitly apply to a defined time and place. We used an inventory-based forest monitoring and simulation tool to quantify C storage effects of actual fires, timber harvests, and forest regeneration conditions in the Greater Yellowstone Ecosystem (GYE). Results show that (1) the 1988 fires had a larger impact on GYE's C storage than harvesting during 1985–2011; (2) continuation of relatively high harvest rates of the region's National Forest land, which declined after 1990, would have shifted the disturbance agent primary importance on those lands from fire to harvest; and (3) accounting for local heterogeneity of post-disturbance regeneration patterns translates into large regional effects on total C storage. Large fires in 1988 released about 8.3 ± 0.3 Mg/ha of C across Yellowstone National Park (YNP, including both disturbed and undisturbed area), compared with total C storage reductions due to harvest of about 2.3 ± 0.3 Mg/ha and 2.6 ± 0.2 Mg/ha in adjacent Caribou-Targhee and Gallatin National Forests, respectively, from 1985–2011. If the high harvest rates observed in 1985–1989 had been maintained through 2011 in GYE National Forests, the C storage effect of harvesting would have quintupled to 10.5 ± 1.0 Mg/ha, exceeding the immediate losses associated with YNP's historic fire but not the longer-term net loss of carbon (16.9 ± 0.8 Mg/ha). Following stand-replacing disturbance such as the 1988 fires, the actual regeneration rate was slower than the default regional average rate assumed by empirically calibrated forest growth models. If regeneration following the 1988 fire had reached regionally average rates, either through different natural circumstances or through more active management, YNP would have had approximately 4.1 Mg/ha more forest carbon by year 2020. This study highlights the relative effects of fire disturbances and management activities on regional C storage, and demonstrates a forest carbon monitoring system that can be both applied consistently across the US and tailored to questions of specific local management interest.*

Zhao, P., Zhou, H. J., Potter, D., Hu, Y. H., Feng, X. J., Dang, M., . . . Woeste, K. (2018). Population genetics, phylogenomics and hybrid speciation of Juglans in China determined from whole chloroplast genomes, transcriptomes, and genotyping-by-sequencing (GBS). *Molecular Phylogenetics and Evolution, 126*, 250-265. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046359418&doi=10.1016%2fj.ympev.2018.04.014&partnerID=40&md5=2ce37e54360da63040782da20210c860. doi:10.1016/j.ympev.2018.04.014

Research Tags: Forestry

Abstract: *Genomic data are a powerful tool for elucidating the processes involved in the evolution and divergence of species. The speciation and phylogenetic relationships among Chinese Juglans remain unclear. Here, we used results from phylogenomic and population genetic analyses, transcriptomics, Genotyping-By-Sequencing (GBS), and whole chloroplast genomes (Cp genome) data to infer processes of lineage formation among the five native Chinese species of the walnut genus (Juglans, Juglandaceae), a widespread, economically important group. We found that the processes of isolation generated diversity during glaciations, but that the recent range expansion of J. regia, probably from multiple refugia, led to hybrid formation both within and between sections of the genus. In southern China, human dispersal of J. regia brought it into contact with J. sigillata, which we determined to be an ecotype of J. regia that is now maintained as a landrace. In northern China, walnut hybridized with a distinct lineage of J. mandshurica to*

form J. hopeiensis, a controversial taxon (considered threatened) that our data indicate is a horticultural variety. Comparisons among whole chloroplast genomes and nuclear transcriptome analyses provided conflicting evidence for the timing of the divergence of Chinese Juglans taxa. J. cathayensis and J. mandshurica are poorly differentiated based our genomic data. Reconstruction of Juglans evolutionary history indicate that episodes of climatic variation over the past 4.5 to 33.80 million years, associated with glacial advances and retreats and population isolation, have shaped Chinese walnut demography and evolution, even in the presence of gene flow and introgression.

Zhou, C., Biederman, J. A., Zhang, H., Li, L., Cui, X., Kuzyakov, Y., . . . Wang, Y. (2019). Extreme-duration drought impacts on soil CO<inf>2</inf> efflux are regulated by plant species composition. *Plant and Soil, 439*(1-2), 357-372. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064251551&doi=10.1007%2fs11104-019-04025-w&partnerID=40&md5=4b241547a7bee646113a7248eb975391. doi:10.1007/s11104-019-04025-w

Research Tags: Weather, Soil

Abstract: *Aims*

Long-duration drought can alter ecosystem plant species composition with subsequent effects on carbon cycling. We conducted a rainfall manipulation field experiment to address the question: how does drought-induced vegetation change, specifically shrub encroachment into grasslands, regulate impacts of subsequent drought on soil CO_2 efflux (Rs) and its components (autotrophic and heterotrophic, Ra and Rh)?

Methods

We conducted a two-year experiment in Inner Mongolia plateau, China, using constructed steppe communities including graminoids, shrubs and their mixture (graminoid + shrub) to test the effects of extreme-duration drought (60-yr return time) on Rs, Rh and Ra.

Results

Our results indicated that extreme-duration drought reduced net primary production, with subsequent effects on Rs, Rh and Ra in all three vegetation communities. There was a larger relative decline in Ra (35–54%) than Rs (30–37%) and Rh (28–35%). Interestingly, we found Rs in graminoids is higher than in shrubs under extreme drought. Meanwhile, Rh declines were largest in the shrub community. Although Ra and Rh both decreased rapidly during drought treatment, Rh recovered quickly after the drought, while Ra did not, limiting the Rs recovery.

Conclusions

This study suggests that plant species composition regulates several aspects of soil CO_2 efflux response to climate extremes. This regulation may be limited by above- and below-ground net primary production depending on soil water availability. The results of this experiment address a critical knowledge gap in the relationship between soil respiration and plant species composition. With shrub encroachment into grasslands, total soil respiration is reduced and can partly offset the effect of reduction in productivity under drought stress.

Zhou, Q., Fellows, A., Flerchinger, G. N., & Flores, A. N. (2019). Examining Interactions Between and Among Predictors of Net Ecosystem Exchange: A Machine Learning Approach in a Semi-arid Landscape. *Scientific Reports, 9*(1). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061743681&doi=10.1038%2fs41598-019-38639-y&partnerID=40&md5=769ea3853292409cf7e01436efa408f6. doi:10.1038/s41598-019-38639-y

Research Tags: Grassland, Research

Abstract: *Net ecosystem exchange (NEE) is an essential climate indicator of the direction and magnitude of carbon dioxide (CO_2) transfer between land surfaces and the atmosphere. Improved estimates of NEE can serve to better constrain spatiotemporal characteristics of terrestrial carbon fluxes, improve verification of land models, and advance monitoring of Earth's terrestrial ecosystems. Spatiotemporal NEE information developed by combining ground-based flux tower observations and spatiotemporal remote sensing datasets are of potential value in benchmarking land models. We apply a machine learning approach (Random Forest (RF)) to develop spatiotemporally varying NEE estimates using observations from a flux tower and several variables that can potentially be retrieved from satellite data and are related to ecosystem dynamics. Specific variables in model development include a mixture of remotely sensed (fraction of photosynthetically active radiation (fPAR), Leaf Area Index (LAI)) and ground-based data (soil moisture, downward solar radiation, precipitation and mean*

air temperature) in a complex landscape of the Reynolds Creek Experimental Watershed (RCEW) in southwest Idaho, USA. Predicted results show good agreement with the observed data for the NEE (r2 = 0.87). We then validate the temporal pattern of the NEE generated by the RF model for two independent years at the two sites not used in the development of the model. The model development process revealed that the most important predictors include LAI, downward solar radiation, and soil moisture. This work provides a demonstration of the potential power of machine learning methods for combining a variety of observational datasets to create spatiotemporally extensive datasets for land model verification and benchmarking.

Zhou, Y., Xiao, X., Wagle, P., Bajgain, R., Mahan, H., Basara, J. B., . . . Steiner, J. L. (2017). Examining the short-term impacts of diverse management practices on plant phenology and carbon fluxes of Old World bluestems pasture. *Agricultural and Forest Meteorology, 237-238*, 60-70. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012044122&doi=10.1016%2fj.agrformet.2017.01.018&partnerID=40&md5=1aebb542edd1e59509732d06fb3bf9e6. doi:10.1016/j.agrformet.2017.01.018
Research Tags: Grassland
Abstract: *Burning, grazing, and baling (hay harvesting) are common management practices in grassland. To develop and adopt sustainable management practices, it is essential to better understand and quantify the impacts of management practices on plant phenology and carbon fluxes. In this study, we combined multiple data sources, including in-situ PhenoCam digital images, eddy covariance data, and satellite data (Landsat and Moderate Resolution Imaging Spectroradiometer (MODIS)) to examine the impacts of burning, baling, and grazing on canopy dynamics, plant phenology, and carbon fluxes in a pasture in El Reno, Oklahoma in 2014. Landsat images were used to assess the baling area and the trajectory of vegetation recovery. MODIS vegetation indices (VIs) were used in the Vegetation Photosynthesis Model (VPM) to estimate gross primary production (GPPVPM) at a MODIS pixel for the flux tower (baled) site. For comparison between baled and unbaled conditions, we used MODIS VIs for a neighbor MODIS pixel (unbaled) and ran VPM. Daily PhenoCam images and green chromatic coordinate (GCC) tracked canopy dynamics and plant phenology well. The grassland greened up immediately after burning in April. GCC values showed two peaks with the similar magnitude because of quick recovery of grassland after baling. Satellite-derived VIs and GPPVPM showed that the pasture recovered in one month after baling. The GPPVPM matched well (R2 = 0.89) with the eddy covariance-derived GPP (GPPEC). Grazing in the late growing season did not influence plant phenology (VIs and GCC) and carbon uptake (GPP) as plants were in the late growing stage. Neither did it affect GPP differently in those two conditions because of even grazing intensity. The reduction in GPP after baling was compensated by higher GPP after large rain events in late July and early September, causing little seasonal differences in GPP (-0.002 g C m−2 day−1) between the baled and unbaled conditions. Interactions of different management practices with climate make it complicated to understand the impacts of different management practices on carbon dynamics and plant phenology. Thus, it is necessary to further investigate the responses of pastures to different management practices under different climate regimes at multiple temporal and spatial scales.*

Zhou, Z., Ouyang, Y., Li, Y., Qiu, Z., & Moran, M. (2017). Estimating impact of rainfall change on hydrological processes in Jianfengling rainforest watershed, China using BASINS-HSPF-CAT modeling system. *Ecological Engineering, 105*, 87-94. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019040097&doi=10.1016%2fj.ecoleng.2017.04.051&partnerID=40&md5=0af0d0d782976ebf6d59064569b06ef1. doi:10.1016/j.ecoleng.2017.04.051
Research Tags: Weather, Water
Abstract: *Climate change over the past several decades has resulted in shifting rainfall pattern and modifying rainfall intensity, which has exacerbated hydrological processes and added the uncertainty and instability to these processes. This study ascertained impacts of potential future rainfall change on hydrological processes at the Jianfengling (JFL) tropical mountain rainforest watershed in Hainan Island, China using the BASINS (Better Assessment Science Integrating Point and Nonpoint Sources)-HSPF (Hydrological Simulation Program-FORTRAN)-CAT (Climate Assessment Tool) modeling system. The HSPF model was calibrated and validated with available measured data prior to its applications. Three simulation scenarios were then performed to gain a better understanding of the impacts of different rainfall rates and storm intensities on stream discharge, surface water runoff from forest land, and water outflow from the JFL watershed outlet.*

Results showed that a 10% increase in rainfall rate could result in 1.3 times increase in stream discharge, surface runoff, and water outflow. A potential future wet climate could have profound impacts on hydrological processes at the JFL watershed, whereas a potential future dry climate could result less impacts on stream discharge, surface runoff, and water outflow at the same watershed. Our simulation further revealed that climate change driven by extreme rain storms had greater impacts on annual surface runoff than on annual stream discharge. The coupled CAT-HSPF model is a useful tool to modify historical rainfall data for projecting future rainfall variation impacts on forest hydrological processes due to climate change. This approach would be able to extend to other regions around the world.

Zhou, Z., Ouyang, Y., Qiu, Z., Zhou, G., Lin, M., & Li, Y. (2017). Evidence of climate change impact on stream low flow from the tropical mountain rainforest watershed in Hainan Island, China. *Journal of Water and Climate Change, 8*(2), 293-302. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85020056293&doi=10.2166%2fwcc.2016.149&partnerID=40&md5=c2af2e22aae449b6b992cd72681e5a63. doi:10.2166/wcc.2016.149

Research Tags: Weather, Water, Forestry

Abstract: *Stream low flow estimates are central to assessing climate change impact, water resource management, and ecosystem restoration. This study investigated the impacts of climate change upon stream low flows from a rainforest watershed in Jianfengling (JFL) Mountain, Hainan Island, China, using the low flow selection method as well as the frequency and probability analysis technique. Results showed that low flow at this watershed over a period of 18 years (1990–2007) was 0.58 m3/s and its recurrence probability and recurrence interval were, respectively, 99% and 1.01 years for low flow with a 60-day duration. Low flow rate decreased linearly both as time increment elapsed (R2 = 0.62, p < 0.01) and as air temperature rose (R2 = 0.60, p < 0.05), whereas the recurrence intervals of low flow were shorter (or occurred more frequently) as time increment elapsed. In contrast, no correlation existed between annual rainfall and low flow for this watershed, indicating that rainfall was not a factor influencing stream low flows. Since there were little to no anthropogenic activities rather than air temperature rise over time at this watershed, we attributed the decreased rate and frequent occurrence of low flow to the warming air temperature as time elapsed.*

Zhu, J., Sun, G., Li, W., Zhang, Y., Miao, G., Noormets, A., . . . Wang, X. (2017). Modeling the potential impacts of climate change on the water table level of selected forested wetlands in the southeastern United States. *Hydrology and Earth System Sciences, 21*(12), 6289-6305. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85038359020&doi=10.5194%2fhess-21-6289-2017&partnerID=40&md5=9d1d3e787e5c8fe2513714aad40ee188. doi:10.5194/hess-21-6289-2017

Research Tags: Water, Forestry

Abstract: *The southeastern United States hosts extensive forested wetlands, providing ecosystem services including carbon sequestration, water quality improvement, groundwater recharge, and wildlife habitat. However, these wetland ecosystems are dependent on local climate and hydrology, and are therefore at risk due to climate and land use change. This study develops site-specific empirical hydrologic models for five forested wetlands with different characteristics by analyzing long-term observed meteorological and hydrological data. These wetlands represent typical cypress ponds/swamps, Carolina bays, pine flatwoods, drained pocosins, and natural bottomland hardwood ecosystems. The validated empirical models are then applied at each wetland to predict future water table changes using climate projections from 20 general circulation models (GCMs) participating in Coupled Model Inter-comparison Project 5 (CMIP5) under the Representative Concentration Pathways (RCPs) 4.5 and 8.5 scenarios. We show that combined future changes in precipitation and potential evapotranspiration would significantly alter wetland hydrology including groundwater dynamics by the end of the 21st century. Compared to the historical period, all five wetlands are predicted to become drier over time. The mean water table depth is predicted to drop by 4 to 22 cm in response to the decrease in water availability (i.e., precipitation minus potential evapotranspiration) by the year 2100. Among the five examined wetlands, the depressional wetland in hot and humid Florida appears to be most vulnerable to future climate change. This study provides quantitative information on the potential magnitude of wetland hydrological response to future climate change in typical forested wetlands in the southeastern US.*

Zhu, P., Jin, Z., Zhuang, Q., Ciais, P., Bernacchi, C., Wang, X., . . . Lobell, D. (2018). The important but weakening maize

yield benefit of grain filling prolongation in the US Midwest. *Global Change Biology, 24*(10), 4718-4730. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050908362&doi=10.1111%2fgcb.14356&partnerID=40&md5=6bfb55debcb5c1d355389a7d5627c224. doi:10.1111/gcb.14356
Research Tags: Crops
Abstract: *A better understanding of recent crop yield trends is necessary for improving the yield and maintaining food security. Several possible mechanisms have been investigated recently in order to explain the steady growth in maize yield over the US Corn-Belt, but a substantial fraction of the increasing trend remains elusive. In this study, trends in grain filling period (GFP) were identified and their relations with maize yield increase were further analyzed. Using satellite data from 2000 to 2015, an average lengthening of GFP of 0.37 days per year was found over the region, which probably results from variety renewal. Statistical analysis suggests that longer GFP accounted for roughly one-quarter (23%) of the yield increase trend by promoting kernel dry matter accumulation, yet had less yield benefit in hotter counties. Both official survey data and crop model simulations estimated a similar contribution of GFP trend to yield. If growing degree days that determines the GFP continues to prolong at the current rate for the next 50 years, yield reduction will be lessened with 25% and 18% longer GFP under Representative Concentration Pathway 2.6 (RCP 2.6) and RCP 6.0, respectively. However, this level of progress is insufficient to offset yield losses in future climates, because drought and heat stress during the GFP will become more prevalent and severe. This study highlights the need to devise multiple effective adaptation strategies to withstand the upcoming challenges in food security.*

Zhu, P., Zhuang, Q., Archontoulis, S. V., Bernacchi, C., & Müller, C. (2019). Dissecting the nonlinear response of maize yield to high temperature stress with model-data integration. *Global Change Biology, 25*(7), 2470-2484. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065420855&doi=10.1111%2fgcb.14632&partnerID=40&md5=92de545bb8146532706c6924e6cc3a75. doi:10.1111/gcb.14632
Research Tags: Crops
Abstract: *Evidence suggests that global maize yield declines with a warming climate, particularly with extreme heat events. However, the degree to which important maize processes such as biomass growth rate, growing season length (GSL) and grain formation are impacted by an increase in temperature is uncertain. Such knowledge is necessary to understand yield responses and develop crop adaptation strategies under warmer climate. Here crop models, satellite observations, survey, and field data were integrated to investigate how high temperature stress influences maize yield in the U.S. Midwest. We showed that both observational evidence and crop model ensemble mean (MEM) suggests the nonlinear sensitivity in yield was driven by the intensified sensitivity of harvest index (HI), but MEM underestimated the warming effects through HI and overstated the effects through GSL. Further analysis showed that the intensified sensitivity in HI mainly results from a greater sensitivity of yield to high temperature stress during the grain filling period, which explained more than half of the yield reduction. When warming effects were decomposed into direct heat stress and indirect water stress (WS), observational data suggest that yield is more reduced by direct heat stress (−4.6 ± 1.0%/°C) than by WS (−1.7 ± 0.65%/°C), whereas MEM gives opposite results. This discrepancy implies that yield reduction by heat stress is underestimated, whereas the yield benefit of increasing atmospheric CO2 might be overestimated in crop models, because elevated CO2 brings yield benefit through water conservation effect but produces limited benefit over heat stress. Our analysis through integrating data and crop models suggests that future adaptation strategies should be targeted at the heat stress during grain formation and changes in agricultural management need to be better accounted for to adequately estimate the effects of heat stress.*

Zhu, P., Zhuang, Q., Eva, J., & Bernacchi, C. (2017). Importance of biophysical effects on climate warming mitigation potential of biofuel crops over the conterminous United States. *GCB Bioenergy, 9*(3), 577-590. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-84978805823&doi=10.1111%2fgcbb.12370&partnerID=40&md5=7d8beb685284b23e957a7bebc7c5cd5c. doi:10.1111/gcbb.12370
Research Tags: Energy, Crops, Emissions
Abstract: *Current quantification of climate warming mitigation potential (CWMP) of biomass-derived energy has focused primarily on its biogeochemical effects. This study used site-level observations of carbon, water, and energy fluxes of biofuel crops to parameterize and evaluate the community land model (CLM) and estimate*

CO2 fluxes, surface energy balance, soil carbon dynamics of corn (Zea mays), switchgrass (Panicum virgatum), and miscanthus (Miscanthus × giganteus) ecosystems across the conterminous United States considering different agricultural management practices and land-use scenarios. We find that neglecting biophysical effects underestimates the CWMP of transitioning from croplands and marginal lands to energy crops. Biogeochemical effects alone result in changes in carbon storage of −1.9, 49.1, and 69.3 g C m−2 y−1 compared to 20.5, 78.5, and 96.2 g C m−2 y−1 when considering both biophysical and biogeochemical effects for corn, switchgrass, and miscanthus, respectively. The biophysical contribution to CWMP is dominated by changes in latent heat fluxes. Using the model to optimize growth conditions through fertilization and irrigation increases the CWMP further to 79.6, 98.3, and 118.8 g C m−2 y−1, respectively, representing the upper threshold for CWMP. Results also show that the CWMP over marginal lands is lower than that over croplands. This study highlights that neglecting the biophysical effects of altered surface energy and water balance underestimates the CWMP of transitioning to bioenergy crops at regional scales.

Zielinski, W. J., Tucker, J. M., & Rennie, K. M. (2017). Niche overlap of competing carnivores across climatic gradients and the conservation implications of climate change at geographic range margins. *Biological Conservation, 209*, 533-545. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017193323&doi=10.1016%2fj.biocon.2017.03.016&partnerID=40&md5=691a83b168b56e63a0d4b20192817951. doi:10.1016/j.biocon.2017.03.016

Research Tags: Wildlife

Abstract: *There is considerable interest in factors controlling "warm-edge" limits – the lower elevation and latitudinal edges of a species' range. Understanding whether conservation measures can mitigate anticipated change in climate requires consideration of future climate as well as species interactions. We explored niche relations of martens and fishers at their southern range margins to understand their spatial and temporal dynamics, and how they may be affected by climate change. We used large-scale non-invasive surveys and home range data from radio-marked individuals to explore the spatial dynamics of each species. Marten and fisher were allopatric in the northern/wetter regions but sympatric at intermediate latitudes with lower precipitation. In the driest/southernmost region only fishers occurred. Martens were not detected when annual precipitation was < 900 mm and rare where minimum temperatures exceeded 4 °C. Fishers were absent where spring snow was > 650 mm. Classification trees, accounting for multivariate interactions, supported these results. Where sympatric, ~ 70% of a marten's home range overlapped with at least one fisher but martens tended to avoid this area. In sympatry, marten expanded their niche into areas with reduced snowpack, warmer temperatures and uncharacteristic lower elevation habitats. Future climate scenarios predict conditions that favor fishers, but our data suggest martens may be capable of shifting their niche somewhat to warmer and less snowy habitats. The conservation of interacting species at their warm range limits will require land managers be aware of interspecific tolerance, how each may respond uniquely to future climates, and how potential climate refugia can be integrated with existing habitat.*

Ziska, L. H., Blumenthal, D. M., & Franks, S. J. (2019). Understanding the nexus of rising CO<inf>2</inf>, climate change, and evolution in weed biology. *Invasive Plant Science and Management, 12*(2), 79-88. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069296887&doi=10.1017%2finp.2019.12&partnerID=40&md5=497653945ddf4a8dfd7a0443b842165c. doi:10.1017/inp.2019.12

Research Tags: Crops

Abstract: *Rapid increases in herbicide resistance have highlighted the ability of weeds to undergo genetic change within a short period of time. That change, in turn, has resulted in an increasing emphasis in weed science on the evolutionary ecology and potential adaptation of weeds to herbicide selection. Here we argue that a similar emphasis would also be invaluable for understanding another challenge that will profoundly alter weed biology: the rapid rise in atmospheric carbon dioxide (CO2) and the associated changes in climate. Our review of the literature suggests that elevated CO2 and climate change will impose strong selection pressures on weeds and that weeds will often have the capacity to respond with rapid adaptive evolution. Based on current data, climate change and rising CO2 levels are likely to alter the evolution of agronomic and invasive weeds, with consequences for distribution, community composition, and herbicide efficacy. In addition, we identify four key areas that represent clear knowledge gaps in weed evolution: (1) differential herbicide resistance in response to a rapidly changing CO2/climate confluence; (2) shifts in the efficacy of biological* *constraints (e.g., pathogens) and resultant selection shifts in affected weed species; (3) climate-induced phenological shifts in weed distribution, demography, and fitness relative to crop systems; and (4) understanding and characterization of epigenetics and the differential expression of phenotypic plasticity versus evolutionary adaptation. These consequences, in turn, should be of fundamental interest to the weed science community.*

Ziska, L. H., Bradley, B. A., Wallace, R. D., Bargeron, C. T., LaForest, J. H., Choudhury, R. A., . . . Vega, F. E. (2018). Climate change, carbon dioxide, and pest biology, managing the future: Coffee as a case study. *Agronomy, 8*(8). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053069075&doi=10.3390%2fagronomy8080152&partnerID=40&md5=ef1ebef74a89ec7148d53eb9caa37d46. doi:10.3390/agronomy8080152

Research Tags: Crops, Wildlife, Emissions

Abstract: *The challenge of maintaining sufficient food, feed, fiber, and forests, for a projected end of century population of between 9–10 billion in the context of a climate averaging 2–4 °C warmer, is a global imperative. However, climate change is likely to alter the geographic ranges and impacts for a variety of insect pests, plant pathogens, and weeds, and the consequences for managed systems, particularly agriculture, remain uncertain. That uncertainty is related, in part, to whether pest management practices (e.g., biological, chemical, cultural, etc.) can adapt to climate/CO2 induced changes in pest biology to minimize potential loss. The ongoing and projected changes in CO2, environment, managed plant systems, and pest interactions, necessitates an assessment of current management practices and, if warranted, development of viable alternative strategies to counter damage from invasive alien species and evolving native pest populations. We provide an overview of the interactions regarding pest biology and climate/CO2; assess these interactions currently using coffee as a case study; identify the potential vulnerabilities regarding future pest impacts; and discuss possible adaptive strategies, including early detection and rapid response via EDDMapS (Early Detection & Distribution Mapping System), and integrated pest management (IPM), as adaptive means to improve monitoring pest movements and minimizing biotic losses while improving the efficacy of pest control.*

Ziska, L. H., Fleisher, D. H., & Linscombe, S. (2018). Ratooning as an adaptive management tool for climatic change in rice systems along a north-south transect in the southern Mississippi valley. *Agricultural and Forest Meteorology, 263*, 409-416. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85053813469&doi=10.1016%2fj.agrformet.2018.09.010&partnerID=40&md5=4bda9447121394ac694f0406d6287000. doi:10.1016/j.agrformet.2018.09.010

Research Tags: Weather, Crops

Abstract: *The effect of climate change on recent and projected increases in surface temperatures is well-documented. For agriculture, such changes can impact crop phenology and production, but the degree of impact will depend, in part, on contemporaneous changes in crop management. In the current study, we quantified recent (last 40 years) and projected (to 2095) changes in air temperature and associated changes in growing season duration for rice along a latitudinal north-south gradient of the lower Mississippi valley. Recent and projected climate data indicated an ongoing increase in air temperature and growing season length with latitudes above ~31 °N. We then applied the DD50 growing degree day model to these data to determine if ratooning, a management practice that produces a second rice harvest with minimal resource input, could be employed. The model results were analyzed and used relative to the southernmost location, Cameron Parish, where the season length and daily temperatures currently allow for ratooning to be a common practice for long-grain cultivars (e.g., Cocodrie, Catahoula). The recent and projected increases in temperature and seasonality indicate that ratooning could already be adopted in Avoyelles Parish, and is potentially possible as far north as Cape Girardeau County (37 °N) by the end of the 21 st century. While additional information regarding possible effects of heat stress, water availability, rising carbon dioxide (CO2) levels, and other factors will be necessary to fully assess ratooning potential, our research indicated that ongoing increases in temperature and season length may allow agronomic management practices, such as ratooning, to help adapt rice production to climatic uncertainty.*

Ziska, L. H., Makra, L., Harry, S. K., Bruffaerts, N., Hendrickx, M., Coates, F., . . . Crimmins, A. R. (2019). Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern

hemisphere: a retrospective data analysis. *The Lancet Planetary Health, 3*(3), e124-e131. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062964154&doi=10.1016%2fS2542-5196%2819%2930015-4&partnerID=40&md5=f2ddc80ec4dba9a765a8c875ce13ec48. doi:10.1016/S2542-5196(19)30015-4
Research Tags: Weather
Abstract: *Background*
Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the northern hemisphere. We aimed to analyse trends in pollen seasonality and pollen load and to establish whether there are specific climate-related links to any observed changes.
Methods
For this retrospective data analysis, we did an extensive search for global datasets with 20 years or more of airborne pollen data that consistently recorded pollen season indices (eg, duration and intensity). 17 locations across three continents with long-term (approximately 26 years on average) quantitative records of seasonal concentrations of multiple pollen (aeroallergen) taxa met the selection criteria. These datasets were analysed in the context of recent annual changes in maximum temperature (Tmax) and minimum temperature (Tmin) associated with anthropogenic climate change. Seasonal regressions (slopes) of variation in pollen load and pollen season duration over time were compared to Tmax, cumulative degree day Tmax, Tmin, cumulative degree day Tmin, and frost-free days among all 17 locations to ascertain significant correlations.
Findings
12 (71%) of the 17 locations showed significant increases in seasonal cumulative pollen or annual pollen load. Similarly, 11 (65%) of the 17 locations showed a significant increase in pollen season duration over time, increasing, on average, 0·9 days per year. Across the northern hemisphere locations analysed, annual cumulative increases in Tmax over time were significantly associated with percentage increases in seasonal pollen load (r=0·52, p=0·034) as were annual cumulative increases in Tmin (r=0·61, p=0·010). Similar results were observed for pollen season duration, but only for cumulative degree days (higher than the freezing point [0°C or 32°F]) for Tmax (r=0·53, p=0·030) and Tmin (r=0·48, p=0·05). Additionally, temporal increases in frost-free days per year were significantly correlated with increases in both pollen load (r=0·62, p=0·008) and pollen season duration (r=0·68, p=0·003) when averaged for all 17 locations.
Interpretation
Our findings reveal that the ongoing increase in temperature extremes (Tmin and Tmax) might already be contributing to extended seasonal duration and increased pollen load for multiple aeroallergenic pollen taxa in diverse locations across the northern hemisphere. This study, done across multiple continents, highlights an important link between ongoing global warming and public health—one that could be exacerbated as temperatures continue to increase.

Zou, C. B., Twidwell, D., Bielski, C. H., Fogarty, D. T., Mittelstet, A. R., Starks, P. J., . . . Acharya, B. S. (2018). Impact of Eastern redcedar proliferation on water resources in the great plains USA- current state of knowledge. *Water (Switzerland), 10*(12). Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057793035&doi=10.3390%2fw10121768&partnerID=40&md5=2bf10a2bb371450cb1a4bf3b2afa23be. doi:10.3390/w10121768
Research Tags: Forestry, Water
Abstract: *In the Great Plains of the central United States, water resources for human and aquatic life rely primarily on surface runoff and local recharge from rangelands that are under rapid transformation to woodland by the encroachment of Eastern redcedar (redcedar; Juniperus virginiana) trees. In this synthesis, the current understanding and impact of redcedar encroachment on the water budget and water resources available for non-ecosystem use are reviewed. Existing studies concluded that the conversion from herbaceous-dominated rangeland to redcedar woodland increases precipitation loss to canopy interception and vegetation transpiration. The decrease of soil moisture, particularly for the subsurface soil layer, is widely documented. The depletion of soil moisture is directly related to the observed decrease in surface runoff, and the potential of deep recharge for redcedar encroached watersheds. Model simulations suggest that complete conversion of the rangelands to redcedar woodland at the watershed and basin scale in the South-central Great Plains would lead to reduced streamflow throughout the year, with the reductions of streamflow between 20 to 40% depending on the aridity of the climate of the watershed. Recommended topics for future studies include: (i) The spatial dynamics of redcedar proliferation and its impact on water budget across a regional hydrologic*

network; (ii) the temporal dynamics of precipitation interception by the herbaceous canopy; (iii) the impact of redcedar infilling into deciduous forests such as the Cross Timbers and its impact on water budget and water availability for non-ecosystem use; (iv) land surface and climate interaction and cross-scale hydrological modeling and forecasting; (v) impact of redcedar encroachment on sediment production and water quality; and (vi) assessment and efficacy of different redcedar control measures in restoring hydrological functions of watershed.

Zou, Y., Wang, Y., Ke, Z., Tian, H., Yang, J., & Liu, Y. (2019). Development of a REgion-Specific Ecosystem Feedback Fire (RESFire) Model in the Community Earth System Model. *Journal of Advances in Modeling Earth Systems, 11*(2), 417-445. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061439418&doi=10.1029%2f2018MS001368&partnerID=40&md5=cd52e1adb943eb4e31aeed2fd968eda0. doi:10.1029/2018MS001368

Research Tags: Weather, Research

Abstract: *We improved the fire simulation capability in the Earth system model to better understand the complex interactions among climate, fire, and ecosystems with anthropogenic disturbance.*

Zurweller, B. A., Rowland, D. L., Mulvaney, M. J., Tillman, B. L., Migliaccio, K., Wright, D., . . . Vellidis, G. (2019). Optimizing cotton irrigation and nitrogen management using a soil water balance model and in-season nitrogen applications. *Agricultural Water Management, 216*, 306-314. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061672509&doi=10.1016%2fj.agwat.2019.01.011&partnerID=40&md5=2b9c77c76072743d0d19440ec7a956dd. doi:10.1016/j.agwat.2019.01.011

Research Tags: Crops, Soil, Water

Abstract: *Nitrogen (N) and irrigation can be two of the costliest management inputs in United States (U.S.) cotton (Gossypium hirsutum L.) production systems. Furthermore, input amounts are often dependent on yearly environmental conditions, making it challenging to optimize N and irrigation management. The objectives of this research were to determine optimal N and irrigation management by: (i) evaluating equally split in-season N rates applied at first square and bloom in combination with varying levels of plant available water replacement (PAWR) estimated by an ET-based soil water balance model for cotton; and (ii) evaluate the whole-plant responses to the interaction between N and water management levels. Field experiments were conducted during 2015 and 2016 at two locations in Florida (Jay and Citra), southeastern U.S. with differing soil textures consisting of a deep sand and sandy loam. Irrigation treatments consisted of: (i) 100% of PAWR (100%); (ii) a primed acclimation (PA) treatment consisting of 50% of PAWR until first bloom and then 100% of PAWR (50%PA); (iii) 50% PAWR for the entire season (50%); (iv) a rain-fed control (RF). Nitrogen treatments consisted of even application splits at first square and bloom applied at a rate of 0 (N0), 22 (N22), 34 (N34), and 45 kg N ha−1 (N45). Lint yield assessments were conducted at both locations in both years. To link yield responses to possible physiological responses, in depth crop measurements consisting of SPAD chlorophyll content, leaf area index (LAI), N uptake, and harvest index (HI) were conducted at the Citra site. Contrasting soil textures and weather conditions between research locations and years allowed for a comprehensive assessment of both N and irrigation management across varying environmental conditions. Lint yield was either increased or at least maintained during the two years of this research at the Citra location by making two split N applications at first square and bloom of N22; while the optimal N treatment at the Jay location was N34 at first square and bloom in both years of this research. Additionally, a yield reduction occurred in the dry year of 2016 at the Citra location when N45 was applied at first square and bloom. The most efficient irrigation strategy at the Citra location was the primed acclimation treatment. At the Jay location, the RF control had similar lint yields as the irrigated treatments in both years, indicating that water application was not limiting at this site. These management strategies offer ways to optimize costly inputs when growing cotton in the southeastern U.S.*