The Alabama Water Institute
Symposium
Boundless Futures

Bryant Conference Center, Sellers Auditorium & Lobby
We are pleased to be hosting you at the Inaugural Alabama Water Institute Symposium!

Water is a signature research and academic thrust at The University of Alabama (UA). UA's Alabama Water Institute (AWI) was created to conduct integrated research and education on complex issues of water quantity, water quality, economy and water security from global to local scales. AWI is a foundation of UA's Strategic Plan to “Increase the University's productivity and innovation in research, scholarship and creative activities that impact economic and societal development.” The establishment of AWI demonstrates the commitment of UA leadership to the future of water research.

The mission of the AWI is to apply science, engineering and technology to create innovative solutions to water challenges. We want to empower decision makers and stakeholders with the latest knowledge and tools for actionable solutions to water challenges. AWI seeks to make a better tomorrow for everyone by addressing the complex challenges and opportunities of water resource management. Ensuring that vital freshwater and coastal resources are available for our local, state, nation and global communities is a guiding principle. Applying a systems approach through interdisciplinary water research to promote resilient and sustainable neighborhoods and communities is a key focus of AWI.

UA has a rich tradition of academic success, which helps us raise the bar in our quest for better water for all. Researchers from diverse fields and disciplines including the sciences, engineering, arts, humanities, business, economics, communication and social sciences provide academic and research training and workforce development opportunities for our undergraduates, graduate students and postdoctoral fellows. For the first time in its history, UA achieved Doctoral Universities – Very High Research Activity status, formerly known as the R1 category, in the Carnegie Classification of Institutions of Higher Education. This is the nation's highest level of research activity for institutions that grant doctoral degrees. Research funding, research staff and the number of doctoral graduates are among the criteria used in determining Carnegie classifications.

The theme of the symposium is Boundless Futures. Why? We see the future in our students. We see the future in our affiliated faculty, center directors and leadership dedicated to research, education for the training and development of our students who will become the leaders of the future. Just as water flows where it pleases, we see boundless possibilities in the efforts and dedication of so many who seek to protect a life-sustaining natural resource now and for future generations.

Patricia A. Sobecky, Ph.D.
Executive Director, Alabama Water Institute
Associate Provost for Academic Affairs
Richard McNider, Ph.D.

Water and the Distribution of Agriculture

The geography of agricultural production in the U.S. changed dramatically in the last century. A significant amount of the nation's vegetable, potato, nuts, fruit, dairy and cotton production shifted from the East to the arid West due to the establishment of irrigation infrastructure, largely made possible by government water projects. Similarly, corn and grain production became concentrated in deep water holding soils in a small area of the upper Midwest that avoided drought losses occurring in the shallow poor water holding soils in much of the East. This had a significant impact on agriculture in Alabama and the Southeast. Millions of acres went out of production in the South as rain-fed farmers could not compete with Midwest grain farmers and western irrigated cotton. These losses of agriculture in Alabama devastated the rural economies of particularly in the Black Belt. These areas, once the richest in Alabama, are now some of the poorest.

The recent droughts in the West and the 2012 Midwest drought underscore the vulnerability of the new geography of U.S. agriculture established in the 20th Century. In the West, burgeoning population growth and environmental restoration are competing with farmers for water supply. The last 100 years, in which western irrigated agriculture evolved, was likely the wettest in the last 500 years in the Colorado Basin. The paleo-climate record shows historical multi-year and decadal droughts in the West far exceeding those in the recent past. Sustaining the country’s agricultural production in the face of these population, water use and climate challenges will be difficult in the 21st Century. While most climate change projections show drying in the West and upper Great Plains, they actually show an increase in precipitation in the East.

Alabama and the Southeast can perhaps take a larger role in national production using irrigation. However, this will likely require changes in water law and assistance in building irrigation infrastructure. This talk will summarize investigation of this issue through nationally funded projects in the last 10 years and also discuss programs and incentives to increase irrigation in Alabama.

Biography

McNider’s original degree was in mathematics from The University of Alabama. He studied oceanography and meteorology at Florida State University where he earned an Master of Science degree and completed his Ph.D in environmental science at the University of Virginia in 1981. He worked for the Environmental Protection Agency and the Alabama Air Pollution Control Commission 1973-1983. He joined the mathematics department at The University of Alabama in Huntsville in 1983 and progressed to full professor in 1994. While most of his career was tied to modeling air quality, over the past 15 years he has worked on water and agriculture. He founded the Earth System Science Center at UAH in 1986, one of its largest research centers, and served as Alabama State Climatologist from 1982-1994. He also helped found the Department of Atmospheric Science at UAH which is now ranked nationally in the top 10 of atmospheric science academic programs. He has served as interim dean of the College of Science and executive director of the National Space Science and Technology Center. He is a Fellow of the American Meteorological Society. He currently chairs the Alabama University Irrigation Initiative and directs research groups at UAH on water and air quality.
# Agenda - Day 1

All events will be located in Sellers Auditorium and Lobby

**Tuesday, December 3**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 a.m. – 3 p.m.</td>
<td>Registration (name badge and bag pick-up)</td>
</tr>
<tr>
<td>8 a.m. – 9 a.m.</td>
<td>Continental Breakfast</td>
</tr>
<tr>
<td>9:15 a.m. – 9:30 a.m.</td>
<td><strong>Welcome &amp; Opening Remarks</strong></td>
</tr>
<tr>
<td>Patricia Sobecky, Ph.D.</td>
<td>Associate Provost for Academic Affairs, Executive Director, Alabama Water Institute</td>
</tr>
<tr>
<td>Russell J. Mumper, Ph.D.</td>
<td>VP for Research &amp; Economic Development</td>
</tr>
<tr>
<td>9:30 a.m. – 10:30 a.m.</td>
<td><strong>Keynote – Richard T. McNider, Ph.D.</strong></td>
</tr>
<tr>
<td>The University of Alabama in Huntsville, Water and the Distribution of Agriculture</td>
<td></td>
</tr>
<tr>
<td>10:30 a.m. – 11:15 a.m.</td>
<td><strong>Laura Myers, Ph.D.</strong></td>
</tr>
<tr>
<td>The University of Alabama, Understanding Extreme Rainfall Weather Event Impacts</td>
<td></td>
</tr>
<tr>
<td>11:15 a.m. – 12 p.m.</td>
<td><strong>Steve Mouzon</strong></td>
</tr>
<tr>
<td>New Urbanist Guild</td>
<td></td>
</tr>
<tr>
<td>Better Cities and Communities for Everyone</td>
<td></td>
</tr>
<tr>
<td>12 p.m. – 2 p.m.</td>
<td><strong>Lunch &amp; Networking</strong></td>
</tr>
<tr>
<td>2 p.m. – 2:45 p.m.</td>
<td><strong>David Weston, Ph.D.</strong></td>
</tr>
<tr>
<td>Oak Ridge National Laboratory</td>
<td></td>
</tr>
<tr>
<td>Mutualism in the Face of Changing Climatic Conditions: Implications on a Plant-Microbiome System Influencing Peatland Carbon and Nitrogen Cycling</td>
<td></td>
</tr>
<tr>
<td>2:45 p.m. – 3 p.m.</td>
<td><strong>Wrap up/Next Day Activities</strong></td>
</tr>
<tr>
<td>Patricia Sobecky, Ph.D.</td>
<td>Associate Provost for Academic Affairs, Executive Director, Alabama Water Institute</td>
</tr>
<tr>
<td>3 p.m. – 4:30 p.m.</td>
<td><strong>Reception &amp; Networking</strong> (Sellers Auditorium &amp; Registration Lobby)</td>
</tr>
</tbody>
</table>
**Wednesday December 4**

8:30 a.m. – 3 p.m.   Registration (name badge and bag pick-up)

9 a.m. – 9:30 a.m.  Continental Breakfast

9:30 a.m. – 12 p.m.  **Poster Session**
   Postdocs, graduate students, and undergraduate students

12 p.m. – 1:15 p.m.  **Lunch & Networking**

1:15 p.m. – 1:40 p.m.  **Researchers:** Adam Branan, Jessica Sifuentes, Katy Sobodos, Ryan Waelde and Courtney Wentz
   **Mentor:** Nikaela Flournoy, Ph.D.,
   Alabama Water Institute: Marine Application Prototype (MAP)

1:45 p.m. – 2:10 p.m.  **Liping Guo (Graduate Student)**
   Scalable Core-Shell MoS$_2$/Sb$_2$Se$_3$ Nanorod Array Photocathodes for Enhanced Photoelectrochemical Water Splitting

2:10 p.m. – 2:30 p.m.  **Refreshments & Networking**

2:30 p.m. – 2:55 p.m.  **Jesse Horne (Graduate Student)**
   Hexavalent Chromium Removal from Treated Water via Electrospun Composite Nanofibers

2:55 p.m. – 3:20 p.m.  **Shuo Chen (Graduate Student)**
   Spatiotemporal Evolution of Organic and Inorganic Nutrient Exports in Agricultural Watersheds in Northern Alabama Over Three Years

3:20 p.m. – 3:45 p.m.  **Johanna Engström, Ph.D., (Postdoc)**
   Future Outlooks of Drought in Southeastern U.S.

3:45 p.m. – 4:15 p.m.  **Awards Ceremony**
   Awards Presentations:
   • Undergraduate Awards
   • Graduate Awards
   • Postdoc Awards
   **Closing Remarks:** Patricia Sobecky, Ph.D.

4:15 p.m.  Symposium Closes
Laura Myers, Ph.D.

Understanding Extreme Rainfall Weather Event Impacts

Abstract:
This presentation will discuss the water quantity issues of the extreme weather warning process. Using examples of extreme hurricanes, floods, debris flows and other water related weather events, the educational process of conveying the seriousness of extreme rainfall impacts will be discussed. The same examples will be used to demonstrate how a lack of understanding of extreme rainfall impacts lead to miscommunication and eventually injury and death from not taking the proper protective actions, such as evacuation, for these events. Recommendations and best practices will be presented on educational outreach and improved warning messaging.

Biography:
Laura Myers, Ph.D. (Criminology), is director and senior research scientist for the Center for Advanced Public Safety (CAPS) at The University of Alabama in Tuscaloosa. Dr. Myers has conducted multiple studies and service assessments about the behavior of the public and emergency response networks regarding various disaster, weather and crime events. Current studies underway include the public’s response to severe weather events in Dixie Alley and how events and responses differ there. Dr. Myers has developed a social science research curriculum for emergency response partners to train response professionals on how to collaborate on social science research for operational applications. Another study conducted by Dr. Myers is an evaluation of the disaster and emergency warning modalities, including NOAA weather radio, mobile apps, alert notification systems, WEA alerts, sirens and other tools to determine how these modalities function in actual events and how they can be refined for better use in actual events.
Biography:
Steve Mouzon is an architect, urbanist, author, blogger and photographer from Miami. He founded the New Urban Guild, which helped foster the Katrina Cottages movement. The Guild hosts Project: SmartDwelling, which works to redefine the house to be much smaller and more sustainable. Steve founded and is a board member of the Guild Foundation; it hosts the Original Green initiative. Steve speaks regularly across the U.S. and abroad on sustainability issues. He blogs on the Original Green Blog, Useful Stuff, and We Do This Because ... He also posts to the Original Green Twitter stream.

Abstract:
In 1909, the cities of the world were home to 250 million people. In 2019, more than 4 billion people live in cities. By the time high school and college graduates of today retire in the future, urban populations will likely have doubled with more than 7 billion people living in cities. Cities have been described as engines for learning, and their locations bring together people and ideas. Sustainable development poses challenges and opportunities for cities and communities as inadequate gains in the provisions of basic services, such as clean water and sanitation, continue to make headlines.

Mitigating urban water issues through improving water quality and stormwater management will continue as climatic change forces cities to adapt. Impervious surfaces (paving and building roofs) shed stormwater much faster than a forest or field, and almost all of that stormwater runs through streets and gutters, picking up contaminants and carrying them to our waterways. Stormwater retention ponds attempt to solve that problem, but they separate buildings, lowering walk appeal and city vitality. Riparian corridor setbacks are meant to protect streams and rivers, but these force neighborhoods further apart, creating cities where everyone drives, burning more fossil fuel adding to climate issues and deposition of pollutants to urban areas and other locales.

Conventional development guidelines have been calling for increasingly larger boxes for decades. Using these standards, seriously disinvested neighborhoods, towns and villages have no hope of services for years or even decades, and thus service shadows such as food deserts abound. The single-crew workplace, on the other hand, makes many things possible today that are considered impossible by the experts. A single-grocer grocery, a restaurant with one cook and one server and a general store with one shopkeeper, for example. These impossibly small (by industrial standards) places of business not only bring services to places that might have none, but also allow people to start building their own dreams who otherwise would have no hope of doing so.

This session will look at the particulars of single-crew workplaces and the conditions necessary to help them thrive.
Abstract:
The importance of plant-microbiome systems on terrestrial carbon and nitrogen processes is perhaps most pronounced in Sphagnum peat moss-dominated ecosystems, which occupy 3% of the Earth's land surface, yet store approximately 30% of terrestrial carbon as recalcitrant organic matter (i.e., peat). The foundation plant genus Sphagnum is responsible for much of the primary production in peatland ecosystems and produces recalcitrant dead organic matter. Together with associated N2-fixing microorganisms, Sphagnum contributes to substantial peatland nitrogen inputs. Sphagnum growth and production (carbon gain) depends, in part, on a symbiotic association with N2-fixing, diazotrophic microbes. Under changing environmental conditions, a central question about these ecosystems is whether the Sphagnum-diazotroph symbiosis will maintain its beneficial interaction, or will it shift to neutral or even antagonistic interactions that ultimately influence peatland carbon gain and storage. In this talk, I will introduce the audience to our large-scale peatland manipulation study, where a range of warming levels from ambient to ambient +9 °C is applied in combination with ambient or elevated (900 ppm) CO2 within 12-m diameter, open-top enclosures. We leverage this field site to isolate Sphagnum associated microbiomes conditioned to experimental temperatures and apply them to germ-free laboratory Sphagnum for molecular genetic studies. A recent result shows that Sphagnum grows better at elevated temperatures when inoculated with a warming conditioned microbiome relative to those inoculated with an ambient microbiome or no microbes at all. I will discuss our current understanding of this phenomena and how these interactions may influence peatland biogeochemistry.

Biography:
Dr. David J. Weston is a senior staff scientist at Oak Ridge National Laboratory. His research focuses on plant responses to changing environmental conditions and how associations with microbial endophytes can benefit plants to harsh environments. He is the recipient of the DOE Early Career award, and has expertise in physiology, genetics and in developing statistical models aimed at harnessing next-generation sequencing technology for trait predictions.
Flash Flood Risk Assessment in the Southeastern U.S.

Atieh Alipour and Hamid Moradkhani

Department of Civil, Construction and Environmental Engineering
Center for Complex Hydrosystems Research
The University of Alabama, Tuscaloosa

Abstract
According to the National Weather Service (NWS), intense rainfall is the most common driver of flash flooding. The southeastern U.S. is among the regions commonly impacted by tropical storms, thunderstorms and hurricanes, all of which are associated with torrential rainfalls. Consequently, flash floods impose millions of dollars in damages every year to this region. Therefore, predicting potential property damages of flash floods is essential for achieving proactive disaster management. However, the majority of previous flood damage prediction assessments were conducted at small scales, explicitly applicable to the region of interest. To fill this gap, in this study, we present a framework that considers a variety of features explaining different components of risk (i.e., hazard, vulnerability and exposure), and multiple machine learning (ML) models to predict flash flood damages. A large database of flash floods consisting of more than 14,000 events are assessed for training and testing the methodology, and multitude of data sources are utilized to acquire reliable information related to each event. A variable selection approach was employed to alleviate the complexity of the dataset and facilitate the model development process. The ML model is implemented in two modes: first, as a binary classifier to estimate whether a region of interest is damaged in any particular flood event, and then as a regression model to predict the amount of damage associated with each event. The results of this study indicated effectiveness of the proposed methodology in predicting flash flood damages across the southeastern U.S. and provided a reference for flood risk management in this region.
Spatiotemporal Patterns of Contiguous United States Drought Awareness

Sungyoon Kim¹, Jonghun Kam¹ and Wanyun Shao²

¹ Department of Civil, Construction, and Environmental Engineering,
The University of Alabama, Tuscaloosa,
² Department of Geography,
The University of Alabama, Tuscaloosa

Abstract
Drought awareness is a lack of social response to an emerging drought because of the intangible characteristics. Local drought awareness can be measured based on how much mass media reports and/or search engine inquiries increase during the emergency of a local drought. High levels of this local drought awareness lead to concerns for water shortage and supports for water policy. However, it is difficult to investigate drought awareness on a national scale. For example, how actual drought risk at local and remote regions is associated with local drought awareness due to the limited sample sizes and costs of survey data collection. In this study, we present national-scale research to study the spatiotemporal characteristics of drought awareness across the 49 Contiguous United States (CONUS) using Google Trends data and principle component analysis (PCA). Results show that PC1 and PC2 explain 38% and 10% of variance of state-level drought awareness over the CONUS. PC1 is related to a national pattern of drought awareness across the CONUS. Unlike actual drought risk, national-scale drought awareness has relationships across adjacent and remote states in the U.S. to the geographical location of the drought occurrence. The spatiotemporal patterns from PC1 can imply that residents living in the northeastern region are sensitive to drought occurrences even if the region does not experience a local drought. These results explain that big datasets from search engine inquiries and social media can help improve the current water policy and water resource management more efficiently and effectively.
**Poster Abstracts**

#A-102

**Dam Nation Revisited: The Prospective of Hazard Potential and Preparedness**

**Junho Song**¹ and **Jonghun Kam**¹²

¹ Department of Civil, Construction, and Environmental Engineering,
The University of Alabama, Tuscaloosa
² Center for Complex Hydrosystems Research,
The University of Alabama, Tuscaloosa

**Abstract**

Aging water infrastructures in the United States are a growing concern. This study reports on the hydrologic data of 70,000 dams over the contiguous U.S. that are registered in the 2018 National Inventory of Dams (NID) database. This report revisited the 2018 NID-registered dams to assess the cumulative hazard potential in terms of the total numbers and the cumulative maximum storage of dams over the 12 National Weather Service River Forecast Center (RFC) areas. Results show that the cumulative storage capacity of the dams with high and significant hazard potential ranges from 50% (North Central) to 98% (Missouri and Colorado). The 2018 NID database shows that 43% of the dams with either high or significant potential hazard have no emergency action plan. Spatial variations of hazard potential and preparedness for dam failure indicate a need of the development of region-specific preparation, emergency and recovery plans for dam failure. This study hints at how big data such as the NID database can improve the current public policies and public outreach programs.
Perfluorooctane sulfonate (PFOS) Removal from Water by a Silver-Metal Organic Framework

Danielle Bretz, Ryan Olson, Mostafa Dadashi Firouzjaei and Milad Rabbani Esfahani

Department of Chemical and Biological Engineering, The University of Alabama, Tuscaloosa

Abstract
Per and polyfluoroalkyl substances (PFAS) are current threats to human and environmental health and pose a risk to the safety of groundwater, surface water and drinking water. The main adverse properties of PFAS can be listed as being highly toxic, bioaccumulate, do not degrade readily in the environment, and are known to be endocrine disruptors and carcinogenic. PFAS contamination of soil and water resources is a nationwide problem. This includes many regions and states in the U.S., such as Alabama, California, Arizona, Tennessee, Michigan, New York and others with proportionally high levels of PFAS in hydrologic units, water resources and wastewater treatment plants (WWTP). We fabricated a novel Ag-MOF nanoparticles for the enhanced adsorption of PFOS from water. The synthesized adsorbent was characterized using scanning electron microscopy (SEM), energy dispersive spectroscopy (EDX), transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), Ultraviolet-visible spectroscopy (UV-Vis), Brunauer–Emmett–Teller (BET) analysis and Zeta Potential. The adsorption of PFOS was studied at different pH, temperature and load of adsorbent (Ag-MOF). The Ag-MOF showed more than 95% adsorption of PFOS from water.
Using Paleoflood Hydrology to Extend Flood Records and Understand Large Floods in South Sauty Creek (Buck’s Pocket State Park, Ala.)

Joni Corbin, Lisa Davis and Matthew Therrell

Department of Geography,
The University of Alabama, Tuscaloosa

Abstract
In this study, we use paleoflood hydrologic techniques to develop a chronology of flood events that pre-date stream gauge data for South Sauty Creek, a tributary of the Tennessee River in north Alabama. Paleoflood hydrology uses physical evidence of flooding to reconstruct the timing and magnitude of floods that occurred prior to historical and instrumental data. South Sauty’s gorge setting makes the stream highly prone to large floods, which as recently as 2019 resulted in loss of life. Streamflow data only begins in 2011, providing limited data for understanding the large floods generated by this stream. Tree core samples were collected from oak (Quercus) trees with flood impact scars in the riparian zone and dated using standard dendrochronology techniques. The earliest dated flood in the cores occurred in 1758 C.E. Preliminary findings suggest that all of the tree scar heights correspond to stages associated with the 25-year event that occurred in 2015. Sediment entrainment equations based on the shield’s parameter were used to determine the minimum water height necessary to move the 10 largest imbricated cobbles located in channel adjacent to the tree sampling site. We use HEC-RAS 5.0.6 to determine the discharge and flow recurrence interval associated with the stage that transported the imbricated boulders. Transportation of 80% of the measured cobbles is associated with flows greater than the largest flows on record. Future work will expand the data set to include higher tree scars to isolate the dates of larger flood events based on inundation mapping of the floodplain.
The Antifouling Mitigation of Cu-MOF-Incorporated Polydopamine Functionalized Nanofiltration Membranes Toward Dye Removal and Water Permeability

Mostafa Dadashi Firouzjaei¹, Zane Joseph Parkerson¹, Ehsan Zolghadr² and Milad Rabbani Esfahani¹

¹ Department of Chemical and Biological Engineering, The University of Alabama, Tuscaloosa, 
² Department of Physics and Astronomy, The University of Alabama, Tuscaloosa

Abstract

Dyes are one the largest contributors to water pollutions. Due to high carcinogenic and biotoxicity effects of dyes on public health, dye removal from water is an essential separation process in water treatment. Nanofiltration (NF) membranes are essential elements of the filtration process for water treatment. In this work, we conducted a facile surficial adhesive modification process to fabricate highly permselective NF membranes for dye removal. The copper metal-organic frameworks nanoparticles (Cu-MOF) were synthesized and incorporated with the polydopamine (pDA) for surface coating of commercial NF membranes using two different static and dynamic fabrication process. The results showed that the pDA coating significantly enhanced the dye rejection up to 98.1% for methyl orange. Also, the incorporation of Cu-MOF to the pDA layer improved the permeability (90%) with a negligible rejection loss (94.5% rejection for the methyl orange). In addition, fouling experiments did not show a significant water flux reduction for modified membranes compared to the pristine commercial membrane. The two different facile fabrication processes and superior performance of modified NF membranes suggest that as prepared is potentially applicable for separation of anionic dye from the water. Both MOF-incorporated membranes (statically and dynamically) show 18, and 13% higher flux recovery ratio than unmodified membrane, respectively. This study shows that the statically fabricated membrane has 68.5% higher rejection rate than unmodified membrane comparing to dynamically fabricated membrane with 56.3% higher rejection rate. Finally, dynamically fabricated membranes showed approximately three times higher water flux rate than the statically fabricated membranes.
Characterization of Unionid Mussel Shell Decomposition and Shell Chemistry

Gabriella Dickinson and Carla L. Atkinson

Department of Biological Sciences,
The University of Alabama, Tuscaloosa

Abstract
Mussels play an important role in freshwater ecosystems as they store and recycle nutrients. While the nutrient content of quickly decomposing mussel soft tissue has been relatively well studied, the breakdown and chemical composition of mussel shell tissue is less known. We predicted that mussel shells are a long-term, slow-releasing nutrient sink. To investigate the decomposition of mussel shells in freshwater rivers, we deployed several mesh bags of individually tagged and weighed shells from the species Pleurobema decisum in five sites along the Sipsey River. After two and a half years, the bags of shells were recollected. We calculated the shell mass lost and decomposition rates for each site by weighing the mass of each shell valve. We found a positive correlation between initial shell mass and the mass of shell lost. This suggests that larger shells decompose at a faster rate, perhaps due their larger surface area. Further studies are in progress to measure the carbon, nitrogen and phosphorus content of mussel shells from several species (P. decisum, Cyclonaias asperata, Obovaria unicolor, Lampsilis ornata, Fusconaia cerina) to help predict how the mussel species composition of a river may affect available nutrient ratios in freshwater ecosystems.
Zif-8/Dopamine Modified Polyvinylidenefluoride (PVDF) Nanofibrous Membranes with Enhanced Antifouling Performance for Direct Contact Membrane Distillation

Mostafa Dadashi Firouzjaei, Luke Perdikis, Caroline Chunn, Elizabeth Connick, Christopher Gothman and Milad Rabbani Esfahani

Department of Chemical and Biological Engineering,
The University of Alabama, Tuscaloosa

Abstract
Despite the conventional desalination methods, membrane distillation (MD) with moderate temperature need, low operating pressure and high salt rejection is a noteworthy choice for seawater desalination. In this study, a novel thin film composite (TFC) membrane with ultrathin zeolitic imidazolate framework (ZIF-8)/dopamine coated on the polyvinylidene fluoride (PVDF) membrane surface was synthesized to improve the membrane distillation (MD) performance for water. The dopamine layer acts as a bridge for immobilization of ZIF-8 on the electrospun PVDF layer. In recent years, electrospinning has been employed to fabricate novel MD membranes. Using high voltage source to provide electric field leads to formation of fiber from polymer solution. Membranes fabricated by electrospinning method possess high surface area and hydrophobicity as well as high surface porosity. The super hydrophobic nature of ZIF-8 increases the liquid entry pressure of the membrane while the hydrophilic nature of the dopamine increases the antifouling property of the membrane. Our expectation is to get a super hydrophobic membrane with a strong antifouling property.
Assimilation of Satellite Soil Moisture and Evapotranspiration Observations into Noah-MP Model

Keyhan Gavahi, Peyman Abbaszadeh and Hamid Moradkhani

Center for Complex Hydrosystems Research, Department of Civil, Construction and Environmental Engineering, The University of Alabama, Tuscaloosa

Abstract
Remotely-sensed satellite data are providing a fertile ground for utilizing data assimilation (DA) methods to improve the reliability and accuracy of hydrologic predictions and quantify their corresponding uncertainties. Many endeavors have gone into assimilating satellite soil moisture observations into land surface models to improve their predictive skills, but little attention has been given to combined use of soil moisture and evapotranspiration (ET) that can simultaneously be assimilated to the land surface models to better characterize hydrologic fluxes. In this study, Noah-MP (Noah multi-parameterization) model is used for soil moisture and evapotranspiration prediction. Comparing to its previous version, Noah-MP shows improvements in skin temperature, snow, runoff and soil moisture, but the computational cost has been increased accordingly. The main objective of this study is to assimilate two remotely-sensed products, namely SMOPS (Soil Moisture Operational Product System) and MODIS evapotranspiration (MODIS16 ET) into this model to improve the simulation of these prognostic variables. To achieve this, the evolutionary particle filter with Markov chain Monte Carlo (EPFM) method will be used which significantly enhances DA performance. Little Washita Watershed in Oklahoma was chosen as the study area where multiple in-situ soil moisture stations are available. These observations are used to validate the performance of the multivariable DA and explore the gained information of assimilating ET for improving the Noah-MP soil moisture prediction skill.

Department of Biological Sciences, The University of Alabama, Tuscaloosa.

Abstract
In light of high rates of wetland loss, restoration and construction of tidal marshes has been encouraged to recover ecosystem functions. However, the impacts of nutrient loading on marsh resilience to sea-level rise may vary between natural and restored or constructed marshes, with consequences for marsh resilience. While natural and restored marshes often have similar structure, they may not function similarly. As coastal restoration, enhancement and creation projects become more common, it is important to understand the similarities and differences in marsh responses to environmental changes, including nutrient enrichment, and their impacts on ecosystem functions and resilience to sea-level rise. To test the effects of nutrient enrichment, on surface elevation maintenance in natural and constructed marshes, we are conducting a controlled mesocosm experiment utilizing intact, vegetated sods collected from natural and constructed tidal marshes along the Fowl River near Theodore, Ala. This experiment is examining biological contributions to surface elevation in response to different nutrient enrichment scenarios, and how these processes differ between natural and constructed marshes. The results of this study will not only identify potential differences in ecosystem function between natural and constructed marshes, but will examine the impact that nutrient loading has on the capacity of tidal marshes to keep pace with sea-level rise.
Application of Micropatterned and Chemically Modified PVDF Membranes for the Treatment of Produced Water via Membrane Distillation

Shahriar Habib and Steven T. Weinman, Ph.D.

Department of Chemical and Biological Engineering, The University of Alabama, Tuscaloosa

Abstract
Produced water, specifically fracking wastewater, is considered one of the principle waste streams from the oil and gas industries. Along with a high concentration of salts, fracking wastewater contains a wide range of harmful contaminants such as heavy metals, emulsified oil and other organics, which pose serious environmental and remediation challenges. According to the Environment America Research and Policy Center in the U.S., fracking wells located in seven states generated around 14 billion gallons of wastewater in 2014 and the amount is likely to increase in the future. Some of the techniques used to treat this water include filtration, cyclonic separation, flotation, evaporation and deep well injection. Recently, membrane distillation (MD) has emerged as a promising candidate for treating fracking wastewater. In contrast to other membrane processes where pressure is used as the driving force, MD is a thermal-driven separation process where water from the feed side (hot temperature side) transports to the permeate side (cold temperature side) through a hydrophobic membrane as vapor molecules, leaving behind non-volatile components. As fracking wastewater usually has a higher temperature than ambient temperature, the feed is not required to be heated which makes MD an energy efficient technique. Though MD is a promising way to treat fracking wastewater, flux reduction and pore wetting due to oil fouling of the hydrophobic membrane is an issue because fouling increases the operating costs, and pore wetting decreases the separation efficiency. As such, an efficient and cost-effective strategy is required to mitigate membrane fouling and will have significant economic and environmental impacts.

Previously, most of the strategies employed for mitigating oil fouling have used surface chemistry modification of membranes. Recent studies showed that surface chemistry modification alone is not sufficient to tackle the problem. However, membranes modified with a specific, ordered surface pattern exhibited reduction of fouling. Based on prior studies, we hypothesize that the combination of surface chemistry modification and surface patterning will make a membrane surface more effective in combatting oil fouling and pore wetting than either method alone. Nano- and micron-sized line and groove patterns were imparted onto the surface of commercial polyvinylidene fluoride (PVDF) membranes. The membrane surface was chemically modified via UV photopolymerization of a sulfobetaine zwitterionic polymer. The surface chemistry modification was characterized by ATR-FTIR and wetting was characterized by water contact angle.

Another approach for fouling mitigation is the use of 3D-printed spacers in the feed and permeate flow channels. Studies suggest that spacers can improve the water flux performance and membrane fouling resistance. To understand the effect of the minimal surface area spacers on membrane performance, pristine PVDF membranes have been tested in a custom made membrane distillation system with and without the spacers to compare the water flux performance and salt rejection.
Freshwater Mussels as a Source of Bioavailable Nutrients and Energy

Garrett W. Hopper¹, Shuo Chen², Irene Sanchez-Gonzalez¹, Jamie Bucholz¹, Yuehan Lu² and Carla L. Atkinson¹

¹ Department of Biological Sciences, The University of Alabama, Tuscaloosa
² Department of Geological Sciences, The University of Alabama, Tuscaloosa

Abstract
Animal communities can mediate the flow of nutrients and energy through ecosystems. However, few studies have investigated the functional role of animals as sources of dissolved organic matter (DOM) that may support microbial production. Freshwater mussels are long-lived, sedentary filter feeders that spend their adult life in dense, multispecies aggregations. Mussels exert strong bottom-up effects through excretion of dissolved inorganic nitrogen where they are abundant, and a portion of ingested resources may be excreted as DOM, which may be more bioavailable due to the physical and chemical digestive processes of mussels. We tested the effects of taxonomy and body size on the quality and quantity of DOM and dissolved inorganic nitrogen excreted by freshwater mussel aggregations distributed across four rivers in Alabama. Individual excretion rates and excretion composition varied across rivers and as a function of body size and taxonomy. Generally, filter feeding mussels tended to transform ambient DOM from microbial and humic acid-like compounds towards protein-like compounds. Similarities among most species likely reflect their shared resource use, and differences emphasize the potential importance of species identity to supporting microbial production. Our study illustrates the role of freshwater mussel aggregations in the transformation of ingested organic matter as a possible significant flux of labile energy and nutrients to heterotrophic microbes.
Polymer Fiber-based Visible Colorimetric Sensor for Selective and Sensitive On-site Determination of Polycyclic Aromatic Hydrocarbons in Aquatic Ecosystems

Jesse Horne, Yang Lu, Clint Cook, Seth Hayes, Brian Washington, Olivia Diaz and Dr. Evan K. Wujcik

Materials Engineering and Nanosensor [MEAN] Laboratory,
Department of Chemical and Biological Engineering,
The University of Alabama, Tuscaloosa

Abstract
Water is an essential part of sustaining society, yet often faces pollution from human-made sources. Polycyclic aromatic hydrocarbons (PAHs) are carcinogenic compounds that result from oil spills and industrial pollution, thus capable of causing long-term health damage and cancer. These chemicals, a large class of uncharged non-polar organic compounds comprised of two or more condensed benzene rings arranged in various configurations, are also particularly harmful to aquatic ecosystems. Here, a nanofibrous polymer-based colorimetric sensor is used for the detection of PAHs at environmentally-relevant levels. Electrospinning is used to create silica nanofibers, which are necessary as a reaction substrate and provides a high surface area. The volatile PAHs will be concentrated in the vapor phase, allowing for detection. Formaldehyde, under acidic conditions, is used to colorimetrically detect the PAHs—reacting to brown quinoid compounds on top of the white sensor mat. Image analysis is used to quantify the PAH concentration. This robust and portable sensor provides a simpler alternative to the traditional, expensive analytical equipment (HPLC, GC-MS), and allows for on-site and rapid water monitoring.
Prediction in Data-Scarce Regions: Toward Behavioral-based Clustering of Catchments in Environmental Systems

Keighobad Jafarzadegan and Hamid Moradkhani

Center for Complex Hydrosystems Research,
Department of Civil, Construction and Environmental Engineering,
The University of Alabama, Tuscaloosa

Abstract
Prediction in data-scarce regions is one of the challenging issues in environmental problems. A common solution is to perform the similarity-based regionalization techniques where first the catchments are clustered based on some physical/climatic characteristics or catchment response signatures. Then, the information of data rich catchments are assigned to those data-scarce catchments that belong to the same cluster. The selection of appropriate catchment characteristics is very subjective, specifically if the environmental system or the model structure is not understood well. Here, we propose a generic regionalization framework with a novel behavioral-based hierarchical clustering (BHC) algorithm. The BHC algorithm finds the similar catchments based on the model parameter transferability, and it doesn't need to deal with the selection of catchment characteristics. To demonstrate the supremacy of the BHC compared to typical clustering techniques and to show the efficacy of our regionalization framework, two different case studies are tested. In the first problem, we regionalize a probabilistic floodplain mapping model and generate reliable probabilistic maps in data-scarce catchments. In the second case study, our framework is used to regionalize stage-discharge rating curves to detect the homogenous river reach catchments with similar river dynamics. The results of both studies confirm that the BHC-based framework can be used as a reliable technique for a wide range of environmental predictions in data-scarce regions.
Trans-Atlantic Flood Frequency and Magnitude in the Common Era

Ray Lombardi

Department of Geography,
The University of Alabama, Tuscaloosa

Abstract

Extreme floods and rain events are predicted to become more severe and frequent under future climate conditions. Most flood frequency analyses assume stochasticity of extreme flood despite evidence that climate variation has a significantly altered flood hydroclimatology. Therefore, to further improve the quality flood frequency models, we must understand how past climates have impacted the occurrence of extreme floods. The common era (2,000 years before present until today) has experienced several warm and cool periods which can offer unique insight into the relationship of extreme floods and climate variation. We synthesized slackwater or floodplain paleoflood chronologies from North American and Europe that report the size and age of each paleoflood and extended back to 900 CE to capture the Medieval Climate Anomaly (MCA; 900–1300 CE) and the Little Ice Age (LIA; 1300–1900 CE). Twelve paleoflood studies from study regions fit all criteria. The frequency of large flood has increased in nearly every record within the last 1,000 years compared to the earlier millennia of the common era with the highest frequency period occurring during the Little Ice Age. Nine paleoflood chronologies specifically designated their most extreme flood events within respective records. Seven out of nine extreme floods occurred between 1000 and 1300 CE during the latter portion of MCA. Despite a small number of studies, these results suggest the MCA, which was approximately 2°C warm, is crucial to understanding extreme flood frequency and magnitude in future climates. Paleoflood records should span both the MCA and LIA to ensure unbiased sample size of extreme floods are utilized in flood frequency analysis.
Quantifying Fate and Transport of Nitrate in Saturated Soil Systems Using Fractional Derivative Model with Reaction

Bingqing Lu and Yong Zhang

Department of Geological Sciences,  
The University of Alabama, Tuscaloosa

Abstract

Natural soil systems usually exhibit complex properties such as fractal geometry, resulting in complex dynamics for the movement of pollutants. This study developed a fractional advection dispersion-reaction equation (fADRE) to quantify nitrate transport in soil systems. Applications showed that the fADRE model can quantify both hydrological and biogeochemical impacts on the fate and transport of nitrate in various saturated soils. The qualitative relationship between model parameters and the target system properties was also explored in detail.
Microbial Community Structure and Diversity of *Avicennia germinans* and *Spartina alterniflora* Associated Sediments in Northern Gulf of Mexico Salt Marsh Habitats

Peter Whitehurst, Flournoy, N., Crawford, P., Tatariw, C., Mortazavi, B. and Sobecky, P.

The Alabama Water Institute and Department of Biological Sciences, The University of Alabama, Tuscaloosa

Abstract

Salt marshes are coastal wetlands that support critical services (e.g., water quality protection, mitigation of shoreline erosion, sediment trapping, fisheries nursery, recreation/tourism). As these coastal wetlands undergo more frequent and intense threats in this century arising from chronic (e.g., rising sea levels, climate change, invasive species) and pulse (i.e. oil spills, flooding, superstorms) disturbances, communities are faced with daunting economic losses. Events such as the 2010 Gulf of Mexico oil spill disaster coupled with significant population changes in human land use and an expanding invasive population of *Avicennia germinans* (black mangrove) act as add-on catalysts to further accelerate deterioration and loss of barrier islands, particularly those at low-elevation such as the Chandeleur Island chain. The Chandeleur island chain’s native vegetation is primarily *Spartina alterniflora* (saltmarsh cordgrass). However, black mangrove (*Avicennia germinans*), an invasive species, is also present. Oil impacted the barrier island chain to varying degrees; therefore, it was important to investigate the microbially-driven ecosystem service, denitrification, a nitrogen (N) cycle pathway. While oil can inhibit microbially-mediated denitrification, nitrification and denitrification processes have been found to be relatively low in *A. germinans* sediment. The objective of this study was to i) characterize microbial community composition along an *S. alterniflora* vs *A. germinans* sampling gradient, ii) compare and contrast the impact of expanding black mangrove on microbial diversity over time, and iii) characterize denitrifying microbes and diversity indices along sampling gradients. Sites containing *A. germinans* exhibited a higher diversity of microbial taxa associated with *Deltaproteobacteria* (known sulfur oxidizing/hydrocarbon degraders) when assessed in Y3. Interestingly, alpha diversity was consistent for *S. alterniflora* marsh across sampled months (i.e. May, July, August 2017) and varied within Site 2 samples associated with *A. germinans*. As weathered oil continues to be detected at our study sites eight years post-spill, it will be important to continue to evaluate the impact of oil and invasive species such as *A. germinans* on vital microbial geochemical processes which act to remove nitrate so as to reduce available N in the system that contributes to eutrophication and further poor water quality.
Nanocolloid SnO$_2$ Buffered Sb$_2$Se$_3$ Thin Film Photocathodes for Highly Efficient Photoelectrochemical Water Splitting

John McDonough$^1$, Liping Guo$^2$, Yanxiao Ma$^3$, Lin Li$^2$, Shanlin Pan$^3$ and Feng Yan$^{1,4}$

1 Department of Mechanical Engineering, The University of Alabama, Tuscaloosa,  
2 Department of Metallurgical and Materials Engineering, The University of Alabama, Tuscaloosa,  
3 Department of Chemistry and Biochemistry, The University of Alabama, Tuscaloosa,  
4 Alabama Water Institute, The University of Alabama, Tuscaloosa

Abstract
Solar hydrogen generation through photoelectrochemical (PEC) water splitting is a promising technique to convert solar energy to chemical energy. Antimony selenide (Sb$_2$Se$_3$) with quasi-one-dimensional (Q1D) ribbons, e.g., (Sb$_4$Se$_6$)$_n$, has been investigated intensely. It is a challenge to achieve the well-oriented ribbons vertically to the transparent conducting oxides coated substrate due to its low-symmetry crystalline structure. In addition, it is also difficult to achieve high photocurrent for the pristine Sb$_2$Se$_3$ films due to the high resistivity of the as-deposited Sb$_2$Se$_3$ films by close space sublimation. Here, we employ a nanocolloid SnO$_2$ as a buffer layer and electron transport layer to assist the ribbons alignment and enhance the photogenerated carrier extraction in the Sb$_2$Se$_3$ films. By tuning the SnO$_2$ thickness and surface roughness, it is demonstrated that highly efficient bare Sb$_2$Se$_3$ thin films with a photocurrent density as high as $-7.5$ mAcm$^{-2}$ at $0$ V$_{RHE}$ in a buffered near-neutral solution ($pH$ 7.0) under a standard simulated AM 1.5 solar illumination. This work demonstrates that SnO$_2$ buffered Sb$_2$Se$_3$ films could be more efficient for PEC water splitting to generate solar fuel.
Fabrication of Thin Film Composite Hollow Fiber Membranes for Removal of Perfluoroalkylated Substances (Pfas) by Ultrafiltration

Maya McKane, John Miller, Caroline Fourroux and Milad Rabbani Esfahani

Department of Chemical and Biological Engineering,
The University of Alabama, Tuscaloosa

Abstract
Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are manufacturing byproducts that have been found to be detrimental to health. Of PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) have been found to be the most prevalent and the most detrimental to long-term health, with the EPA issuing a lifetime health advisory stating that drinking water should contain at most 70 ppt to remain potable. Furthermore, the EPA has determined that PFAS have been found in at least one public water system in 24 states, with states prevalent in manufacturing containing multiple contaminated public water systems. As such, it is imperative that effective and efficient methods of water filtration be developed with the specific purpose of removing PFAS from water. This project involves the fabrication of polyethersulfone (PES) hollow fiber membranes using phase inversion dry–jet wet spinning methods. In order to filter 90% of PFOS and PFOA from water using ultrafiltration techniques, the membranes have been functionalized with a polyamide selective layer. Furthermore, this project will present a novel HFM filtration cell that mimics common purchasable filtration units with the added benefit of being reusable for long term laboratory use and testing.
Predicting Disturbance-Driven Impact on Ecosystem Services in Coastal Wetlands in the Northern Gulf of Mexico

Nikaela Flournoy, Crawford, P., Kleinhuizen, A., Whitehurst, P., Mortazavi, B. and Sobecky, P.A.

1 Department of Biological Sciences, The University of Alabama, Tuscaloosa
2 The Alabama Water Institute

Abstract
Natural and human-induced disturbances pose significant threats to the health and long-term productivity of Alabama coastal wetlands. As wetlands are increasingly impacted by recurrent pulse (i.e. oil spills, flooding) and chronic (i.e. invasive species, climate change, rising sea levels) disturbances in this century, decisions on management, restoration and remediation require actionable data if socio-economic demands are to be balanced with efforts to sustain these habitats. In 2010, the BP oil spill was a large and severe disturbance that threatened coastal Gulf ecosystem services. The largest marine oil spill to date served to highlight fundamental gaps in our knowledge of oil-induced disturbances and the resiliency and restoration of coastal Alabama wetland functions. To address these gaps, a year-long mesocosm study was conducted to investigate oil-induced effects on i) plant-microbial interactions, ii) microbial and plant biodiversity, and iii) the contributions of microbial genetic biodiversity to ecosystems services. In this study, Avicennia germinans (black mangrove), a C3 plant that grows from the tropics to warm temperate latitudes, were grown with or without mono- and polyculture mixtures of Spartina alterniflora, a C4 plant. Three months after transplant, 1.9 L m-2 of Louisiana sweet crude oil was added to mesocosms representative of disturbances in the northern Gulf of Mexico. Molecular based analyses of microbial community biodiversity and abundance of denitrifier functional marker genes nirS (nitrite reductases) and nosZ (nitrous oxide reductases) were compared to controls (i.e., no oil) six and eleven months after oiling. Our results showed that microbial community composition and phylogenetic diversity differed significantly as a result of oil exposure. In addition to oil exposure, plant type had a significant role in nirS and nosZ abundance six months post oil exposure. As denitrification is an ecosystem service that directly contributes to removing nitrate (NO\textsubscript{3}) loading to coastal zones, impairment of this process is detrimental to the long-term health and productivity of the Gulf of Mexico. Our results are designed to investigate controlling factors and yield insights to aid decision makers in their ongoing management efforts to restore wetlands along the Alabama coast and related habitats.
Hydrodynamic Driven Dissolution in Carbonates with Fluid-Filled Cavities: Application to Sinkhole Formation Evaluation

Wyatt Kuehster and Mojdeh Rasoulzadeh

Department of Mathematics,
The University of Alabama, Tuscaloosa

Abstract
The objective of this research is to improve our understanding of the process of sinkhole formation and evolution and to investigate the hydrological and geological features controlling the development of sinkholes. This research is aimed to alert high-risk zones for sinkhole formation based on the coupled hydro-chemical modeling of cavity dissolution in carbonate rocks. Sinkhole formation is a highly nonlinear multiscale multiphysics process in which flow, dissolution, solute transport and mechanical deformation in a heterogeneous rock structure should be considered. Hydrodynamics enforced by the presence of cavities is a key player in defining the dissolution rate and dissolution hotspots. Cavities rearrange the pressure and flow field locally and affect the dissolution. On cavity surroundings, the fluid velocity maintains the concentration gradient and provides a fresh source of the solvent that facilitates dissolution. Given the characteristics of the cavity and the porous zone, vorticities may form, and the cavity may partially or fully participate in the overall flow. The full analytical solutions for a Darcy-Stokes system is coupled to the reactive transport system for calcite dissolution in acidified brine. A sequential non-iterative approach is applied to handle the coupling between hydrodynamics and mineral dissolution. Transport of solute provides the concentration of solute at every grid point then the dissolved minerals are updated. Effective reaction rate together with dissolution hotspots are detected.
Sustainable Novel Bamboo-Based Membranes for Water Treatment Fabricated by Regeneration of Bamboo Waste Fibers

Nicole Serwinowski, Zane Parkerson, Elizabeth McDonough, Chris Popiolek and Milad Rabbani Esfahan

Department of Chemical and Biological Engineering, The University of Alabama, Tuscaloosa

Abstract
The fibrous waste by-product of the bamboo construction industry was used as the sustainable feedstock for the fabrication of cellulose-based membranes using 1-butyl-3-methylimidazolium chloride (BmimCl) ionic liquid (IL) as a green and environmentally friendly solvent. The lignin and hemicellulose fractions of the bamboo waste fibers were removed, and the extracted cellulose was used at different concentrations (3, 5 and 10%) for the fabrication of membranes using phase inversion technique. The intrinsic properties of the fabricated membranes such as morphology, crystallinity, surface charge, roughness and chemistry were characterized using scanning electron microscopy, X-ray powder diffraction, surface Zeta potential, atomic force macroscopy and water contact angle, respectively. The transformation of cellulose I to cellulose II with different crystallinity index was observed for each membrane based on the initial concentration of cellulose digested by BmimCl. The performance of the bamboo-based membranes in the removal of different dyes (methylene blue, methylene orange, crystal violet) from water was studied regarding membrane permeance, anti-fouling and rejection. In general, the bamboo-based membranes performed similarly or better than comparable cellulose-based membranes in water flux, antifouling and rejection, which confirmed the successful conversion process of waste materials (bamboo waste fibers) to high-value-added product (membrane) through sustainable, green technology. Size exclusion was detected as the main mechanism for dye rejection, and solute-diffusion was the dominant transport mechanism through the bamboo-based membranes. The physical membrane structure (dense layer) and the dye size were the two governing factors of rejection, and the surface charge and hydrophilicity were the governing factors of antifouling ability of the membranes. The 10%-bamboo-based membranes and 3%-bamboo-membranes both showed the highest dye rejection (87%) and 600 LMH water flux respectively.
Spatial Variation in Freshwater Mussel Communities in the Tennessee and Mobile River Basins

Irene Sanchez, Garrett W. Hopper, Jamie Bucholz and Carla L. Atkinson

Department of Biological Sciences,
The University of Alabama, Tuscaloosa

Abstract
The southeastern United States is a global hotspot for freshwater biodiversity with southeastern freshwater mussel (Family: Unionidae) species representing 90% of the species in North America, but are now among the most endangered fauna, with 72% of species imperiled. Environmental factors (e.g., stream-channel stability, water and sediment quality) greatly affect mussel distributions and abundance; therefore, understanding their variation across environmental gradients is key to improve conservation and management for these organisms. We measured water velocity, depth and substrate size at 14 sites in the Tennessee and Mobile River Basins where we conducted quantitative surveys to determine mussel community composition. We summarized our data by calculating species richness, Shannon’s diversity and species abundance and used nonmetric dimensional scaling and canonical correspondence analysis to compare community assemblages across sites and environmental gradients. The Paint Rock River in the Tennessee River drainage had the greatest richness overall and had the highest richness and Shannon’s diversity index, while sites on the Sipsey River of the Mobile Basin had the highest mussel densities and biomass. Mussel communities were distinct between the two basins, but sites within the Mobile Basin had greater variation in community structure than those in the Tennessee. Our future works aims to characterize how species traits (e.g. morphology) of these communities vary across spatial and temporal gradients.
Seasonal and Event-Based Concentration Discharge Relationships from Contrasting Arctic Headwater Catchments

Arial J. Shogren*, Jay P. Zarnetske, Sam Cairns, Megan Duda¹, Benjamin W. Abbott², Frances Iannucci³ and William B. Bowden³

*Visiting scholar in the University of Alabama Biology Dept.
1 Michigan State University, Department of Earth & Environmental Sciences
2 Brigham Young University, Department of Plant & Wildlife Sciences
3 University of Vermont, Rubenstein School of the Environment

Abstract
Climate change is predicted to accelerate hydrologic cycle and amplify the release of carbon and nutrients from the permafrost landscapes of the Arctic. However, we have limited understanding of how seasonality and landscape characteristics influence hydrologic mobilization and transport of carbon and nutrients into Arctic river networks, especially during intense precipitation and stream flow events. To fill this knowledge gap, we assess river carbon and nutrient dynamics across three headwater catchments and a range of flow conditions. The three watersheds represent dominant landscape types of the northern Arctic Alaska and are part of the Arctic Long-Term Ecological Research (LTER) site: low-gradient tundra, low-gradient but lake-influenced tundra and high-gradient alpine. In each watershed, we collected high-frequency dissolved organic carbon (DOC) and nitrate (NO₃⁻) concentrations. We evaluated seasonal concentration-discharge (CQ) relationships within each watershed for DOC and NO₃⁻. We also analyzed event-based CQ relationships, estimating the CQ slope, Hysteresis Index (HI), and Flushing Index (FI) for each high-flow event. Across the low-gradient tundra watersheds, we found consistent DOC enrichment during storm events. In the higher-gradient and low productivity alpine watershed, DOC was primarily source-limited and diluted during storms. Conversely, we observed consistent patterns of NO₃⁻-dilution in the low-gradient tundra watersheds, while the alpine watershed exhibited NO₃⁻-enrichment. Critically, our analysis suggests that storms, particularly in the late thaw season, contribute disproportionately to downstream carbon and nutrient fluxes. However, the late season represents a period of time that is historically ignored in studies of Arctic biogeochemistry. Additionally, storm events are expected to increase in frequency and intensity in the Arctic as a direct result of climate change. Therefore, it will become increasingly important to quantify their relative influence on the mobilization, transport and cycling of solutes.
Reach-Scale Geomorphic Impacts of Freshwater Mussels in the Sipsey River, Ala.

Gregory Shafer

Department of Geography,
The University of Alabama, Tuscaloosa

Abstract
Mussels are burrowing, filter feeders that reside within many of Alabama’s rivers. The lifespan of some species can exceed a century. Population densities have the potential to reach 100 individuals per square meter. Few studies have examined ecosystem engineering by mussels and their potential effects on spatio-temporal changes in river morphology. We tested whether mussel population densities can predict reach-scale river bank erosion during a five-month long study conducted on the Sipsey River of Alabama (U.S.). We quantified bank erosion, mussel density, median particle size distribution, woody debris and determined bank erosion hazard index (BEHI) scores at 44 transects across two 80-meter and one 60-meter reaches. Mussel density and particle size counts were conducted within a 1-meter square plot every 2.5 meters across each transect. Erosions pins were used to quantify bank erosion. We created a stepwise linear regression model to determine the effect of mussel population density on bank erosion. Independent variables included mussel density, median particle size distribution, woody debris, distance to thalweg and each individual BEHI category. Bank material, root density, and mussel density generated the best model (R² = 0.68). Despite the BEHI being widely used to predict river bank erosion, the model chose mussel density over the majority of the other BEHI variables. The results of this study provide a critical step toward understanding reciprocal relationships between abiotic and biotic systems and new insights into the evolution of channel morphology not previously considered.
A Multi-Hazard Indicator for Atlantic Hurricanes Considering Wind-Speed and Rainfall

Jae Yeol Song, Atieh Alipour, Hamed Moftakhari and Hamid Moradkhani

Center for Complex Hydrosystems Research,
Department of Civil, Construction and Environmental Engineering,
The University of Alabama, Tuscaloosa

Abstract
Landfalling Atlantic hurricanes are multihazard events which cause casualties, economic losses and environmental damages in the coastal regions with different types of hazards (e.g. strong winds, floods and storm surges). The Saffir-Simpson Hurricane Scale (SSHS), the current rating system based on the hurricane's sustained wind speed, does not account for the overall hazardousness information in different aspects. In this study, we propose an alternative approach that characterizes hurricane risk taking different components of hazards into account. We use wind speed and rainfall associated with the landfalling Atlantic hurricane events between 1979-2017 to derive the marginal and joint probability, and then combine them with the vulnerability information of hurricane-impacted regions. The results of our approach reflects the hazardousness of Atlantic hurricanes significantly better as compared with the conventional univariate classifying systems (i.e. SSHS) and shows higher correlation with the actual damage estimated by NOAA. Our proposed approach provides useful information for emergency managers and decision makers in case of hurricane hazard.
Differences in Carbon Storage Between Constructed and Natural Brackish Marshes

Erin Smyth¹, Julia Cherry, Kevin Kuehn, Abigail Griffin Wood, Taylor Ledford, Behzad Mortazavi, Lorae’T. Simpson and Corianne Tatariw

¹ Presenting Author
Department of Biological Sciences,
The University of Alabama, Tuscaloosa

Abstract
Coastal vegetated areas provide a myriad of ecosystem services, yet are increasingly threatened by anthropogenic activities and environmental changes, including land use change. Their loss or degradation corresponds to a disproportionately large loss of ecosystem services, but wetland restoration and construction are promising tools for recovering lost ecosystem functions and services. One of the most notable ecosystem services that coastal ecosystems provide is carbon (C) sequestration, which helps to mitigate the effects of climate change. The capacity of constructed marshes to sequester C may differ from that of natural marshes, with significant temporal lags in the recovery of ecosystem services possible for many restored or constructed wetlands. In this study, C stocks in a natural reference marsh and two constructed salt marshes were quantified in above- and below ground plant biomass and the soil/sediment pool. In addition, factors that may regulate C production and storage, including organic matter decomposition and sediment characteristics, were measured. Through this analysis, the following questions were addressed: 1) Do constructed marshes and naturally occurring brackish marshes differ in their carbon content? 2) What are the factors driving differences in storage between the natural and constructed marshes; and 3) How much C was lost in the construction of the marshes, and how long will the marshes take to recover that C? Trends in C storage between the two marshes revealed differences in C storage both between the natural and constructed marshes, and between the two constructed marshes. Data from this project will provide useful information on the success of tidal wetland creation projects along the northern Gulf of Mexico, a region that is increasingly threatened by urbanization and land use change.
Atlantic Ocean Sea Surface Temperatures and Southeast United States Streamflow Variability

Sahar Tabatabaei Sadeghi1, G. Tootle1, E. Elliott2, V. Lakshmi3, M. Therrell2, J. Kam1 and B. Bearden4

1 The University of Alabama, Department of Civil, Construction, and Environmental Engineering
2 The University of Alabama, Department of Geography
3 University of Virginia, Department of Engineering Systems and Environment
4 Geological Survey of Alabama

Abstract

The growing demand for water has raised concerns regarding future resource scarcity. For water management, agriculture and fisheries needs, recent conflict over water in the southeastern United States (SEUS) has led to litigation concerning consumptive use in greater Atlanta, agricultural demands in southern Georgia and Florida’s shellfish instream flow needs in Apalachicola Bay. Previous studies have identified regional effects of teleconnections to stream flow and precipitation using non-parametric testing. The current research presented applied the singular value decomposition (SVD) statistical method to explore the influence of Atlantic Ocean (AO) sea surface temperatures (SSTs) on SEUS streamflow. AO SSTs for three different six-month seasons (January to June or JFMAMJ, April to September or AMJIAS, July to December or JASOND) for the current year (1951-2015) were evaluated with 26 unimpaired SEUS (Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina and Tennessee) stream flow gages for the following year (1952-2016). Thus, the lead-time varied from six to zero months. The study identified an Atlantic Multidecadal Oscillation (AMO) “like” northern AO SST region that was teleconnected with SEUS stream flow. The results showed multidecadal increase in AO SSTs was associated with a multidecadal decrease in SEUS stream flow beginning around 1980. An index similar to the AMO index was developed for this northern AO SST region, and that index was highly correlated with SEUS stream flow. This strong linear relationship was also evident in the development of regression based models.
Trophic Niche Differentiation Within Freshwater Mussel Communities

Brian C. van Ee and Carla L. Atkinson

Department of Biological Sciences,
The University of Alabama, Tuscaloosa

Abstract
Freshwater mussels are a highly imperiled group of animals that typically occur in dense speciose communities in rivers. While all mussels are filter feeders and anticipated to occupy the same trophic guild, it is unclear to what degree species are differentiated in diet. We investigated whether freshwater mussel species have differentiated into distinct trophic niches and if patterns were consistent among communities, and the biotic factors may be driving differences along a river gradient. We collected the most common mussel species from 4 sites along the Sipsey River, AL, as well as seston, benthic organic matter, chlorophyll, and water samples. We analyzed mussel tissue for stable isotopic composition (δ13C and δ15N) and described the isotopic niche. Mussel gill tissue was used to determine cilia density via scanning electron microscopy, to understand differences in the ability to capture particles of different size. Based on our stable isotope results, our results suggest that freshwater mussels partition into distinct trophic niches, but species trophic width was variable across sites. We also noted separation in gill structure between species with the differences being consistent across sites, as well as shifts in cilia density within species between sites. Cilia density was not correlated with isotopic signature or river characteristics, so it is unclear what is driving differences in gill structure. Our findings suggest that freshwater mussel partition into niches to limit competition locally, but diet and gill structure is flexible based on available resources. As mussel species are anticipated to continue to decline and communities simplify, unique species traits could be lost which would impact river ecosystem function and downstream material and nutrient transport.
Spectracide, an Environmental Pollutant, Causes Parkinsonian Symptoms in Fly Model: Is Dopamine Pathway a Target for Spectracide?

Samuel Vielee, Kim Lackey, Laura Reed and Anathbandhu Chaudhuri

Department of Biological Sciences,
The University of Alabama, Tuscaloosa

Abstract
Extensive use of pesticides and herbicides worldwide leads to environmental pollution (water, land and air) which causes severe health issues in humans and non-target organisms. Parkinson's disease is often associated with the destruction of dopamine neurons and is one of the main targets for several pesticides. In relation to the development of movement disorders, the herbicide called Spectracide has been observed as a chemical of major interest due its negative health effect and has been banned in European countries. However, the United States and some other countries still allow the use of these environmental toxic herbicides. Spectracide has four known major ingredients, and most of them have been found to have a significant soil half-life, which leads to increase groundwater contamination. The present study focuses on the toxic effects of Spectracide on movement disorders using fruit fly (Drosophila melanogaster), a unique model to study human diseases. We treated flies with Spectracide during the juvenile stage (36-48 hours old larva) at the doses of 0.05%, 0.1%, 0.25%, 0.5%, 1.0%, and 5.0% to test the toxicity. Spectracide was mixed with normal fly food for the treatment while normal food without Spectracide was used as a control. We found that pupation rate declines in a dose dependent manner upon exposure to Spectracide with a significant (p<0.05) decline in larval negative geotaxis. The flies that survived and emerged as functional adults showed significant (p<0.05) movement defects with clear symptoms of hyperactivity in herbicide treated groups. Thus, Spectracide exposure caused significant movement disorders in flies, including slow movement with frequent falls during climbing is a strong indication of Parkinsonian symptoms in fly model. We hypothesized that the dopamine pathway could be a possible target for the major components of Spectracide to cause movement disorder and the experiment is still in progress. In conclusion, Spectracide should be considered as an environmental pollutant due to its toxic effect with a controlled used of such pollutants.
The Alabama Water Institute’s Marine Application Prototype (MAP): Mobile Application Development for Marine Users in the Gulf Coast

Adam Branan, Jessica Sifuentes, Katy Sobodos, Ryan Waelde and Courtney Wentz

Department of Information Systems, Statistics and Management Science, The Alabama Water Institute, The University of Alabama, Tuscaloosa

Abstract
The Alabama Water Institute and The University of Alabama MIS Capstone Program collaborated this semester to create a prototype application that serves marine users in the Gulf Coast area. The prototype created is titled Marine Application Prototype (MAP) and aims to collect relevant marine data and information into one source. MAP collects various marine data sources from sites such as NOAA and other government agencies into a mobile application, with four main focuses: map view, weather, regulation and safety. Each of these focuses have their own tab in the application containing various pieces of data relevant to marine users. The “Map View” tab presents five key metric map views: wind speed, chlorophyll a content, wave height, sea surface temperature and reef location. It also includes a buoy overlay that presents associated buoy data across the Gulf. This data is presented in real time, refreshed every 5 minutes to ensure accuracy. The “Weather” tab contains information pulled directly from NOAA and is also updated every 5 minutes. The weather information is formatted in the Marine Point Forecast, a format that marine users utilize and are familiar with. The “Regulation” tab highlights relevant boating and fishing regulations relating to the Gulf Coast. It pulls information directly from Outdoor Alabama, a main source for regulation information and is split into three sections: saltwater, freshwater, and snapper check. It additionally includes links to source data for most up-to-date information. Lastly is the “Safety” tab, which includes boating safety information relating to both commercial and personal boaters. This section pulls its information from the Alabama Law Enforcement Agency and also includes links to the source data for up-to-date information. Each item also includes graphics for ease of access and understanding. This prototype was created in need for marine users to access relevant data in an efficient and user-friendly manner. Much of the data that is collected within MAP is scattered across the web on various government agency websites. These websites are not mobile friendly and require users to jump through a variety of hoops to access the data they need. Often times, these websites are filled with jargon that the average user would not understand. MAP solves this problem by collecting these various data sources and views into a mobile application. While there are other mobile applications on the market with similar uses, the specific data that is collected, such as chlorophyll a content and the data with which it is paired is not available. This app is a huge step forward in regard to data accessibility.
Water Turbidity Measurements for Rivers in Tombigbee River Basin and the Mobile Bay from Satellite Multispectral Imagery

Min Xu\textsuperscript{1*}, Hongxing Liu\textsuperscript{1}, David Mitchell\textsuperscript{2}, Yuehan Lu\textsuperscript{3}

\textsuperscript{1} Department of Geography, The University of Alabama, Tuscaloosa, \\
\textsuperscript{2} Department of Field Science, The National Ecological Observatory Network, Tuscaloosa, \\
\textsuperscript{3} Department of Geological Sciences, The University of Alabama, Tuscaloosa

Abstract

Timely monitoring water turbidity of rivers is critical for making informed water resources management decisions. Satellite-based remote sensing is a cost-effective way to gather information needed for water quality assessment, especially at a basin or regional scale. In previous studies, empirical models have been widely used to derive water quality parameters from remotely sensed images. A single empirical model was normally used to map turbidity for the entire water body under study, whereas its performance is often limited due to the complex optical properties of inland waters. Moreover, traditional empirical models are often one-time applications that cannot be extended to other water bodies for regional water quality mapping. To overcome the limitations, this study adopts a multi-predictor ensemble model, which synergistically exploits a set of empirical models to obtain optimal estimation of turbidity in different water conditions. In this study, we processed four spatially consecutive Landsat 8 multispectral images acquired on May 2, 2019, which were combined to cover the rivers of the Tombigbee River Basin, the Mobile River and the Mobile Bay. During the Landsat 8 overpass, \textit{in situ} water-truth data at 20 sites were collected with a YSI multi-parameter water quality sonde. The sampling sites are distributed in the Tombigbee River, the Black Warrior River and their confluence area including Lake Demopolis. After atmospheric correction, a set of empirical turbidity models are calibrated by associating single spectral bands, band ratios or band differences of Landsat 8 images with the \textit{in situ} turbidity measurements. Based on the training data set, we identified that the ratio of band 4 and band 2 (B4/B2) explained the most proportion of the variation in turbidity with $R^2$ of 0.70. Four heterogeneous empirical models are selected as the candidate component models in the ensemble model base. To establish the ensemble model, we first optimized the component empirical models with an iterative approach, and then combined their predictions through a selection strategy based on the spectral space partition. Evaluated by the independent testing set, the ensemble model (RMSE=2.05NTU) has remarkably improved the turbidity prediction accuracy by 33% compared with the best traditional empirical model (RMSE=3.08NTU). Then, the ensemble model was applied to rivers in the entire Tombigbee River Basin, Mobile River and Mobile Bay. Our analysis shows that Tombigbee River has significantly higher turbidity levels than the Black Warrior River near Demopolis where they converge. Within the Tombigbee River Basin, the lower Tombigbee is more turbid than the upper Tombigbee. We also observed that Mobile River and Mobile Bay have very high turbidity levels. This study demonstrates that our multi-predictor ensemble model possesses an improved prediction ability and stronger spatial extensibility than traditional empirical models and hence is critical for basin and regional scale river water quality monitoring and assessment.
Spatiotemporal Evolution of Organic and Inorganic Nutrient Exports in Agricultural Watersheds in Northern Alabama Over Three Years

Shuo Chen, YueHan Lu

Department of Geological Sciences, The University of Alabama, Tuscaloosa

Abstract

Surface water nutrient enrichment has been recognized as a leading cause of deterioration of water quality and ecosystem health around the nation, including in Alabama. Relating nutrient loading to non-point sources in watersheds and ecological responses within aquatic environments is one of the priority water challenges to address in Alabama. Over the past three years, we have performed bimonthly assessments of organic and inorganic nutrients exported from watersheds across a broad gradient of agricultural lands in northern Alabama. In addition to regular inorganic nutrient analysis, we characterized the amount, source and composition of dissolved organic nutrient (C and N), a component that has been largely ignored in previous water quality studies. Nutrient exports from the study watersheds displayed clear spatial and temporal patterns. Spatially, the amounts of organic carbon and inorganic nitrogen exported from agricultural watersheds were up to eight times higher than those from pristine, less impacted watersheds. Organic nutrients in agricultural streams were sourced mainly from microbial sources and showed high reactivity to microbial degradation. In contrast, those from forested streams originated mostly from decayed plants and were less likely to stimulate aquatic microbial activity. Temporally, we found a rapid rise in microbially sourced organic nutrients from 2014 to 2018, demonstrating an increasing influence of agricultural lands on the source and quality of organic nutrients in streams. Precipitation events following a hot, dry summer represented a ‘hot moment’ of nutrient exports when nutrient flux was 35 times higher than the annual average. Collectively, our findings demonstrate that agricultural activities alter the energy and nutrient availability within drainage networks that can lead to far-reaching impacts on water quality and aquatic ecosystem dynamics.
Future Outlooks of Drought in the Southeastern U.S.

Johanna Engström

Center for Complex Hydrosystems Research,
The University of Alabama, Tuscaloosa

Abstract

The southeastern United States has been struck by droughts repeatedly in the last decades. The droughts of 1986-1988, 1998-2002, 2006-2009, and 2016-2017 have caused substantial environmental and economic losses and generated multiple lawsuits, including the “Tri-State Water Dispute” between Alabama, Florida, and Georgia. This study is an assessment of future outlooks for extended dry spells in the Southeast. The study is divided into two parts, starting with an evaluation of the performance of 32 CMIP5 models’ capability of predicting historical dry spells (1950-2005) in the southeastern U.S. The data is divided into warm and cool seasons, based on timing of planting and harvesting dates of key agricultural crops. The models generally simulate the distribution of dry periods well, but there are large differences between the ability of the best and worst performing models, particularly when it comes to the upper tail of the distribution. Only the top models provide a good estimate of extreme dry spell lengths with simulations of 20-year return values within ±5 days of observed values across the region. In the second step of the analysis, the five best performing models for each season are used to make projections for the length of future (2020-2059 and 2060-2099) 20-year return period dry spells in the region, considering the RCP 4.5 and RCP 8.5 concentration pathways. Analysis based on the best models shows that future warm period droughts are likely to become shorter while the length of cold period droughts exhibit a north (drier) to south (wetter) gradient.
Scalable Core-Shell MoS$_2$/Sb$_2$Se$_3$ Nanorod Array Photocathodes for Enhanced Photoelectrochemical Water Splitting

Liping Guo

Department of Metallurgical and Materials Engineering, The University of Alabama, Tuscaloosa

Abstract

Photoelectrochemical (PEC) hydrogen generation is a promising solar energy harvesting technique to address the concerns about the ongoing energy crisis. Antimony selenide (Sb$_2$Se$_3$) with van der Waals-bonded quasi-1D (Q1D) nanoribbons, for instance, (Sb$_4$Se$_6$)$_n$, has attracted considerable interest as a light absorber with earth-abundant elements, suitable bandgap and a desired sunlight absorption coefficient. By tuning its anisotropic growth behavior, it is possible to achieve Sb$_2$Se$_3$ films with nanostructured morphologies that can improve the light absorption and photo-generated charge separation, eventually boosting the PEC water-splitting performance. Herein, high-quality Sb$_2$Se$_3$ films with nanorod (NR) array surface morphologies are synthesized by a low-cost, high-yield and scalable close-spaced sublimation technique. By sputtering a nonprecious and scalable crystalline molybdenum sulfide (MoS$_2$) film as a cocatalyst and a protective layer on Sb$_2$Se$_3$ NR arrays, the fabricated core-shell structured MoS$_2$/Sb$_2$Se$_3$ NR PEC devices can achieve a photocurrent density as high as ~10 mA cm$^{-2}$ at 0 VRHE in a buffered near-neutral solution (PH 6.5) under a standard simulated air mass 1.5 solar illumination. The scalable manufacturing pf nanostructured MoS$_2$/Sb$_2$Se$_3$ NR array thin-film photocathode electrodes for efficient PEC water splitting to generate solar fuel is demonstrated.
Hexavalent Chromium Removal from Treated Water via Electrospun Composite Nanofibers

Jesse Horne¹, Yang Lu¹, Joshua Perch¹, Zhanhu Guo² and Dr. Evan K. Wujcik¹

¹ Materials Engineering and Nanosensor [MEAN] Laboratory, Department of Chemical and Biological Engineering, The University of Alabama, Tuscaloosa
² Integrated Composites Laboratory (ICL), Department of Chemical and Biomolecular Engineering, University of Tennessee, Knoxville, TN

Abstract

Hexavalent chromium is a toxic and carcinogenic compound that is the result of industrial processes and poses a health threat for humans and aquatic populations. Trivalent chromium, however, is not as soluble as hexavalent chromium and does not present a threat to human health. To remove and reduce the hexavalent chromium, a nanoadsorbent was successfully developed. Uniform electrospun polyacrylonitrile/iron (III) nitrate nanofibers with small diameters were successfully prepared by systematically optimizing the electrospinning parameters, including polymer concentration, salt loading, applied voltage, tip to collector distance and flow rate. These parameters are shown to affect the fiber morphology, and the addition of iron (III) nitrate salt was found to be able to reduce the fiber size and required electrospinning voltage. The improved thermal properties of the composite fibers were investigated and shown by thermal gravimetric analysis (TGA) and differential scanning calorimetry (DSC). The composite nanofibers were further carbonized to carbon nanofibers to show their potential for hexavalent chromium removal from water. The removal percentage has been found to show a pH dependence that is related to the iron loading. The removal of hexavalent chromium was sustained for 30 days. This material has shown promising results towards an effective water purification method.
The Alabama Water Institute's Marine Application Prototype (MAP): Mobile Application Development for Marine Users in the Gulf Coast

Adam Branan, Jessica Sifuentes, Katy Sobodos, Ryan Waelde and Courtney Wentz

Department of Information Systems, Statistics and Management Science,
The Alabama Water Institute,
The University of Alabama, Tuscaloosa

Abstract

The Alabama Water Institute and The University of Alabama MIS Capstone Program collaborated this semester to create a prototype application that serves marine users in the Gulf Coast area. The prototype created is titled Marine Application Prototype (MAP) and aims to collect relevant marine data and information into one source. MAP collects various marine data sources from sites such as NOAA and other government agencies into a mobile application, with four main focuses: map view, weather, regulation and safety. Each of these focuses have their own tab in the application containing various pieces of data relevant to marine users. The “Map View” tab presents five key metric map views: wind speed, chlorophyll a content, wave height, sea surface temperature and reef location. It also includes a buoy overlay that presents associated buoy data across the Gulf. This data is presented in real time, refreshed every 5 minutes to ensure accuracy. The “Weather” tab contains information pulled directly from NOAA and is also updated every 5 minutes. The weather information is formatted in the Marine Point Forecast, a format that marine users utilize and are familiar with. The “Regulation” tab highlights relevant boating and fishing regulations relating to the Gulf Coast. It pulls information directly from Outdoor Alabama, a main source for regulation information and is split into three sections: saltwater, freshwater, and snapper check. It additionally includes links to source data for most up-to-date information. Lastly is the “Safety” tab, which includes boating safety information relating to both commercial and personal boaters. This section pulls its information from the Alabama Law Enforcement Agency and also includes links to the source data for up-to-date information. Each item also includes graphics for ease of access and understanding. This prototype was created in need for marine users to access relevant data in an efficient and user-friendly manner. Much of the data that is collected within MAP is scattered across the web on various government agency websites. These websites are not mobile friendly and require users to jump through a variety of hoops to access the data they need. Often times, these websites are filled with jargon that the average user would not understand. MAP solves this problem by collecting these various data sources and views into a mobile application. While there are other mobile applications on the market with similar uses, the specific data that is collected, such as chlorophyll a content and the data with which it is paired is not available. This app is a huge step forward in regard to data accessibility.
Thank You to Our Sponsors:

THE UNIVERSITY OF ALABAMA® | Alabama Water Institute

THE UNIVERSITY OF ALABAMA® | Office for Research & Economic Development

THE UNIVERSITY OF ALABAMA® | Office for Academic Affairs