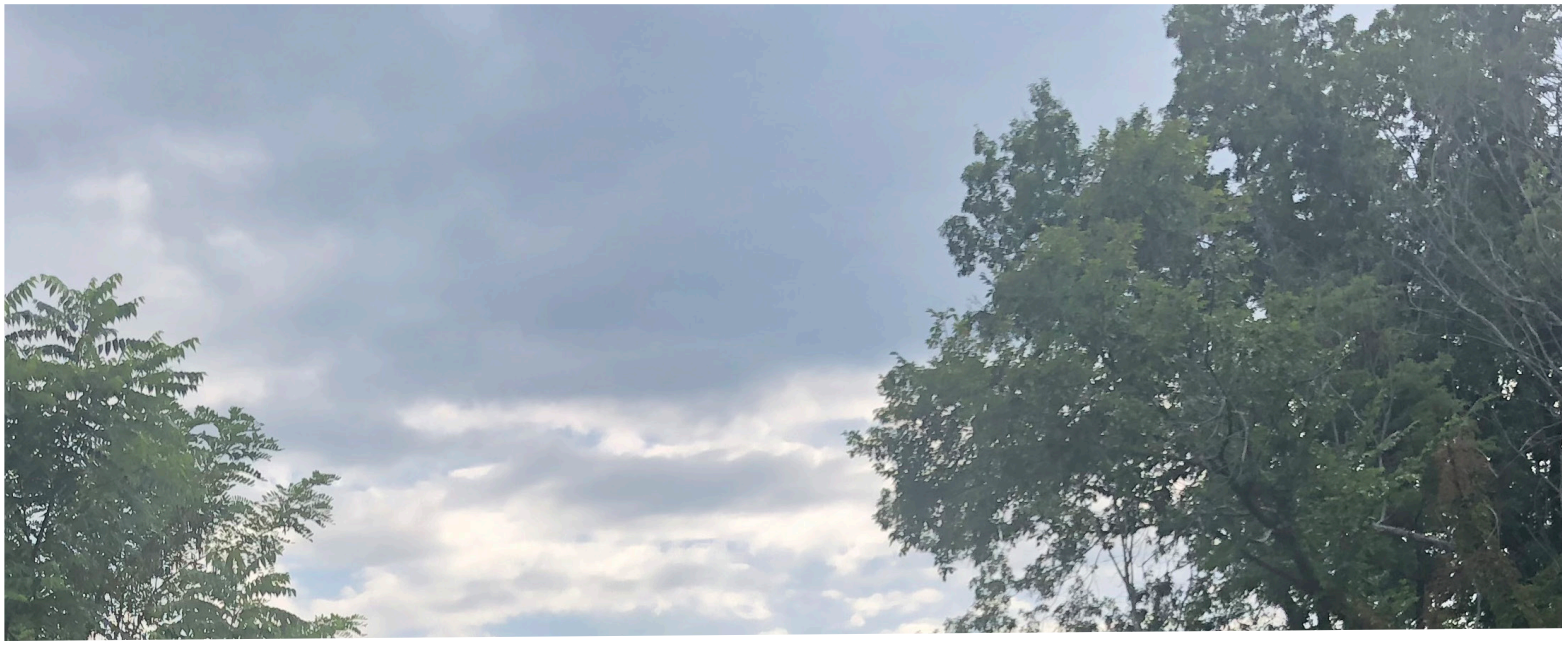
The Transect

Missouri EPSCoR Newsletter • *Fall 2018*



MISSOURI EPSCoR

The Established Program to Stimulate Competitive Research (EPSCoR) is designed to fulfill the mandate of the National Science Foundation (NSF) to promote scientifc progress nationwide. Missouri became eligible to apply for EPSCoR funding in 2012. The program aims to provide strategic opportunities to stimulate sustainable improvements in R&D infrastructure, capacity and competitiveness, and to advance science and engineering capabilities for discovery, innovation and knowledge-based prosperity - capabilities that will benefit Missourians from all regions - urban to rural - and from all economic levels.

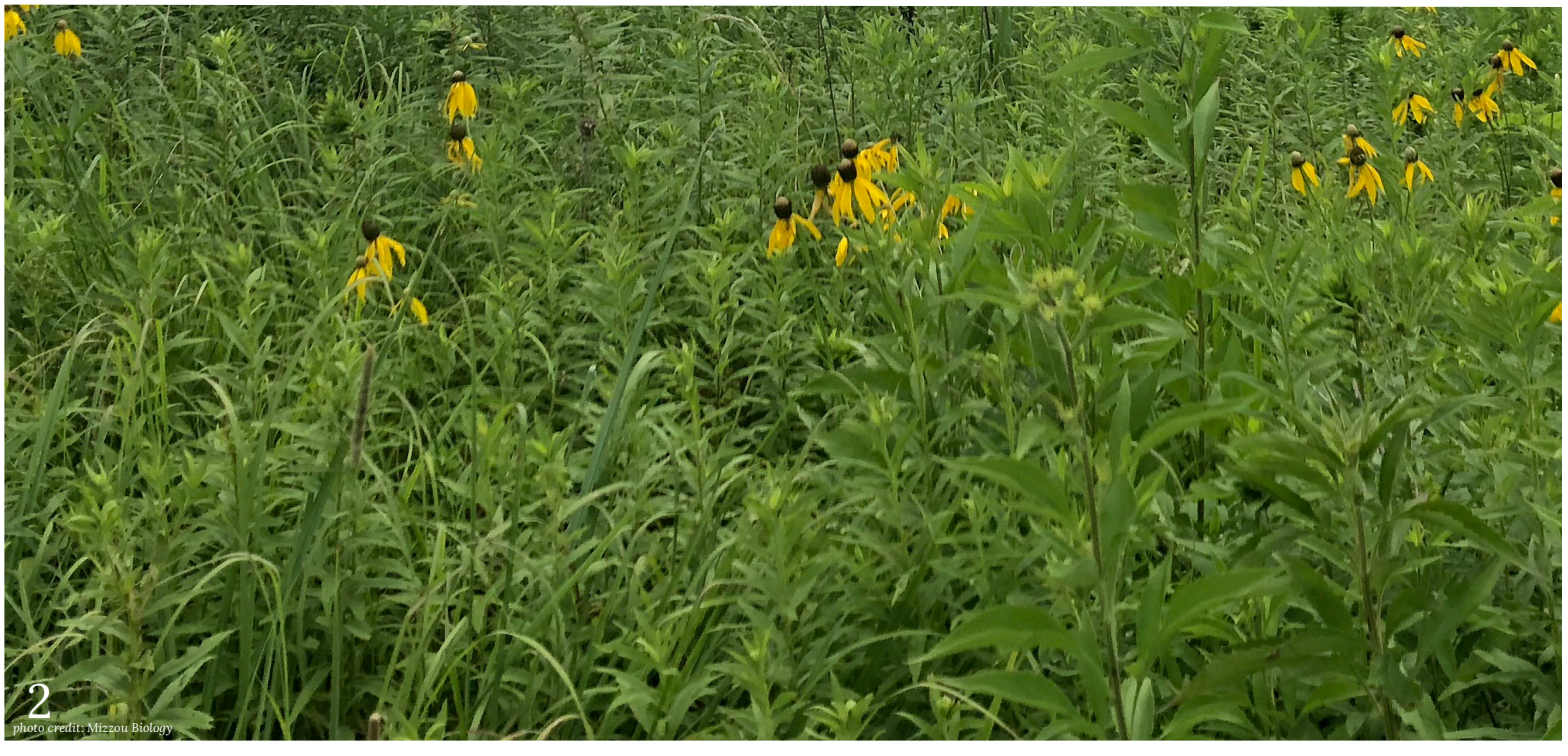


photo credit: Mizzou Biology

MISSOURI TRANSECT

Mission

The Missouri Transect will enhance our state's capacity to model and respond to the effects of climate change on plants and communities on a local scale.

Project Overview

The Established Program to Stimulate Competitive Research* (EPSCoR) is a National Science Foundation (NSF) program that awards up to $20 million over five years to eligible jurisdictions (U.S. states and territories) for "Track 1" programs to build research infrastructure and improve the jurisdictions' competitiveness on a national-scale for NSF funding.

Missouri NSF EPSCoR's Track 1 program is called the Missouri Transect because it is a statewide collaborative research effort that transects the research of plants, climate and community. Ten institutions and over 150 faculty, students, and technical staff conduct research and outreach programs in the five collaborative Missouri Transect teams: Plant, Climate, Community, Science Education & Outreach, and Cyberinfrastructure.

The Missouri Transect builds on established capacities in plant sciences, remote sensing and imaging, atmospheric and environmental sciences, economics, and the social sciences to better understand and predict the responses of plants and society to climate variability and increasing numbers of extreme weather events.

Infrastructure investments in people, technology, approaches, and ideas will enable us to better understand, model and predict (1) short and long term trends in temperature and water availability in the state; (2) the effects of these trends on the productivity of our state's native flora and agricultural crops; and (3) how different stakeholder communities are likely to respond to these changes. In addition to advancing our research capabilities, the Missouri Transect research infrastructure investments are enhancing our educational efforts to develop and diversify Missouri's STEM workforce.

*formerly Experimental Program to Stimulate Competitive Research

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In this issue of The Transect, you will see several "QR Code" squares. These are barcoded links to websites and YouTube videos of exciting Missouri EPSCoR research. To scan the code on iPhone or Android, open your camera app and point it at the QR Code box. You will be prompted to open YouTube or a web browser. Tap to open. That's it!

Missouri EPSCoR is funded by the National Science Foundation under Award #IIA-1355406 and #IIA-1430427. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily refect the views of the National Science Foundation.

Credits

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message from the DIRECTOR

The Missouri Transect brings together researchers and the public to tackle important statewide issues surrounding climate variability. Scientists from the Transect actively work alongside stakeholders to better understand and mitigate the effects of climate variability in our communities. As you read this issue of The Transect, you will learn more about the work in our Missouri State Parks and our native prairie ecosystems.

Research teams have been working with the Missouri State Parks system to understand how park managers and visitors interpret and respond to our changing climate. Park managers have provided key information that will help decision makers deal with the impacts of climate change on our parks systems. Over 2500 visitors have provided feedback through interviews or and surveys that help us understand how individuals and communities respond to the impacts on these parks. This research ultimately will affect how these natural resources are enjoyed by Missourians and those visiting our state.

Native prairies are another important ecosystem within our landscape. They build soil, prevent erosion, capture carbon, provide habitat for wildlife, and support pollinators. We rely on these prairies to keep our Missouri agricultural economy thriving. Researchers within the Transect are studying how these prairies respond to an ever-increasing threat of drought. The findings from this work will help us preserve the native prairies for future generations.

Our researchers continue to work toward funding to expand the reach of the Missouri Transect. In the past year, EPSCoR investigators worked on 42 grants totaling over $68 million from federal, state and private sources.

This issue of The Transect shares the work of our researchers working within communities throughout the state to better prepare us for the changing climate of the future.

John C. Walker, Ph.D.

Project Administrator
Missouri EPSCoR

photo credit: Mizzou Biology

Interdisciplinary Research

Prairie Strong

There are a lot of reasons to care about prairies. Prairies build soil, prevent erosion, capture carbon, provide habitat for wildlife, and support pollinators. They also are a rich source of plant and soil microbial biodiversity.

Prairies are also tough. They exist in areas too wet for desert yet too dry for forests. They can withstand extreme heat in summers and bitter cold in winters. With roots reaching deep into the ground, prairie plants are also well adapted to survive droughts, fires, and other natural disturbances.

With a high likelihood of more frequent and intense droughts in our future, the resiliency of this native ecosystem is drawing the interest of a growing and diverse constituency, including homeowners tired of paying high water bills, farmers interested in drought-resistant crops, and conservation managers charged with protecting habitats and natural resources.

But, prairies have largely disappeared, said Keith Goyne.

"About one-third of Missouri was once covered by prairie. Within a generation, however, the vast majority of the American prairie was plowed and converted to row-crop agriculture or pasture. Today, less than 0.5% of native prairies continue to exist within the state," said Goyne.

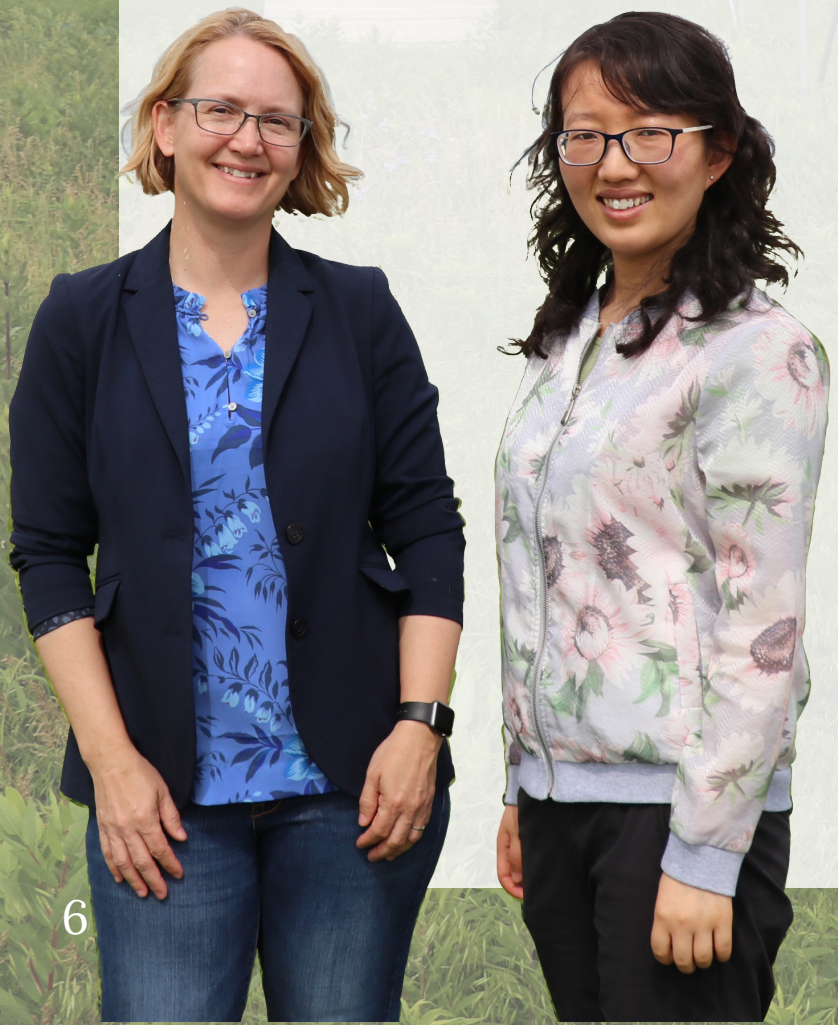
Goyne is a professor of environmental soil chemistry and associate director of the School of Natural Resources at the University of Missouri. As a member of the Missouri Transect Climate Team, he is participating in several investigations aimed at understanding how climate change affects the soils of various ecosystems, including prairies.

While many organizations within Missouri are seeking to reestablish prairies within the landscape, Goyne said how prairies will respond to increased drought isn't clearly understood. Nor are the factors that make this ecosystem more resilient than others.

"Climate change can cause shifts in the populations of plants and soil microorganisms. Moreover, alterations to soil chemical properties, particularly loss of soil organic carbon through conversion to carbon dioxide, are possible," he said.

Goyne hopes to shed light on the response of prairies to climate change as part of a new collaborative project being conducted by a team of Missouri Transect scientists. For the project, the team custom built rain-out shelters that allow them to experimentally reduce rainfall and simulate predicted future drought conditions at a restored prairie site in Columbia, Missouri. Findings from the project are expected to inform not only native prairie reconstructions but also provide strategies for mitigating the impact of drought in other ecosystems.

In addition to Goyne, the team includes Kristen Veum with the USDA-Agricultural Research Service; Felix Fritschi and Chenhui Li with the Division of Plant Sciences at the University of Missouri; and Lisa Webb with the USGS-Missouri Cooperative Fish and Wildlife Unit.



(pictured) Dr. Kristen Veum, Research Soil Scientist at USDA-ARS (left) and Dr. Chenhui Li, Postdoctoral Fellow at MU (right) stand under the Missouri EPSCoR-funded rain-out shelters at the Bradford Farm reclaimed prairie site.

Veum explained that the rain-out shelters work by excluding all-natural rainfall from reaching the area under the shelter.

"We consider the roof to be the watershed of the study site," she said. "We collect all ambient precipitation into tanks. We have three plots under each structure, a control and two reduction treatment plots, and we feed that rain back to the plots via drip irrigation. The control plot receives 100% of the rainfall amount, while the two treatments plots will receive 71 or 59 percent of the rainfall."

According to Veum, the reduction amounts represent mild and extreme drought conditions, respectively. "Those reduction numbers don't sound very big, but they represent the tail ends of the historical rainfall distribution for this area," she said.

Every month, the researchers document the composition and productivity of the plant community in each plot by inventorying the species present and measuring certain physical aspects of the plants, such as their height and bloom time. In addition, they plan to use special imaging devices installed in the ground of each plot to monitor the growth and structure of plant roots. Each season, they also collect soil from each plot, which they run through a series of rigorous and comprehensive analyses, including a sequencing of the soils' metagenomes, or genetic material recovered directly from the soil.

"Understanding soil microbial diversity is the new frontier and only recently have techniques, such as metagenomics, been developed to characterize the diverse life below our feet," said Goyne. "The use of metagenomics in our study will help us understand how the below-ground community of microorganisms is affected by drought and how changes in the soil microbial community may alter above-ground plant species and vice versa."

The soil data, including the metagenomes, collected from the experimental plots will be compared with similar data collected at Tucker Prairie, a native prairie remnant located in Fulton, Missouri. The team will analyze all the data to provide a comprehensive picture of how plants and soils cope under different drought conditions over time in a restored prairie.

Goyne said a lot of drought research is focused on agricultural systems and producing drought-tolerant crops. "This project is interesting because it expands drought research beyond agroecosystems to prairies," he said.

Fritschi, who conducts drought studies on annual crops of a single species, including corn and soybean, says the opportunity to study the impact of water stress on a complex mixture of species is exciting and expects it to reveal novel information.

"Exploration of how water availability influences the interrelationships among plant species and the opportunity to examine the relationship of physiological, morphological, and anatomical differences of individual species with their success in the different environments is very exciting as it can provide a better understanding of the mechanisms underlying observed changes," he said.

Veum said she can see many practical benefits of knowing how this native ecosystem will respond to drought.

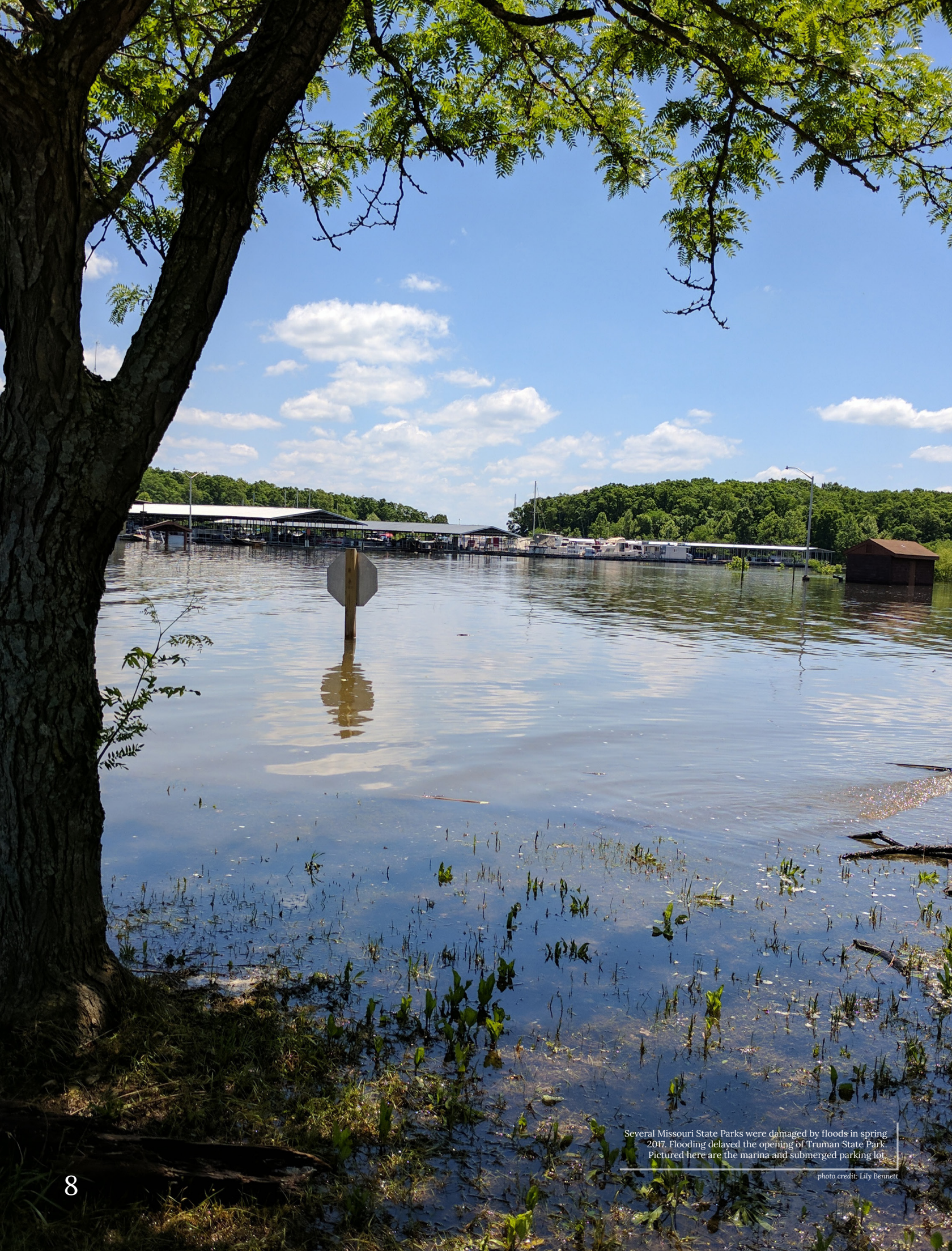
"Managed agricultural systems can benefit from discovery of traits related to drought resistance in different soils, knowledge of shifts in the microbial population that relate to plant pathogens, and microbial activities that control the bioavailability of soil-borne nutrients and water uptake," she said. "In addition, a better understanding of the ecological interactions that promote plant growth can lead to selection of drought-resistant natives that can be used for riparian or upland buffers and alleys, selection of drought-tolerant perennial biomass crops or cover crops, and potentially alternative cash crops that are resilient under various conditions."

Veum said the tallgrass prairie is also an untapped reservoir of above and below-ground biodiversity and genetic resources. As such, it also represents an important source of scientific and ecological information.

"Knowledge of native ecosystems can provide a benchmark of ecological functioning against which we can monitor change related to land management, anticipate ecological responses to abiotic stress such as drought, and quantify the potential benefits of prairie reconstruction and other conservation efforts," she said.

Ultimately, this research will improve our understanding of native prairie ecosystems, preserving this natural resource for generations, and teach us how native plants' resilience to drought can improve agricultural ecosystems as well.

photo credit: Melody Kroll



Several Missouri State Parks were damaged by floods in spring 2017. Flooding delayed the opening of Truman State Park. Pictured here are the marina and submerged parking lot.

photo credit: Lily Bennett

Transect Student Spotlight

Lisa Groshong

photo credit: Lily Bennett

(pictured) Lisa Groshong stands ready to survey individuals at Knob Noster State Park

For University of Missouri PhD student Lisa Groshong, the Missouri Transect project has been life changing. As a member of the community team, she hopes that her work with Transect will change the lives of others as well. Groshong worked on a statewide survey to determine how Missouri state park visitors perceive climate change. She has surveyed just over 2,500 visitors at 20 Missouri State Parks from across the state

"On the one hand, we're learning that a lot of people don't believe that climate change is happening in Missouri or they think it's just this natural cycle that's going to reverse itself," she said.

But it's more complicated than that, she said. To explain, she shared how one group of people she surveyed identified as "conservative" and indicated that they did not believe in climate change and also that if it was happening it was due to natural causes. However, they also marked that they agreed with climate-related occurrences and also agreed with things that cause climate change to happen.

"Clearly, some people are conflicted," Groshong said.

She noted that one of those individuals also left a comment thanking her for the opportunity to participate. They also wrote, "This survey made me wonder how much my political views influence my opinions about climate change."

This comment, said Groshong, shows that the survey itself can serve as a tool to raise awareness and change perceptions.

"We could use this to start changing people's perceptions, not in a confrontational way but in a way that makes them reconsider what they already believe and also what they value," she said.

Groshong is hopeful the survey can be used to start a dialogue with regular people in Missouri about climate change.

"You love Missouri State Parks, right? Look at the flooding that's happening at the Meramac. There's a reason for it, and it's going to get worse, so maybe we should start thinking about what we could do about it," she said.

Groshong said she's grateful to have been a part of the Missouri Transect.

"I feel like I've gotten so much out of my research experience," she said. "I was able to design the project, implement it, and now analyze the data. Plus, the funding from the Missouri Transect allowed me to focus solely on this project. I've really been able to fully devote myself to it."

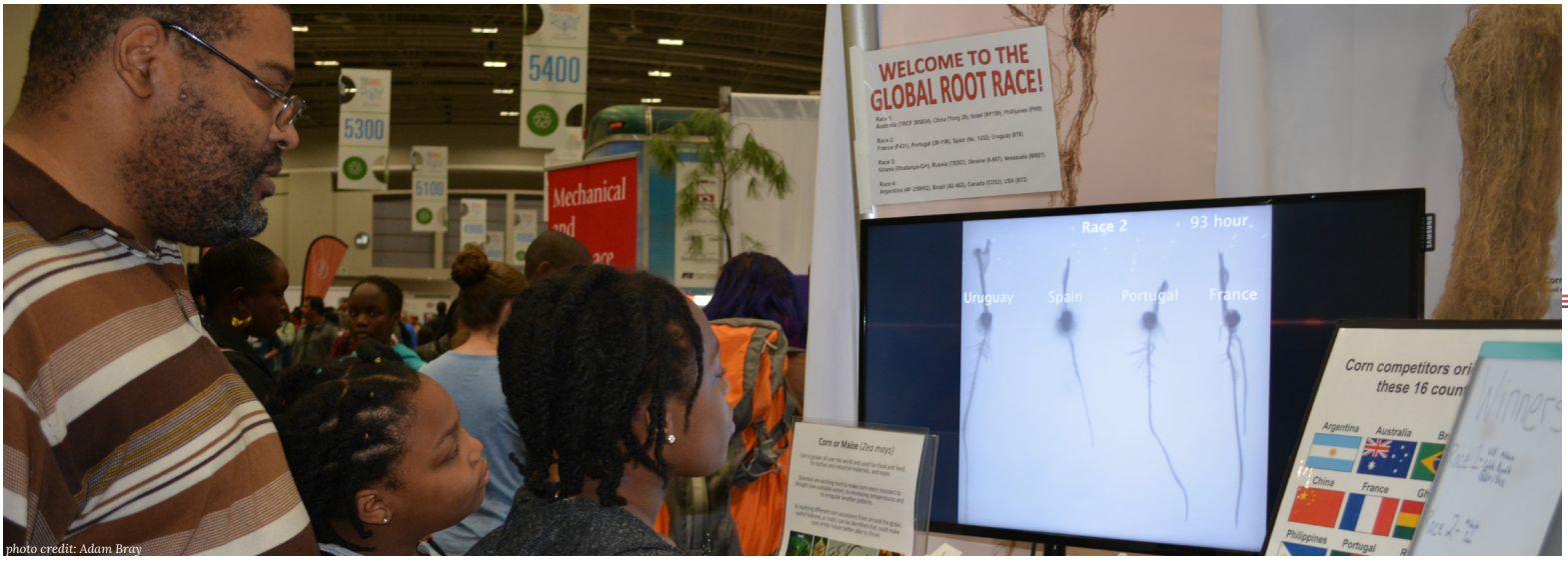


photo credit: Adam Bray

(*pictured*) A family visiting the "Join the Plant Movement" booth at the 2016 USA Science and Engineering Festival held at the Washington DC Convention Center during April 15-17 is intrigued by time-lapse videos of maize seedling root growth.

Outreach

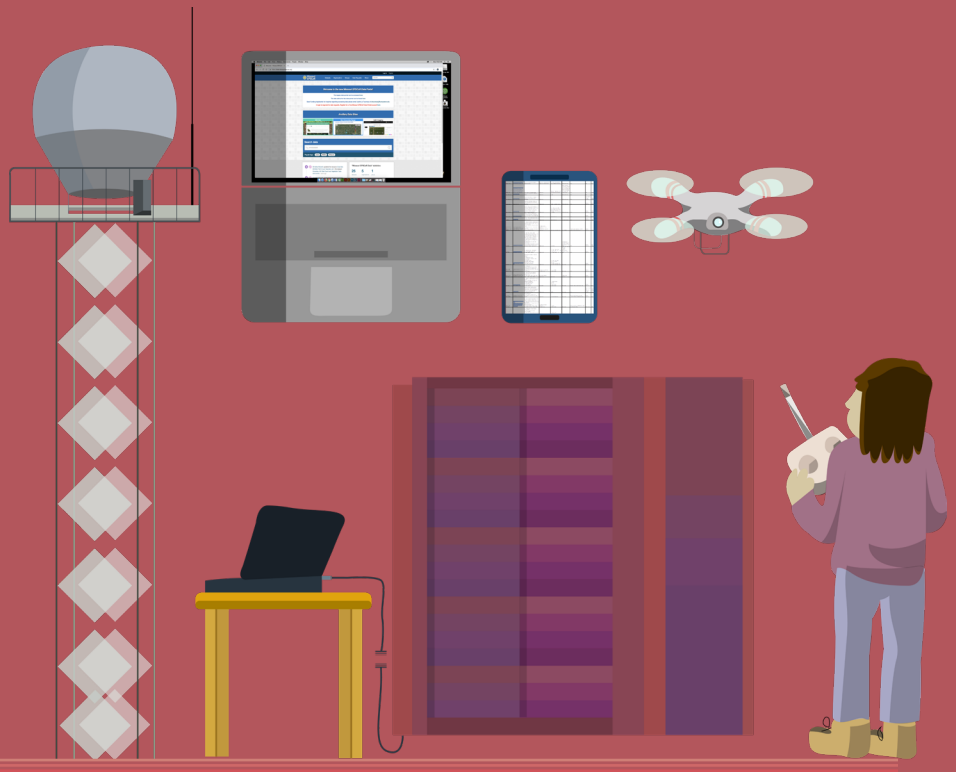
Each year, the **USA Science and Engineering Festival** brings in more than 350,000 K-12 students and teachers, STEM organizations, government officials, and members of the press. A cross-disciplinary group of Missouri Transect investigators were there to present a colorful and interactive display called "Join the Plant Movement." Dr. Terry Woodford-Thomas (Danforth Center, Missouri EPSCoR Education Team Lead), Adam Bray (Danforth Center, Missouri EPSCoR Plant Team, PhD student), and Dr. Sherry Flint Garcia (MU Plant Sciences and USDA-ARS) showed the wonders of plant phenotyping to over 10,000 visitors throughout the three-day festival. The Global Root Race was a popular spot where visitors could watch time-lapse videos, captured by Raspberry Pi cameras, of the early root growth of maize plants from 16 countries.

http://www.usasciencefestival.org.

Place-Based Climate Change Education with High School Students: Missouri Transect Community Team member, Dr. Christine Li (MU)and her graduate student, Akriti Khadka, led the Natural Resources Careers Academy for 20high school students around Missouri. This was a six-day residential program where scientists and natural resources managers provided hands-on learning with the students. The academy took place in July 2018 on the University of Missouri campus and the Prairie Fork Conservation Area as well as Eagle Bluffs and Rock Bridge State Park. Education Team member, Dr. Sandra Arango-Caro(Danforth Center, MO DIRT project lead) conducted a MO DIRT soil health survey training with the students to teach them about thehealth and chemistry of soils sampled from a variety of locations, including prairies, crop land, and forests. Dr. Li and Ms. Khadka conducted a place-based climate change education session and collected pre-and post-surveys to assess students' knowledge of climate change. This empirical study of place-based education will be analyzed and published through support of EPSCoR funding.


photo credit: Emily Haghighi

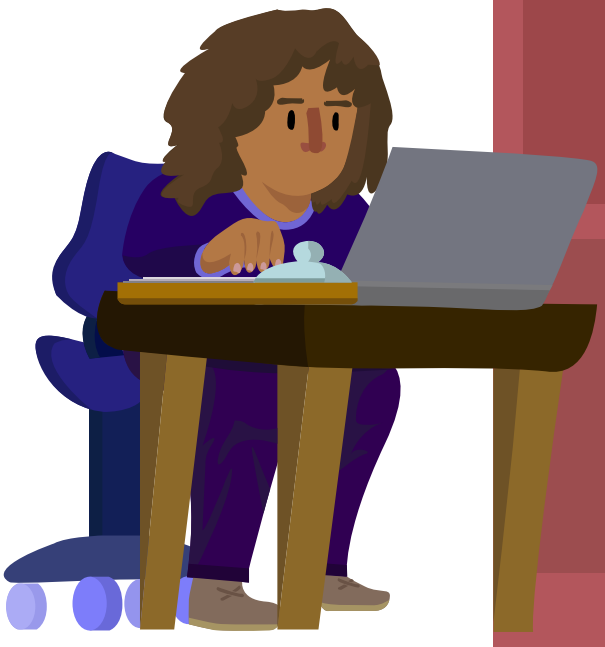
Cyberinfrastructure



An Integrated and Visualized Data Portal

The Missouri Transect program provides its researchers with a Data Portal to store, share, and visualize their data. Researchers choose the level of privacy for each of their data sets. The CI Team is currently working on data visualization and data integration. If researchers want to create visualizations of their data sets, they can contact Justin Le Tourneau on the CI Team: *LeTourneauJJ@umsystem.edu*

The CI Team reminds all Missouri Transect researchers to continue uploading their data to the portal to ensure broadest possible accessibility.



Enhancing Research, Collaboration, and Engagment

Sharing data among Missouri Transect participants is instrumental to successful collaboration and in finding innovative ways to integrate data among the research teams. Sharing data between researchers and the public, for example in the MO DIRT citizen science project and in MZZU RADAR data, ensures that all stakeholders have ready access to the latest information. The Cyberinfrastructure (CI) Team established the Missouri Transect data policy to ensure the timely release of research data and products.

This QR Code will take you to the full data policy.

This QR Code will take you to the Data Portal

(*left*) 2017 AEESP Fellows (Dr. Joel Burken, fourth from left).

Rachel Owen (MU, PhD candidate, Climate Team) and **Tunde Ojewola** (MU, PhD candidate, Community Team) were both selected for the 2017 Science to Action Fellowship. The one-year fellowship, supported through a partnership between the USGS National Climate Change and Wildlife Science Center (NCCWSC) and Michigan State University, helps graduate students bring their research into "policy-relevant products." Mr. Ojewola will examine the U.S. Fish and Wildlife Service land managers' perceptions of climate change in the Midwest and use that info to create interactive tools and maps. Ms. Owen also will develop educational materials based on her research about how climate change impacts playa wetlands in the Great Plains.

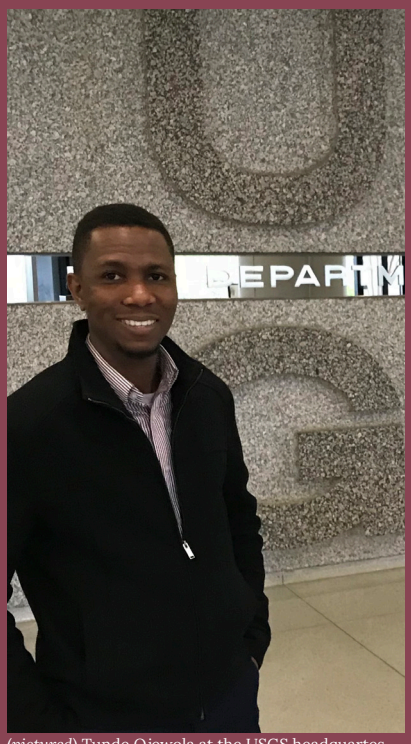
https://nccwsc.usgs.gov/science-action-fellowship

Dr. Vidya Balasubramanyam (MU, Community Team) was awarded a Coastal Management Fellowship from the National Oceanic and Atmospheric Administration's (NOAA) Office of Coastal Management. Dr. Balasubramanyam earned her PhD from the MU School of Natural Resources in May 2017. This fellowship. She is leading a project on costal management in New Hampshire and is also training with NOAA. Her goal is to have a leadership role in coastal management and policy.

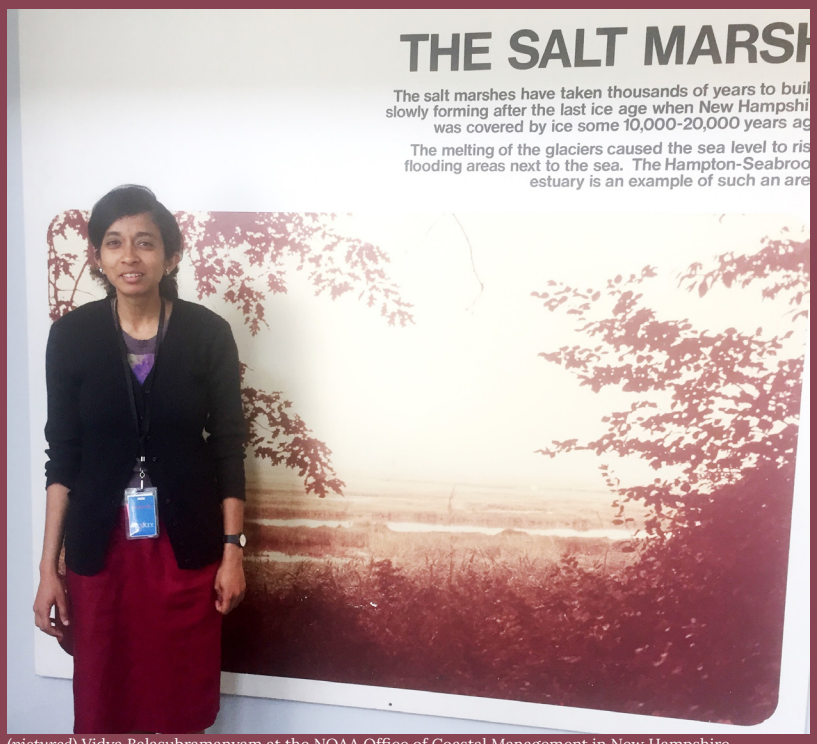
Dr. Joel Burken, (Plant Team Co-Lead) Curators' Professor of Civil, Architectural and Environmental Engineering at Missouri University of Science and Technology, was elected a Fellow of the Association of Environmental Engineering and Science Professors (AEESP). AEESP is an international association of professors in academic programs that teach "the sciences and technologies of environmental protection." AEESP Fellows are selected based on their accomplishments in environmental engineering and science research, teaching and professional service, and their service within AEESP.

https://news.mst.edu/2016/06/burken-elevated-to-fellow-by-environmental-engineering-and-science-professors/

Wyatt Hunziker (Lincoln University, Community Team) has received a Bittersweet Garden Club Scholarship for his work with urban food production and resiliency in Missouri's "Bootheel" region.



(*pictured*) Tunde Ojewola at the USGS headquartes in Washington, DC.



(*pictured*) Vidya Balasubramanyam at the NOAA Office of Coastal Management in New Hampshire.

(*pictured*) Rachel Owen at the USGS headquarters in Washington, DC.

Paul Manley (Missouri S&T, Plant Team) attended the 14th International Phytotechnologies Conference "New Sustainable Solutions for Environmental Challenges" in Montreal, Canada, in September 2017. His poster and presentation on "Hyperspectral image assessment of agricultural plant stress" received "Best Presentation" at the conference. Manley's research focused on finding differences in stressors of plants, mainly between drought and explosives, using hyperspectral imaging. This experiement was conducted in the greenhouse using the plant species studied in the 2016 field season of the Transect. Mr. Manley is pursuing his PhD in Civil Engineering at Missouri S&T.

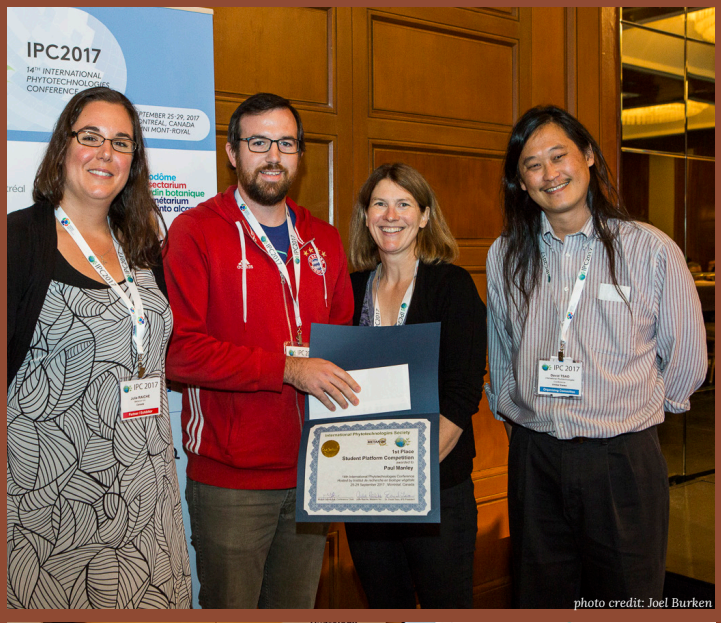


photo credit: Joel Burken

Jordan Wendt (MU, Climate Team) was awarded "Best Paper" for his presentation at the 2017 International Symposium on Weather Radar and Hydrology in Seoul, South Korea, in April 2017. His presentation was titled, "Comparison of X-band Dual-Polarization Radar-Derived and Present Weather Sensor Drop-Size Distributions." Wendt graduated from MU with a master's in Atmospheric Sciences and Meterology in 2017 and currently works as a hydraulic technician for the U.S. Geological Survey in Tulsa, OK.

photo credit: Neil Fox

(*top*) Paul Manley (*pictured with certificate*) at the IPC2017
(*bottom*) Jordan Wendt delivers a presentation at the 2017 International Symposium on Weather Radar and Hydrology

NSF Funding Opportunities
with Spring/Summer Deadlines

Understanding the Rules of Life: Epigenetics

NSF 18-600
Deadline: February 1, 2019

Resource Implementations for Data Intensive Research in the Social, Behavioral and Economic Sciences (RIDIR)

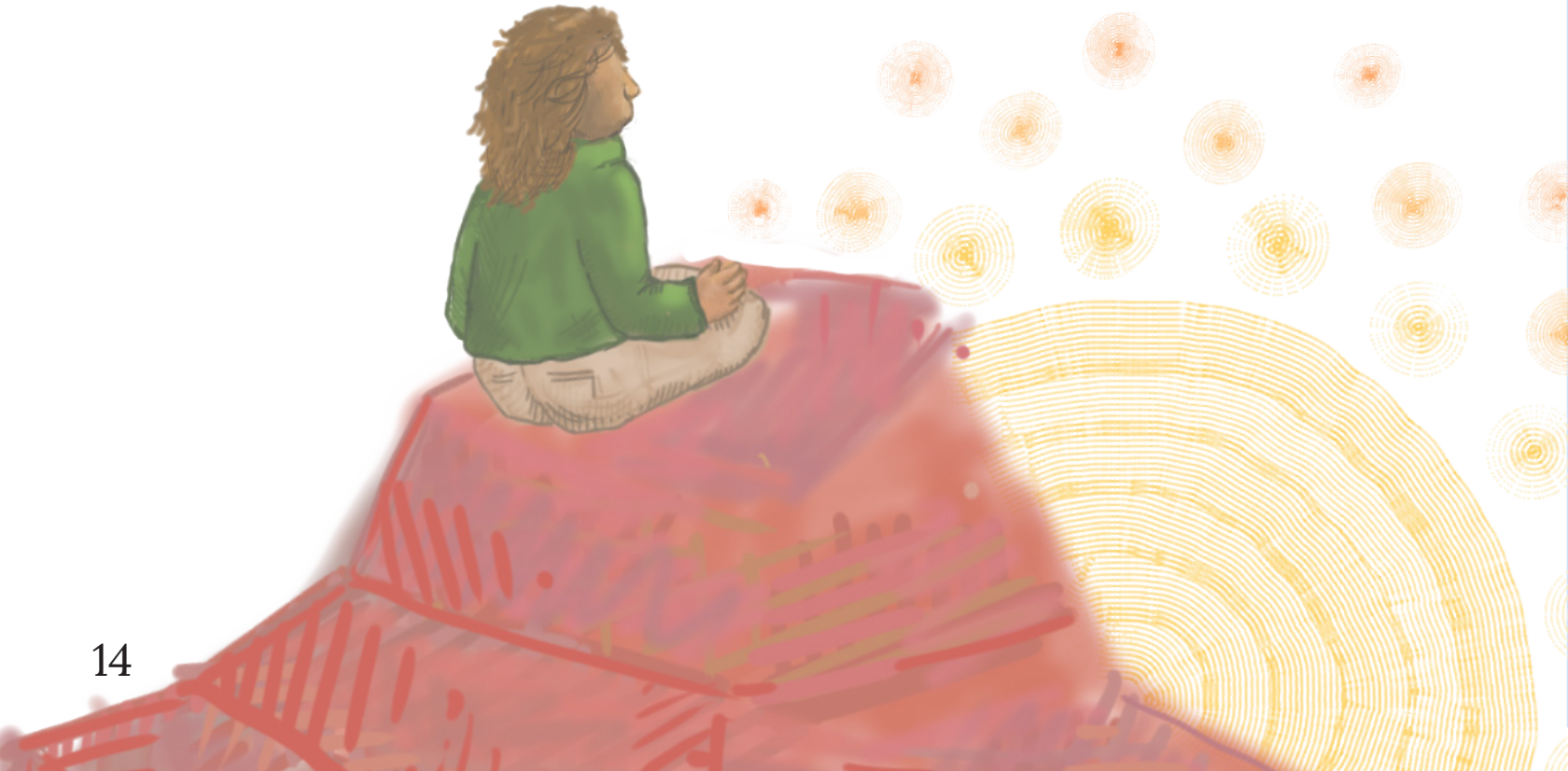
NSF 18-517
Deadline: February 28, 2018 and February 25, 2019

Cyberinfrastructure for Sustained Scientific Innovation (CSSI) - Data and Software: Elements and Frameworks

NSF 18-531
Deadline: April 18, 2018

Non-Academic Research Internships for Graduate Students (INTERN) Supplemental Funding Opportunity

NSF 18-102
Deadline: May 1, 2019 (FY2019 funds) and May 1, 2020 (FY2020 funds)



Where Are They Now?

Undergraduate Researchers

Carson Broeker

Broeker is a junior in Biochemistry at the University of Missouri. He completed a Research Experiences for Undergraduates (REU) program with Dr. Ruthie Angelovici (Plant Team) in the Summer of 2017, researching ways to increase the nutritional value in seeds by measuring amino acid levels. Carson has extended his research experiment beyond the summer and will continue to work in the Angelovici lab this year. Carson enjoys the field of genetics and hopes to pursue a PhD after he graduates with his Bachelor's.

Jack Blumeyer

Blumeyer is a senior in Bioengineering at MU. In the Summer of 2017, he worked with Dr. Felix Fritschi on the Plant Team as an undergraduate researcher in the REU program. He used his education in engineering to help design and build a high-throughput phenotyping (HTP) platform mounted on a Highboy tractor to be used in Dr. Fritschi's experimental soybean fields.

Feature on Carson in the MU Bond Life Sciences Center *decoding science* blog

Watch an interview with Carson about his REU summer experience

Learn more about the Highboy tractor phenotyping system and see it in action

Careers Beyond EPSCoR

Wes Buchheit

Wes Buchheit graduated with a master of science degree in fisheries and wildlife from the University of Missouri in 2016. As a member of the Missouri Transect Community Team, he studied bird communities in Scott County in southeast Missouri and looked at how land management practices might be modified due to changing climate and vegetation. After graduation, Buchheit was hired by the Missouri Department of Conservation (MDC) as a private land conservationist in Bollinger and Madison counties in southeast Missouri.

Read Buchheit's job announcement

Cesar Lizarraga

Lizarraga worked as a computational technician on the Missouri Transect's Plant Team in the Mockler Lab at the Donald Danforth Plant Science Center. Cesar was hired as an engagement engineer at CiBO Technologies, a "computational agronomy" startup based in St. Louis.

Learn more about CiBO Technologies

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(*Pictured*) Dr. Sandra Arango-Caro and Aleah Brooks, Education Outreach Assistant (Education Team, Danforth Center) conduct soil sampling at Tucker Prairie for the MO DIRT Citizen Science program. The soil chemistry and characteristics are tested by Dr. Kristen Veum (Climate Team, USDA-ARS) and data is made available on the MO DIRT Data Portal.

photo credit: Emily Haghighi