From the Director's Desk …

Mississippi State University completed Fall semester and held four graduation ceremonies on November 25. For the first time in 10 years, MSU is offering a Winter Session for students to stay on track for completing their coursework and attaining their degree. Spring semester, in an abundance of caution, will begin on Monday, January 11, 2021.

In this issue, MWRRI features one of our USGS 104b funded research projects. Wei Wu, Associate Professor in Landscape Ecology at the University of Southern Mississippi is the PI. Her background and research areas are quite extensive.

Dr. Jason Barrett continues the collection of well water samples around the state with drop off locations at MSU Extension Offices. Questions you may have about your well water quality can be addressed with Dr. Barrett by phone 662-325-1788 or jason.barrett@msstate.edu.

Learn more about how water with lead can impact children under five years of age. The Sip Safe program helps educate parents and teachers at home, in schools, and daycare centers..

If anyone would like to share how their agency research projects are progressing during the COVID-19, please email your information to Jessie Schmidt for sharing, jessie.schmidt@msstate.edu.

All of us at MWRRI wish you and your family a holiday season filled with joy and happiness. Continue to stay safe as we look forward to 2021.

Jason

Jason Krutz, Ph.D.

From the desk of Dr. Barrett …

This calendar year and fall semester are coming to an end and there are still many unknowns around the state and the nation. One thing that does remain constant is our individual need for water. We often times take water for granted but do take a moment over the holiday break and consider how water impacts our lives every single day. We must have it to physically survive, we use it for sanitation and cleaning, and we recreate in/on/with it. Water is vital to our existence which drives us here at the Institute to do more to assist our communities, producers, and partners across the state. Each individual person can make an impact on our water quality and quantity and if we all make an effort, we can make a greater positive impact. So, this holiday season let's look to approach our lives in a manner that allow us to be good stewards of this precious resource. If we at MSU Extension or the Mississippi Water Resources Research Institute can be of any assistance, please give us a call or check our website for upcoming events/trainings.

Thanks so much,

Jason R. Barrett

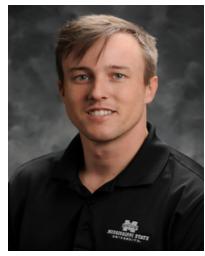# From the desk of Nelson …
Research Technician, MWRRI

Increased exposure to lead can be harmful to human health, especially in children ages five and younger. We know that elevated blood lead levels in children can cause slowed cognitive and physical development. We also know that lead exposure in children is 100% preventable.

When we think of lead poisoning in children, quite often our first and only thought is of older homes with chipping lead-

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based paint, however many older buildings still maintain lead water service lines and lead solder in their water pipes. The Sip Safe program, conducted by the MSU Extension Service and funded by a grant from the Environmental Protection Agency, is working to reduce lead exposure in children ages birth to five years by screening drinking water in qualifying schools and child care facilities.

The program will:

1. **Communicate** educational information about lead in drinking water, lead testing, and how to understand test results.
2. **Train** officials at participating school and childcare facilities to share information about lead in drinking water and ways to reduce student exposure to lead in drinking water.
3. **Test** drinking water in participating schools and childcare facilities to identify potential sources of lead.
4. **Take action** through the development of curriculum materials, educational and outreach materials, a social media toolkit, and planning materials for addressing test results for participating schools and childcare facilities.

If you would like to know more about the Sip Safe program, or know of an elementary school or childcare facility that would be interested in free drinking water screening and educational support materials, contact Nelson McGough at 662-325-0849 or nelson.mcgough@msstate.edu.

Wei Wu, PhD
Associate Professor, Landscape Ecology
Division of Coastal Sciences
School of Ocean Science & Engineering
The University of Southern Mississippi

Tell us a bit about your background and education

I am an associate professor at the University of Southern Mississippi. I obtained my BS degree in Ecology at Wuhan University, one of the top universities with the earliest ecological and environmental programs in China. I pursued my MS degree in Marine Biology at the South China Sea Institute of Oceanography, Chinese Academy of Sciences.

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With a passion for ecological modeling and feeling the need to learn quantitative techniques to synthesize pieces of data collected in order to see the larger picture and make predictions, I luckily joined Dr. Charles Hall's Systems Ecology Lab at the State University of New York – College of Environmental Science and Forestry to pursue my PhD. My research focused on hydrology cycles in the tropical forests in the northeastern Puerto Rico. While earning a PhD in Systems Ecology, I obtained my second MS in computer science at Syracuse University. After graduation with a PhD degree, I went to Syracuse University (Dr. Charles Driscoll's lab) and Duke University (Dr. James Clark's lab) for post-doc research training in hydrological and biogeochemical modeling. At Duke University, I first learned Bayesian inference, which greatly enhanced my research toolsets. These diverse research and education experiences prepare me well for my job as a Landscape Ecologist at the University of Southern Mississippi.

As a broadly trained systems ecologist, I primarily take an interdisciplinary and systematic approach to measure, map, and model real and complex ecosystems at multiple spatial and temporal scales. The specific research interests at my Ecospatial lab have centered on examining and predicting ecological resilience, or lack thereof, through understanding the response of species and ecosystems to environmental change. In addition to conducting research and educating next-generation scientists, I aim to produce accessible, interactive, updatable, and informative model-based tools to facilitate effective decision making by resource management and lay communities. Although the research projects have been mostly natural ecosystem-centered, including coastal wetlands, coastal waters, temperate forests, and tropical forests, with humans as the main cause for environmental change, we are beginning to take the approach of coupled natural-human system and address the resilience of the holistic system. The integration of both natural and human–dominated ecosystems using both natural and social science is not straightforward but necessary for a more informed and more sustainable future.

Describe your research lab

Mississippi has a relatively short, but extremely important, coastal environment. While this environment has been extremely important in the cultural, economic and recreational history of the state, it has never been, nor is it now, a static environment. Past hurricanes have devastated regions, fisheries have risen and fallen, species have changed, and now the entire region is undergoing relatively rapid impacts of sea level rise. To make things worse, more and more frequent spillway openings that divert large amounts of freshwater into Mississippi Sound stress the natural resources and human livelihood even more. Unfortunately, we know relatively little about what this will bring to Mississippi and neighboring states. The main objective of my lab is to improve our understanding and prediction of what this environment will be like in the future so society can undertake

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needed adjustments appropriately and relatively cheaply. With the Mississippi-centered research as the main mission, my lab's research goes beyond Mississippi coasts to include the entire northern Gulf of Mexico and even go up to high-elevation forests that are indispensable parts of the ecosystems.

The main research topics in the lab include:

1) Coastal vegetation and geomorphology – modeling the impact of sea-level rise, climate change, hydrological extremes (river diversions, storms, drought), and episodic oil spill on vegetation and landscape of coastal wetlands and their ecosystem services, in particular, blue carbon sequestration, and how management strategies, such as prescribed fires, can mitigate some of the negative impacts.
2) Forest hydrology and biogeochemistry – modeling hydrologic and biogeochemical cycles of forests in response to climate change, air pollution, and land use/land cover (LULC) change with a focus on evapotranspiration, streamflow, and primary productivity.

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3) Connection of upland and coastal ecosystems – assessing the impact of upland land use / land cover change and climate change on water quantity and quality, and how this could affect vegetation and landscapes of coastal wetlands.

4) Species distribution – modeling species distribution in forest, estuarine, and marine systems under changing environment.

5) Antibiotic resistance – modeling climatic and socioeconomic drivers for antibiotic resistance in aquatic environment.

In addition, I continue in my research on energy issues with earlier colleagues. Our research tools are mostly quantitative and systems-oriented. The main research tools are multi-scale models, supported by field surveys and controlled experiments. Modeling is a great tool to synthesize data, make predictions, and generate new hypotheses. More specifically, we implement cutting-edge Bayesian inference, traditional frequentist statistics, spatial statistics, machine learning, and process/mechanistic models. The development of these models are supported by remote sensing, GIS, field-based observations/experiments, and controlled experiments in green house and *in-situ*. We pay special attention to temporal and spatial scales relevant to the research questions and emphasize prediction uncertainties that are important in science and policy making but largely missing in the literatures.

What are your teaching and research interests

I have a wide research portfolio. During my 13 years at the USM, I have been a PI/Co-PI on 19 external research projects from NASA, NOAA, NSF, EPA, NAS, Sea Grant, USACE-ERDC, and the National Estuarine Research Reserve, plus others. The current projects in the lab include:

2020-22   PI. "Multi-scale evaluation of the impact of hydrological extremes on coastal wetland vegetation". Mississippi Water Resources Research Institute.

2020-22   PI (Co-PI: P. Biber). "Salt marsh upland migration: past, present, and future". Mississippi-Alabama Sea Grant.

2019-22   Co-PI (M. Bethel (PI)). "Developing a locally-relevant community resilience index for use with indigenous communities in the Gulf of Mexico region". EPA GOM.

2019-22   PI. "Field studies to quantify inundation effects on marsh vegetation." U.S. Army Engineer Research and Development Center.

2019-21   PI (Co-PI: Bo Li). "Application of deep learning neural networks in identifying key drivers of vulnerability of coastal wetlands to sea-level rise". Microsoft AI for Earth.

My teaching interests complement my research interests. I am dedicated to teaching students how to think quantitatively, spatially, and systematically. The courses I have developed and

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regularly teach include Bayesian models in Ecology, Geostatistics in Environmental Science, Introduction to GIS in Marine Science, and Geographic modeling. I also taught Ecological Data and Models, Coastal Water Quality, Landscape Ecology, and Ecology. My lab is currently composed of two PhD students, three MS students, and two undergraduate student assistants. I strive to recruit students with high academic performance and diverse background. I have mentored and served on steering committees of 22 graduate students, and supervised one post-doc, one technician, four international visiting scholars, and six undergraduate interns.

What are your teaching and service experiences

I stay active in promoting the best education experiences at different levels. I was a chair of student progress committee at my department for two years and continue to serve on that committee, as well as student admission committee, and diversity fellowship committee at the department level. I am a panel member for NSF's Graduate Research Fellowship Program and the chair of coordinators for Outstanding Student Presentation Awards (OSPA) in Global Environmental Change section of American Geophysical Union. I serve as a judge and mentor at various national and international conferences. I am also active in serving professional societies. I am the chair of Global Change Ecology Section for Society of Wetland Scientists, an editor for PLOS ONE, and a reviewer or reviewer panel member for scientific journals, NSF, DOE, Sea Grants, and RESTORE funds. Furthermore, I am interested in making innovative research accessible to K-12 education. I helped develop the curriculum for high school science courses in coastal counties in Mississippi to integrate the research of the impact of sea-level rise on coastal environment, funded by NOAA. My lab developed a model-based sea-level rise tool for K-12 students and resource managers to understand how sea-level rise affects coastal wetlands. (https://ecospatial.usm.edu/2017/05/01/education-outreach-sea-level-rise-wetland-loss/).

What does MWRRI provide in research and mentoring

While the main objective of the WRRI laboratory is scientific, I feel strongly that the science, which uses public monies, should be in contribution to better management of coastal ecosystems, including both the protection and well-being of the natural organisms that live there and the economic well-being of coastal communities. Within that larger context, WRRI is very supportive of innovative research and student training. For example, when Bonnet Carré Spillway on the lower Mississippi River opened twice in 2019 and the public was eager to learn how this would impact coastal wetlands, it was very surprising to me to learn how limited was the existing research on long-term effect of extended flooding on coastal wetlands. Furthermore, the knowledge of the response of *Juncus roemerianus*, a dominant salt marsh species east of Pearl River in the northern Gulf of Mexico, to hydrological extremes is scarce.

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Through our WRRI-funded project "Multi-scale evaluation of the impact of hydrological extremes on coastal wetland vegetation", we aim to evaluate the short- and long-term impact of hydrological extremes, including meteorologically driven events and anthropogenic activities such as drought, storms, and openings of Bonnet Carré spillways, on vegetation in salt marshes, and identify the ecological thresholds of inundation depth and soil salinity for primary productivity. We will combine field survey, remote sensing techniques, and multi-scale modeling in Bayesian inference for the proposed research.

With this two-year project, I get to train a MS student Kodi Feldpausch. Kodi is a first generation college student and is also the first one in her immediate family to pursue a MS degree. Kodi relocated to Mississippi from Michigan to explore the opportunity that the WRRI, Ecospatial lab, and the USM will provide to her to continue to expand as a Marine Biologist. The project will greatly enrich her education experiences and will prepare her well for a challenging but rewarding career in marine biology. She has been learning the essential skills she needs to approach new and improved conservation strategies to protect fragile coastal marine ecosystems, including but not limited to, quantitative modeling, system thinking, GIS, and remote sensing.

Other students in the lab

Dr. Shuo Shen – Graduated in May 2020. Shuo focused on antibiotic-resistant bacteria and antibiotic resistance genes in aquatic environments. He does not only use innovative molecular methods to quantify resistance, but also applies Bayesian models to predict resistance gene concentrations at the global scale.

Hailong Huang – PhD student. Just successfully defended his dissertation in November of 2020. His dissertation research is on hydrochemical and vegetation response of high-elevation forests to changes in climate and atmospheric depositions in the southeastern U.S. He is also interested in the research on the impact of sea-level rise on coastal wetlands in the Northern Gulf of Mexico.

Jason Tilley – PhD student. Jason is a research associate with the Center for Fisheries Research and Development at the Gulf Coast Research Laboratory. He has a background in biological oceanography and is currently a PhD candidate researching the relation between seston fatty acids and oyster condition.

Evan Grimes – MS student. Evan studies how inundation affects vegetation productivity in coastal wetlands. His research methods include remote sensing, Bayesian multi-level models,

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field surveys, and marsh organ experiments. His interests include spatial ecology, as well as herpetology.

Devin Jen – MS student. Devin studies historical, current, and future landward migration patterns of salt marshes in Mississippi. She is particularly interested in how prescribed fires could affect the migration rates. Her research methods include remote sensing, field surveys, and mechanistic modeling.

Upcoming Events

> ➤ NIWR Annual Meeting for institute directors and associates will be held virtually February 8-10, 2021.
> ➤ Georgia Water Resources Conference – March 22-23, 2021 (will be virtual) https://rivercenter.uga.edu/georgia-water-resources-conference/

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➤ UCOWR/NIWR Annual Water Resources Conference will be held June 8-10, 2021 in Greenville, SC. Use this link for conference updates, registration, and agenda https://ucowr.org/conference/
➤ Upcoming county water testing dates include:

Do you have a publication that you would like to share? Consider distribution through the MWRRI newsletter. Contact Jessie Schmidt for information.

Do you have an upcoming event that all those interested in water-related issues and agriculture would find interesting? Considering adding it to the newsletter and/or listserv. Also available is the MWRRI Twitter account - @MS_WRRI.

About the Mississippi Water Resources Research Institute (MWRRI)

The institute exists as both a federal and a state research unit. Established in 1964, the MWRRI is one of 54 institutes (one in each state, The District of Columbia, Guam, Puerto Rico, and the Virgin Islands) that form a national network to solve water problems of state, regional, or national significance. In 1983, the Mississippi legislature formally designated the MWRRI as a state research institute. Federal funds designated for the institute are used to consult with state water officials to develop coordinated research, technology transfer and training programs that apply academic expertise to water and related land-use problems. These various activities are funded through an annual grant from the United States Geological Survey (USGS). Mississippi state appropriations provide additional funds for cost share. The institute also assists state agencies in the development of a state water management plan, maintaining a technology transfer program, and serves as a liaison between Mississippi and federal funding agencies.

Discrimination based upon race, ethnicity, religion, gender, national origin, age, disability, or veteran's status is a violation of federal and state law and MSU policy and will not be tolerated. Discrimination based upon sexual orientation or group affiliation is a violation of MSU policy and will not be tolerated.

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