Abstract #: 001

Title: ***2022 Updates to Alabama's Blue Book***

Authors: Perry Oakes, Earl Norton

Organization: AL Soil and Water Conservation Committee

The Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management (The Blue Book) has recently been revised to incorporate research results from the Auburn University Stormwater Research Facility. While not a regulatory document, the Handbook is referenced as the acceptable technical document in the ADEM NPDES stormwater regulations. Significant changes to the Handbook include: the suggested use of a sand drainage diaphragm instead of an anti-seep collar; silt fence storage requirements; silt fence overtopping and dewatering devices; off-set silt fence installation method; stress design for grass lined conveyance, and the use of wildlife friendly netting. These changes, along with other information, will be discussed. Information on how to access and obtain the handbook will be provided.

Abstract #: 002

Title: ***ARSNiC: A New Approach for Prioritizing Aquatic Organism Passage and Infrastructure in Alabama***

Authors: Daniel West

Organization: Geological Survey of Alabama

The Southeastern U.S., specifically Alabama, is an aquatic biodiversity hotspot. However, many species are at risk from habitat fragmentation. Assessments confirming the ecological importance of providing aquatic organism passage (AOP) through road-stream crossings for all aquatic species during all stages of life are needed to ensure robust communities and healthy populations. Longitudinal connectivity of stream reaches and channels is necessary for species to access spawning grounds to allow opportunities for successful reproduction and adequate gene flow among populations. A common cause for stream reaches to become isolated is perched crossing structures (culverts), which can restrict the movements of aquatic organisms during critical time periods. Perched culverts result from erosion on the downstream side of the crossing related to hydrologic changes in the stream altered by the crossing structure. Increased erosion degrades habitat downstream through, scouring, bank destabilization, and burying of primary habitat under excessive sediment, which can suffocate bottom dwelling species. Other threats related to increased erosion of crossing structures are issues with transportation infrastructure. From structure failure to collapsing roadways, these events can leave communities completely isolated, disrupting daily lives, blocking main throughways for shipping and emergency services, and lead to increased costs for repair and/or replacement. In an effort to confront these issues, the Alabama Rivers and Streams Network including Connectivity (ARSNiC) team was created to identify, assess, evaluate, and prioritize longitudinal connectivity projects on a statewide scale. ARSNiC is a multi-agency partnership which performs assessments using multiple compounding methodologies from evaluating sediment risk input for roadways, to the structural influence on fluvial geomorphic responses, to the ecological and social benefits. Applying a step-up approach, the ARSNiC team is assisting in streamlining restoration efforts through identifying and prioritizing crossing structure replacements, along with improving transportation corridors. Utilizing this new approach focusing on longitudinal connectivity, ARSNiC provides potential opportunities for improving watershed connectivity and habitat availability for aquatic organisms, strengthening transportation infrastructure, as well as adding to the social feasibility in a statewide diverse partnership.

Abstract #: 003

Title: ***Rural Resources - Mapping Alabama Grassroots Groups***

Authors: Ryan Thomson, Farzana Zinnat

Organization: Auburn University Dept of Agricultural Economics and Rural Sociology

Building upon the Alabama Grassroots Clearinghouse (https://agriculture.auburn.edu/research/aers/alabama-grassroots-clearinghouse/) the following study examines Alabama groups seeking to protect, conserve, and improve their local environment and natural-resources through citizen engagement. A geospatial and network approach is used to examine patterns in focus, objectives, and service strategies across Non-Governmental Organizations (NGO's) ranging from the 'hook and bullet crowd' of conservation, to ornithology bird tours across the Black Belt region, to watershed protection organizations seeking to limit the point source pollutions impact on local water quality.

Abstract #: 004

Title: ***Using molecular tools to discover organisms responsible for taste and odor episodes in a drinking water reservoir***

Authors: Brendan Higgins, Morgan Thomas, Dillon Sprague

Organization: Auburn University

Taste and odor (T&O) episodes are a major problem facing drinking water reservoirs across the country, including in Alabama. These episodes are caused by microorganisms, primarily bacteria belonging to cyanobacteria and actinomycetota, that live in aquatic and sediment environments. The cost of treating such episodes can be very expensive and so water managers are interested in preventive measures. However, many water utilities don't know which organisms are causing episodes in their reservoirs nor where they live. This is the case of Opelika Utilities which operates Lake Saugahatchee, the primary water source for the City of Opelika, AL. The objective of this research was to employ molecular tools (PCR and sequencing) to better understand the causative agents of their T&O episodes. Such methods can be applied to other sites if proven effective in Lake Saugahatchee. The 2021 season brought a strong geosmin episode (> 60 ppt) and a mild 2-methylisoborneol (2-MIB) episode (24 ppt) in Lake Saugahatchee. We used a set of primers that our lab recently developed for detecting the cyanobacteria geosmin synthase gene and found a strong correlation ($r = 0.81$) between this gene's abundance and geosmin levels in the lake over the entire 2021 season. Sequencing with this primer set revealed that the most likely organism is a species of Dolichospermum. The organism was found distributed near the water surface over much of the lake area. This taxa was present throughout the entire season and is likely endemic to the lake; the cause of its rapid increase in abundance during the episode is under investigation. The smaller 2-MIB episode was concentrated in a particular region of the lake and was highest in detrital matter near the shoreline. This led us to suspect that this episode was caused by actinomycetota rather than cyanobacteria. Molecular tools for detecting the 2-MIB synthase gene are poor due to very low conservation of genetic material across taxa. Using the limited primer tools in the literature, we found no correlation between 2-MIB levels and synthase gene abundance in either cyanobacteria or streptomyces (the most well-documented actinomycetota that makes 2-MIB). We therefore pursued generic 16S rRNA targeted amplicon sequencing and created correlations between taxa relative abundance and 2-MIB levels. This narrowed the field to 18 taxa that had strong correlation ($r > 0.5$) and relative abundance greater than 0.1% of the total bacteria. Among the most promising of these was the actinomycetota, Conexibacter with $r = 0.78$ and a relative abundance of 1.25% of total bacteria. It had particular high abundance in the shoreline detritus. This taxa was only recently discovered and nothing is known about its ability to produce 2-MIB. We are currently undertaking metagenomic sequencing to better understand potential 2-MIB producers.

Abstract #: 005

Title: ***Alabama's Area Wide Optimization Program***

Authors: William McClimans

Organization: Alabama Department of Environmental Management

This presentation will focus on the impact in Alabama that the US EPA's Area Wide Optimization Program (AWOP) has created. It will show the optimization efforts of the State before AWOP was founded in 1997, a history of AWOP in Alabama since 1997 and highlight a few success stories showing how AWOP has improved water quality over the years. Additionally, the presentation will highlight some of the regulatory changes over the years that further enabled AWOP to be successful.

Abstract #: 006

Title: ***ADEM Drinking Water Update***

Authors: Ross Caton

Organization: Alabama Department of Environmental Management

This presentation will focus on the current priorities and regulation changes of Alabama Department of Environmental Management's Drinking Water Branch. Topics discussed will be PFAS monitored at drinking water sources and the regulatory impacts on the results observed throughout the state. The lead and copper rule revisions and their potential impacts on water resources. Source water protection requirements and how interagency collaboration can provide sustainable sources of drinking water. Lastly, there will be a discussion on resources that are available to the public and could be beneficial for the audience.

Abstract #: 007

Title: ***Projected Mid-Century Rainfall Erosivity Under Climate Change Over the Southeastern United States***

Authors: Bijoychandra Takhellambam, Puneet Srivastava, Jasmeet Lamba, Ryan McGehee, Hemendra Kumar

Organization: Auburn University

Recent observations and projections of climate change are expected to amplify erosion rates around the globe due to changes in rainfall characteristics (e.g., energy, intensity, duration, and frequency), which determine the erosive power of rainfall. However, the degree and extent of these future changes are still largely unknown, especially at finer resolution and local scales. Previous studies have relied on aggregated rainfall data or erosivity density-based extrapolations for erosivity estimations due to a lack of available projected future sub-hourly climate data. This study calculated erosivity for the southeastern US using the standard erosivity calculation approach with a recently published 15-minute precipitation dataset. This precipitation data was derived from five NA-CORDEX climate models' precipitation products under the Representative Concentration Pathway (RCP) 8.5 scenario. In this dataset, hourly climate projections of precipitation were bias corrected and temporally downscaled to 15-minute resolution for 187 locations with collocated 15-minute precipitation observations. Precipitation, erosivity or erosion index (EI), and erosivity density (ED) estimations were provided for historical (1970-1999) and future (2030-2059) time periods. Grid-derived values were also compared to corresponding values from the original 187 station observations as well. Ensemble results for projected values (as compared to historical values) indicated changes of 14%, 47%, and 29% for precipitation, erosivity, and erosivity density, respectively. These results indicate that changes in precipitation characteristics may be driving more of the change in erosivity than precipitation amount. However, this particular outcome was obscured by bias correction and downscaling limitations inherent in the original precipitation dataset and this st's analyses. In general, coastal and mountainous regions are projected to experience the greatest absolute increase in erosivity while other inland areas may see the greatest relative change. This work provides a novel analysis of projected future precipitation characteristics as they pertain to erosivity and potential future erosion.

Abstract #: 008

Title: ***Stream Connectivity: Geomorphic and Anthropogenic Influence on Longitudinal Fragmentation in Alabama***

Authors: Daniel West

Organization: Geological Survey of Alabama

The Southeastern U.S. is an aquatic biodiversity hotspot. However, many species are at risk from habitat fragmentation. Assessments confirming the ecological importance of providing aquatic organism passage (AOP) through road-stream crossings for all aquatic species during all stages of life are needed to ensure robust communities and healthy populations. Connectivity of stream reaches and channels is necessary for species to access spawning grounds and allow for successful reproduction and adequate gene flow among populations. A common cause for stream reaches to become isolated is perched crossing structures (culverts), which restrict the movement of aquatic organisms during critical time periods. Perched culverts result from erosion on the downstream side of the crossing related to hydrologic changes in the stream altered by the crossing structure. Increased erosion degrades habitat downstream through bank destabilization and burying of primary habitat under excessive sediment, which can suffocate bottom dwelling species. To determine if aquatic organism passages are influenced by structure features or landscape-level factors, a sediment risk index dataset was analyzed to define sites with and without AOP barriers. Sites determined to feature aquatic organism passage barriers were then cross-referenced with ArcGIS physical geography layers to create generalized linear models for evaluating which variables influence AOP barrier presence. Analytical results suggest statistically significant trends for correlating factors in both landscape-level and crossing structure features for aquatic organism passage barriers. The results will assist in identifying crossing structure features or areas that are more likely to feature an AOP barrier and could streamline restoration efforts by prioritizing crossing structure replacements, or influencing crossing structure design for new installations, thereby improving watershed connectivity and habitat availability for aquatic organisms.

Abstract #: 009

Title: ***Functionalized-MXene Thin-Film Nanocomposite Hollow Fiber Membranes for Enhanced PFAS Removal from Water***

Authors: Milad Esfahani, Tin Le

Organization: The University of Alabama

Due to adverse health effects and the broad sources of per- and polyfluoroakyl substances (PFAS), PFAS removal is a critical research area in water purification. We demonstrate the functionalization of thin-film composite (TFC) hollow fiber nanofiltration (HFN) membranes by MXene nanosheets during the interfacial polymerization (IP) process for enhanced removal of Perfluorooctane sulfonic acid (PFOS) from water. A MXene-polyamide (PA) selective layer was fabricated on top of polysulfone (PSF) hollow fiber support via IP of trimesoyl chloride (TMC) and a mixture of piperazine (PIP) and MXene nanosheets to form MXene-PA Thin-film nanocomposites (TFN) membranes. Incorporating MXene nanosheets during the IP process tuned the morphology and negative surface charge of the selective layer resulting in enhanced PFOS rejection from 72% (bare TFC) to more than 96% (0.025 wt% MXene TFN) while the water permeability was also increased from 13.19 (bare TFC) to 29.26 LMH/bar (0.025 wt% MXene TFN). Our results demonstrate that both electrostatic interaction and size exclusion are the two main factors governing the PFOS rejection, and both are determined by PA selective layer structural and chemical properties. The lamella structure and interlayer of MXene nanosheets inside the PA layer provided different transport mechanisms for water, ions, and PFAS molecules resulting in enhanced water permeability and PFAS rejection due to traveling through the membrane by both diffusions through the PA layer and the MXenes intralayer channels. MXene nanosheets showed very promising capability as a 2-D additive for tuning the structural and chemical properties of PA layer at the permeability-rejection tradeoff.

Abstract #: 010

Title: ***Flue Gas Desulfurization (FGD) Gypsum can Effectively Remove Phosphorous (P) from Water***

Authors: Ansley Hamid, Dengjun Wang

Organization: Auburn University

Phosphorous (P) over-loading into aquatic systems has always been a central topic due to its strong linkage to harmful algal blooms (HABs) and eutrophication, which degrades water quality, increases fish death, and causes significant economic losses (e.g., $2.2 billion USD in the United States annually; McGowan 2016). This has fueled immediate remediation attempts to reduce P loading from point and nonpoint sources (e.g., P fertilizer use). Demand for a sufficient remediation technique is further exacerbated by the increased use of fertilizers (P, N, and K) by 5.2% between 2019 and 2021 (Market Intelligence Service 2021). However, most P and HAB remediation techniques (e.g., algaecide copper sulfate treatment and aeration) have proven to be expensive and difficult for larger water bodies. Flue Gas Desulfurization (FGD) gypsum (a waste byproduct at energy plants) has been proposed as a cost-effective strategy to remove P through physical and chemical sorption. However, very limited research is available on the practical use of FGD gypsum to sorb P from water. In this project, batch sorption kinetics and equilibrium experiments of P by FGD gypsum were performed to investigate the mechanisms behind P sorption by gypsum under environmentally relevant P concentrations (0.01 mM â€“ 1.0 mM). Column experiments packed with gypsum were also performed to understand the usability and scalability of gypsum for P removal in practical applications. It was found that gypsum could sorb P quickly and the equilibrium was reached at approximately 24 hours. P sorption kinetics by FGD gypsum can be well-simulated by the pseudo second-order kinetics. Increasing P concentration was found to increase sorption by gypsum at equilibrium, which can be modeled by the Freundlich multilayer adsorption isotherm. Finally, column transport experimental results showed that increasing the P concentration and flow rate caused an earlier breakthrough of P through the gypsum-packed column. The gathered data can be extrapolated to understand the usability of gypsum in water bodies as a means of adsorbing P. Our findings suggest that FGD gypsum could be a cost-effective and efficient way to remove P and potentially mitigate HABs in aquaculture ponds.

Abstract #: 011

Title: ***Rainfall Intensity-duration-frequency curves over Southeastern, US under climate scenarios using Artificial Neural Networks***

Authors: Bijoychandra Takhellambam, Puneet Srivastava, Jasmeet Lamba, Wenpeng Zhao, Hemendra Kumar

Organization: Auburn University

Human activities have created an excess emission of greenhouse gasses (Carbon dioxide, methane, etc.) in the atmosphere. The globe has been warmed by 1 degree Celsius from the pre-industrial period and is further projected to 1.5 degrees Celsius by 2052 with the current trend. With the climate variability, future extreme rainfall events are expected to change. According to the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4), by the mid-21st Century, the rainfall across the southeastern US is projected to both increase and decrease in intensity. Therefore, proper hydrologic infrastructure designs such as dams, culverts, etc. is required based on the projected rainfall intensity-duration-frequency (IDF) curves. In this study, we assess the projected rainfall IDF curves with a stochastic and Artificial Neural Networks (ANN) approach for 2030-2059 using five climate models from the North-American Coordinated Regional Downscaling Experiment (NA-CORDEX) datasets under the Representative Concentration Pathway (RCP) 8.5 over southeastern, US. The results showed that the projected maximum rainfall depth with 2 and 100-year return periods was found in a range of -22 to 163% and -16 to 268% respectively. We expect the ANN approach will further improve the findings using the stochastic method.

Abstract #: 012

Title: ***Assessment of Water Quality and Sediment Chemistry at an Abandoned Mine Land Site in Eastern Tuscaloosa County, Alabama***

Authors: Abby Friedman, Rebecca Bearden, Rona Donahoe

Organization: The University of Alabama

The study area, located in eastern Tuscaloosa County, Alabama, is part of the Hurricane Creek Watershed. This area has a long history of coal mining and related ongoing water quality issues. The 67 acre study site, deemed an abandoned mine land (AML), is slated for reclamation by the Alabama Department of Labor as part of the Abandoned Mine Land Reclamation Economic Development Pilot Program. This research project focuses on assessing the pre-reclamation water quality and sediment chemistry of the study area. The next phase of the larger study will monitor water quality and sediment chemistry during and after reclamation to assess the effectiveness of site reclamation. In order to determine the extent of water quality and sediment impairment, 10 surface water samples were collected monthly and 10 sediment samples were collected quarterly at select locations in the headwater area of Hurricane Creek over a 12 month period. Water quality parameters such as conductivity, DO, pH, temperature, turbidity (February-May), and TDS were measured in the field. Sediment samples were characterized for particle size, mineralogy, and extractable element concentrations and water samples were analyzed for cation and anion concentrations, alkalinity, and acidity. The pH values of surface water samples SW1-SW7 (pH=7.00-8.00) and SW8-SW10 (pH=3.10-4.39) were consistently in the same ranges during the sampling period. Excluding winter months (November, December, January, February) and samples collected at SW7, surface water had elevated conductivity (736-1778 µS/cm) and sulfate concentrations (362-875 mg/L). Water samples collected during the winter months had lower conductivity and higher pH; this was also true for all water samples collected at SW7. Increased water turbidity (60-140 NTU) observed at SW1-SW6 and SW9 was caused by active logging near these sites. Sediment mineralogy showed higher abundances of goethite, alunite, jarosite, ferrihydrite, pyrite, and hematite in August and decreased abundances in November and February. Low surface water pH, high conductivity, high sulfate concentrations, and the presence of AMD indicator minerals suggest that AMD has impacted much of the study site. Ultimately, this study will provide geochemical guidance for best AML reclamation practices to protect water quality.

Abstract #: 013

Title: ***Restoring streamflow in southeastern watersheds: simulated forest restoration and irrigation reduction have similar effects***

Authors: Steven Brantley, Jill Qi, Seth Younger, Jeffery Cannon, Stephen Golladay

Organization: Jones Center at Ichauway

Episodes of water scarcity in the southeastern United States have increased in frequency and severity in recent decades. While precipitation is relatively high, population growth, land use intensification and climate variability have led to declines in river discharge and increased stream drying during droughts, stressing aquatic ecosystems. Watersheds like the lower Flint River Basin represent complex ecological and socioeconomic systems. Heterogeneous land use suggests a growing need to evaluate multiple land management options that balance sustainable water yield with rural economic priorities. We used the SWAT model to evaluate and compare the potential hydrologic effects of reducing water consumption by row crop irrigation and reducing evapotranspiration by restoring native longleaf pine savanna. We compared these two options in the Ichawaynochaway Creek Basin, a major tributary of the lower Flint River. We simulated the effects of irrigation reduction across the entire range of water withdrawals from â€œbusiness as usualâ€irrigation to a 100% reduction. Stopping irrigation increased annual water yield ~21 mm, or +7%, and smaller reductions in irrigation had proportionally smaller effects. Proportional increases in water yield were greatest during low- and extremely low-flow periods. For forest restoration scenarios, we used field-derived plant growth parameters in the model to simulate the conversion of loblolly pine plantation and unmanaged mixed-species forest to longleaf pine savanna. Low-density longleaf pine savanna had lower evapotranspiration rates than other forest types and longleaf restoration increased annual water yield ~18 mm, or +6%. The effect of longleaf restoration on streamflow was also greatest during low- and extremely low-flow periods. Small changes in water consumption may prove vitally important in supporting streamflow during critically dry periods, and help conserve quality in-stream habitat for imperiled aquatic organisms. Moderate irrigation reduction (e.g. 30%), possible through advances in irrigation technology, coupled with longleaf pine restoration could help mitigate water scarcity in the Ichawaynochaway Creek Basin during drought, while minimally impacting the local economy. Ongoing research is expanding longleaf restoration simulations to several watersheds across the southeast to better understand the potential of forest treatments for protecting streamflow across a wider geographic range. Offering these two approaches may allow greater flexibility and opportunities to rural landowners and watershed managers interested in protecting and restoring streamflow in imperiled watersheds.

Abstract #: 014

Title: ***Life Cycle Analysis of Water Distribution Systems in the Context of Physicochemical Pipe Degradation***

Authors: Jonathan Clayton, Leigh Terry, Daqian Jiang

Organization: The University of Alabama

Drinking water distribution systems are integral to the urban water cycle, public health, and infrastructure because they transport treated water often over large distances while maintaining the chemical and biological integrity of the water throughout the network. A key challenge in the operation of water distribution systems is determining the pipe replacement frequency. According to Steven Folkman's publication, â€œWater Main Break Rates In the USA and Canada: A Comprehensive Study,â€ operators with set replacement periods replace pipes every 125 years on average due to the high costs of pipe manufacturing and installation. Meanwhile, the average age of failing water mains is 50 years according to the same study. As a result, much of the nation's pipe is due for replacement in what experts have referred to as the â€œGreat Replacementâ€ era. However, pipe leaks, pipe roughness, and chlorine decay all increase with pipe age, potentially leading to significantly increased chemical/energy consumption and undesirable human health and environmental impacts. Past research has not been satisfactorily comprehensive in accounting for the myriad effects of pipe aging and in reporting impacts across a wide array of categories. This study incorporated these often-neglected factors into a cradle-to-grave life cycle analysis of a sample water distribution system. The analysis was performed for four scenarios over which pipe replacement occurred every 10, 20, 50 and 100 years. Impacts were quantified for acidification, carcinogenic substances, non-carcinogenic substances, ecotoxicity, eutrophication, fossil fuel depletion, global warming, ozone depletion, respiratory effects, and smog. The results indicated that almost all reported impacts of water distribution systems increase with less frequent replacement of the pipes. Impacts under a 10-year replacement schedule were often 40-50% less than the impacts under a 100-year replacement schedule. Pumping energy was often the largest contributing factor to these impacts, as pumping energy increases over time due to increased pipe leaks and pipe roughness. Carcinogenic output was a notable exception to these trends, with a decreasing impact for longer replacement periods. This was likely due to the relatively large contribution of pipe manufacturing and placement to this impact category. Apart from this exception, the findings of this study suggest shorter replacement periods minimize environmental and human health impacts, with 10-year replacement yielding the lowest impacts of the studied frequencies. This information may be used in decision making for the design and operation of water distribution systems while prioritizing the impacts of aging infrastructure.

Abstract #: 015

Title: ***EPA Gulf of Mexico Program Funding***

Authors: Amy Newbold

Organization: US EPA Gulf of Mexico Program

In this lightning talk, EPA will give an overview of the EPA Gulf of Mexico Division (GMD) funding sources and the types of projects and applicants that are eligible. EPA's GMD will be putting over $53 million of Bipartisan Infrastructure funding on the ground over the next several years, as well as continuing to implement GMD's congressionally appropriated funds, and working with the other members of the RESTORE Act Council to utilize the RESTORE funds for restoration across the Gulf Coast.

Abstract #: 016

Title: ***How EPA's How's My Waterway Creates Easy Access to EPA's Data***

Authors: Amy Newbold

Organization: US EPA Gulf of Mexico Program

EPA's How's My Waterwayâ€¯was designed to provide the general public with information about the condition of their local waters based on data that states, federal, tribal, local agencies and others have provided to EPA. Water quality information is displayed on 3 scales in How's My Waterway; community, state and national. Users can retrieve information on assessments and reported condition of local waters for anywhere in the nation by searching based on address, zip code or place name. Results include a list and map of the waters within a small watershed (HUC 12 watershed), including which waters are assessed and impaired or good based on the most recent state reporting under the Clean Water Act. Selecting a specific waterway from the list or map shows the impairment reported, existing restoration plans, and nonpoint source projects in the area. Information on permitted dischargers, water monitoring locations and drinking water systems can also be found within a small watershed area after entering a location. In this presentation, EPA will wall the viewers through what How's My Waterway has to offer, and will discuss future additional capabilities that are on the horizon.

Abstract #: 017

Title: ***Freshwater Conservation at Scale: A 5-Year Review of Successes, Challenges and Adaptive Thinking***

Authors: Jason Throneberry, Alana Reynolds

Organization: The Nature Conservancy

The Southeastern United States supports the highest aquatic biodiversity of any other region in North America. Many factors, including stream diversity, habitat diversity, geological variation, and seasonal variation contribute to our regions unsurpassed freshwater diversity. Although Alabama ranks as one of the top five most biologically rich states in the nation, it is also foremost in the number of imperiled species, rate of endemism, and species decline. To address the ever-growing threats faced by the stream systems of Alabama, it is necessary to use a watershed-scale conservation approach. Over the past 20 years The Nature Conservancy (TNC), along with its local, state, and federal partners, has demonstrated how to develop and implement a successful watershed-scale protection and restoration methodology. Our extensive and persistent work in Alabama's most biodiverse watersheds includes over 50 conservation and restoration projects. TNC of Alabama currently has 5 priority watersheds, each of which is at different stages of watershed scale assessment, prioritization, and restoration. We are currently working with partners to assess physical, chemical, and anthropogenic stressors of each river system, analyze data to highlight watershed health and stress points, and use this information to prioritize protection and restoration locations and activities. Private and public landowners are critical to the protection and restoration phase of conservation. TNC leverages private and public funds targeted toward restoration, protection, and implementation projects. This collaborative approach continues to drive efforts of TNC and partners to maximize conservation benefits. Over the past 5 years TNC of Alabama has undertaken, completed, and remain engaged in several watershed and landscape scale conservation projects. Currently, we have a Regional Conservation Partnership Program grant through the Natural Resources Conservation Service to prioritize private agricultural lands for sediment abatement restoration implementation in priority watersheds. Also, TNC of Alabama is the sediment abatement planning lead for the entire Southern Appalachians landscape. In the urban corridor around Birmingham, we are actively engaging local communities regarding potential stormwater and sediment abatement projects to bolster environmental planning and restoration through Green Infrastructure and Low Impact Development. TNC of Alabama is also the non-federal sponsor for the Lower Alabama River Fish Passage Feasibility Study with the U.S. Army Corps of Engineers to assess the feasibility of fish passage at Claiborne and Millers Ferry locks and dams on the lower Alabama River. Implementation of fish passage projects at these sites would ecologically re-connect the Cahaba River to the Gulf of Mexico and re-open a paramount migratory corridor for fishes and bolster system resilience in the face of climate change.

Abstract #: 018

Title: ***Demonstrating De Minimis Impacts at Cooling Water Intake Structures***

Authors: Lynn Sisk, Sheila Scott

Organization: Jacobs Engineering

The Federal Water Pollution Control Act Amendments of 1972, better known as the Clean Water Act, requires that any standard established to regulate point sources of pollution shall also require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact. The United States Environmental Protection Agency (USEPA) has implemented this provision in three phases. Phase 1 regulations promulgated in 2001 and amended in 2003 regulate new facilities with cooling water intakes. Phase II regulations were promulgated in 2004 but were later withdrawn and re-issued in 2014 to reduce impingement and entrainment of fish and other aquatic organisms at cooling water intake structures used by certain existing power generation and manufacturing facilities. Phase III regulations were promulgated in 2006 to regulate cooling water intake structures at new offshore oil and gas extraction facilities. This presentation will discuss the applicability and implementation of the Phase II regulations at a large chemical manufacturing facility and will present a case study which demonstrates that a de minimis rate of impingement and biological impact exists at an existing cooling water intake structure, despite the use of large quantities of river water for industrial purposes.

Abstract #: 019

Title: ***Long term trends in temperature, salinity, oxygen, and pH in Alabama coastal waters***

Authors: John Lehrter, Mai Fung

Organization: University of South Alabama

Warming, deoxygenation, and acidification are global trends apparent in ocean time series. Yet, there are few reports of similar trends in estuarine systems due to a lack of long-term data and the greater variability in estuaries that makes it more difficult to identify a statistically valid trend. In this study, time-series of continuous, 30-minutely temperature, salinity, oxygen, and pH data from the Alabama Real-time Coastal Observing System (ARCOS) were analyzed. Some of the ARCOS stations have now been collecting data for more than twenty years, which provides an opportunity to assess long-term trends and to quantify dominant modes of variability across annual, seasonal, and residual components. Time series data were assessed using non-parametric statistics to identify monotonic trends and/or abrupt changes in the time series. The analyses revealed statistically significant trends in temperature (increasing), salinity (decreasing), oxygen (decreasing), and pH (decreasing), The temperature trend is linked to a warming Gulf of Mexico with the warming mainly occurring during winter months. The declining salinity trend was driven by increasing river discharge over the last two decades in the Alabama and Tombigbee rivers as well as in more local systems such as Perdido and Fish rivers. Decreasing oxygen and pH trends were related to the increasing temperature and decreasing salinity. There were also increasing trends in nutrients and phytoplankton biomass in Alabama coastal waters that likely contributed to deoxygenation and acidification. Our presentation will highlight the complex interactions among these primary water quality variables and what these trends predict for the future Alabama coastal waters.

Abstract #: 020

Title: ***Delineation of Groundwater Recharge Areas for Water Management and Water Policy Development***

Authors: Gregory M. Guthrie, Mary Hastings Puckett, Bennett Bearden, Gary A. Hastert

Organization: Geological Survey of Alabama

Promoting sustainable water resources often requires the implementation of regulations and policies that identify and protect recharge areas. Managed aquifer recharge (MAR) policies can reduce demands on groundwater and surface water and provide sustainable water supplies for economic development and ecosystem management. Management of shallow groundwater sources is critical because of their susceptibility to both natural and anthropogenic stressors that affect the amount and quality of water available due to the unconfined or semi-confined character of water-bearing units. A shallow aquifer recharge model (SARM) developed for Alabama allows for the identification of potential recharge areas. The model utilizes Multicriteria Decision Analysis in conjunction with the Analytical Hierarchy Process in a Geographic Information System environment to produce maps that can be modified for different climatic and land use scenarios to identify potential recharge areas. The model uses three intrinsic factors, soil permeability, slope, and aquifer conductivity, and three extrinsic factors, net recharge, land use/land cover, and depth to water table, to rank recharge potential across the state. The Huntsville (northern Alabama) and Baldwin County (southern Alabama) areas are experiencing high growth and concomitant land use conversion from agricultural lands to urban landscapes. Shallow aquifers are used extensively in these areas to provide groundwater for all applications. Fractured karstic carbonate rocks form aquifers in the Huntsville area and predominantly sandy strata form aquifers in Baldwin County. Depth to water tables in both areas fluctuates widely in response to changing climatic conditions, which affects water availability, and high permeabilities promote rapid infiltration of contaminants. SARM maps indicate that extensive recharge areas have been lost over the last few decades resulting from conversion of open agricultural lands to urban landscapes, promoting surface runoff and diminishing potential aquifer recharge. Shallow aquifer contamination potential has also increased due to expansion of urban and industrial potential contaminant sources. Implementation of MAR policies at the state and local levels can help address the loss of recharge areas by guiding management decisions that promote sustainable water resources for future growth and environmental health.

Abstract #: 021

Title: ***Muddied waters: Stakeholder perceptions of water quality and clarity in the northern Gulf of Mexico***

Authors: Kelly Dunning, Greg Johnson

Organization: Auburn University College of Forestry, Wildlife, and Environment

Water quality and clarity in coastal Gulf of Mexico ecosystems are important factors to the livelihoods of human populations, the coastal economy, and the benefits provided by a healthy ocean. There are a wide variety of stakeholders that work on issues of water quality and clarity along the Gulf of Mexico coast, from government agencies to non-governmental organizations (NGOs) to privately-owned businesses. Many of the ways that stakeholders work to maintain or improve water quality and clarity is through the planning and implementation of public policies that govern the coastal waters. Important to the public policy-making process is the availability of scientific data and whether it is easily digestible and usable for stakeholders that have to put policies into place. To date, there is no study that seeks to understand what local stakeholders perceive to be the most important factors impacting water quality and clarity along the Gulf of Mexico and how policies should be shaped to lessen those impacts. In this study, we demonstrate how stakeholders along the coast in two main study sites, 1) Perdido and Pensacola Bays and 2) St. Andrew and St. Joseph Bays, perceive the issues around water quality and clarity, how water quality and clarity impacts the local economy and society, their knowledge on current coastal and ocean policies, how they work to implement policies, and their perceptions on the availability of scientific data. We used a survey and individual interviews to collect information from select respondents (e.g., government officials, NGOs, academia, private business). We used the results to measure how stakeholders perceived problems, their knowledge of policies, and what they believed needed to be changed to improve water quality and clarity in their respective areas. Between the two main study sites, 100% of respondents (n=29) agreed that poor water quality and clarity are major threats to the local economy and society. Additionally, only 20% of respondents (n=6) agreed that current policies are suitable to prevent declines in water quality and clarity. 62% of respondents (n=18) believed that the amount of scientific data available for decision-making is less than adequate. There is also broad agreement between every type of respondent we surveyed (federal, state, and local government, NGOs, academia, and private business) that declines in water quality and clarity will impact the local society and economy. These findings suggest that there is a need for improved policies and that scientific data needs to be more readily available to improve decision-making in the policy-making process. The findings of this research will be informative to policymakers seeking to meet the emerging challenges of a changing climate, providing them with crucial information to make coastal management decisions and inform future management plans.

Abstract #: 022

Title: ***Applying what we know about local ecological knowledge of Gulf of Mexico Anglers to Coastal Resilience and Management Challenges across Ecosystems***

Authors: Kelly Dunning, Daniel Morris

Organization: Auburn University College of Forestry, Wildlife and Environment

Local ecological knowledge, or the practical wisdom held by non-experts who engage with habitats, ecosystems, and species of the Gulf of Mexico holds great potential to inform coastal management decisions (Dunning, 2021). Gulf of Mexico anglers hold vast stores of knowledge that can be useful for answering ongoing management questions, but also for adapting to climate change and variability which is expected to worsen in the coming decades. To date, there is no consistent or accepted framework for feeding local ecological knowledge into management and decision-making, which makes Gulf of Mexico communities vulnerable to a changing climate. This is especially important because Alabama's gulf coast provides protection to over 15,000 Alabama residents. Additionally, coastal tourism in Alabama is a vital economic resource, welcoming over 6 million visitors every year, over 50,000 jobs, and $6 billion annually to the Alabama economy. Our research presents 1) a proposed framework for local ecological knowledge of anglers drawn from a Gulf of Mexico community recovering from a hurricane, 2) testing of this framework with empirical data from Florida recreational and commercial anglers, and 3) a novel, data-driven framework on how local ecological knowledge of anglers can be used in decision-making across a wider range of marine and coastal habitats in Alabama, the Gulf of Mexico, and international settings.

Abstract #: 023

Title: ***Engineering Cost-Effective Biochars for Efficient Removal of PFAS in Water***

Authors: Samuel Krebsbach, Dengjun Wang

Organization: Auburn University

Mass production and widespread use of per- and polyfluoroalkyl substances (PFAS) over the past several decades have caused their contamination in soil, surface water, and groundwater. Adsorptive removal of PFAS from water using granular activated carbon is a common way, but its efficiency is generally low for short chain PFAS (e.g., perfluorobutanoic acid (PFBA) and perfluorobutane sulfonate (PFBS)). Biochar, a carbonaceous substance pyrolyzed under relatively low temperatures, has shown potential for the sorptive removal of both long-chain and short-chain PFAS. Furthermore, biochar is cost-effective ($350-$1,200 per ton biochar vs $1,100-$1,700 per ton activated carbon) and more environmentally friendly since activated carbon is typically derived from non-renewable coal sources. Additionally, biochar can offer other benefits like energy coproduction, carbon sequestration, and biowaste valorization. While promising, current literature on PFAS removal by biochar fails to provide mechanistic insights into the sorptive mechanisms. The goal of this study is to determine which physicochemical properties of biochar control PFAS sorptive removal from water. To achieve this, various properties of biochar will be characterized such as specific surface area, micropore size and distribution, hydrophobicity, surface functional groups, surface charge, and elemental composition. Batch sorption experiments will also be performed to determine what biochars produced from different feedstocks (corn cob, douglas fir, eucalyptus, poplar, and switchgrass) will have the highest adsorption rate and capacity for PFAS. This will allow us to draw correlations between physicochemical properties of biochars and PFAS removal efficiency, so the most important properties controlling PFAS sorption can be further optimized for a better performance. Our preliminary batch sorption experiments show that biochar produced from douglas fir had the highest specific surface area (363 m2/g) and highest adsorption efficiency (~75% removal of PFOA at 100 ng/L). This suggests that specific surface area plays a large role in the adsorption process. It is hypothesized that biochar may significantly out-perform other sorbents for short-chain PFAS removal, since biochar has more functional groups to capture less hydrophobic species. Future experiments from this study will include environmentally relevant solutions with different electrolyte type, concentration, and natural organic matter. Performance of biochar at environmentally relevant solutions will enable us to evaluate biochar performance in practical remediation conditions. Our goal is to provide a better understanding of PFAS sorption mechanisms to push PFAS remediation research further, as well as provide a cost-effective solution to combat PFAS contamination using biochar.

Abstract #: 024

Title: ***Floating Aquatic Vegetation on Wheeler Reservoir, Alabama***

Authors: Daniel Saint, Thomas Matthew Boyington

Organization: Tennessee Valley Authority

Over the past several years there has been an increase in aquatic vegetation, particularly eelgrass, on Wheeler Reservoir, Alabama. Large amounts of this vegetation can be broken and uprooted from the reservoir bottom and form large floating mats. These mats have been ingested at power plant intakes, causing outages and resulting in revenue loss. To address these incursions, TVA has implemented regular field monitoring and is deploying a forecasting system. A multitude of field instruments are in the process of being procured and deployed in Wheeler Reservoir. Over twenty visible-spectrum cameras will be installed at the power plant intake, on TVA transmission towers, and at Guntersville Dam. The images from these cameras will feed into an image recognition algorithm that quantifies the extent of floating aquatic vegetation (FAV) on the water surface. Echosounders, a sonar type device, will be located in tandem with several of the cameras to detect FAV amounts in the water column. Wave monitors will alert forecasters if vegetation breakage or detachment from the reservoir bottom is likely. Water quality sensor platforms will continually gather environmental and meteorological data. These observations and data will be used for real-time assessment of FAV as well as to calibrate the forecasting framework. Images and plots of detected FAV will be accessible to plant operators and management via a dashboard. The TVA River Management forecasting system is being extended to include particle tracking, wave modeling, and a custom aquatic vegetation release function. The foundation of the forecasting system is a three-dimensional river model coupled with wave and particle tracking modules. Various water quality parameters, such as light penetration and water temperature, are combined with wave strength to determine when and where aquatic vegetation detachment and breakage occurs. The hydrodynamic model calculates the future movement and temperature of water in the reservoir, and the particle tracking module predicts the movement of FAV. The end result is a multi-day forecast of FAV amounts arriving at the power plant intake.

Abstract #: 025

Title: ***AFC Coastal Program Update: Current and Future Funding Opportunities***

Authors: Ryan Peek

Organization: Alabama Forestry Commission

In late December 2019, the Alabama Forestry Commission established the AFC Coastal Program as a new and innovative initiative to provide extra focus on enhancing water quality in the watersheds connected to coastal Alabama. It is supported with funding from two primary sources: 1) a Gulf of Mexico Energy Security Act (GOMESA) grant and 2) the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) Enhancing Gulf Waters through Forested Watershed Restoration project. This program will allow the AFC to allocate additional resources to maintain and improve forests in the Alabama coastal counties and associated watersheds. It will also provide financial and technical assistance for forest landowners to aid in better management of their forests. Forested watersheds provide a multitude of ecological services including erosion control, water quality improvement, wildlife and aquatic habitat, and water storage. In addition to the ecological benefits, a properly managed forest can yield significant economic return. There are many acres of forest land in Mobile and Baldwin Counties that could be better managed to enhance the ecological and economic benefits derived from the forest. Many factors that can lead to forest degradation and stagnation. The AFC's Coastal Watershed Enhancement Program (CWEP) provides cost share, in the form of reduced service rates, to assist landowners in overcoming some of the most common barriers to better managing their forests. Landowners can apply for forest enhancement practices that the AFC will conduct on their property. The primary focus of the CWEP is to improve coastal watersheds by assisting landowners in controlling and eradicating invasive species. The CWEP will assist non-industrial private family forest (NIPFF) landowners who own 10 or more acres of forest land in Mobile or Baldwin County, Alabama. These NIPFF landowners may include private individuals or joint owners. This program has soft launched, with a full launch planned for summer 2022. Once the RESTORE funding has been fully executed (2023) it will allow the AFC to offer additional cost share and funding opportunities. One such opportunity will be in the form of urban forestry pass through grants. The AFC will announce a request for proposals, at which time coastal communities and municipalities will have the opportunity to submit proposals for urban forestry projects. These projects could be urban tree canopy inventories, green infrastructure projects, forest restoration on city property, or a wide variety of other activities. These opportunities and others will be announced of the AFC website.

Abstract #: 026

Title: ***Recovering the Oyster Fisheries and Habitat in the Pensacola Bay System***

Authors: Anne Birch, Bryan DeAngelis, Laura Geselbracht, Matt Posner, Whitney Scheffel

Organization: The Nature Conservancy

Oyster habitat has been declining worldwide. The decline is mirrored throughout Florida's estuaries and the oyster fishery is almost non-existent in scale and geographic scope. The number of harvesters is dwindling and aging. Communities are facing economic and social impacts and tough decisions about management of this once abundant resource. A change in how we manage oysters as a fishery and habitat is needed if we want to recover and sustain oysters for their economic, cultural and ecosystem service values. The State of Florida is championing a new management approach that will establish a regional system for restoration and management using a collaborative stakeholder input process while recognizing the state's legal authority over management of oysters. The regional estuary scale plans will have management strategies, actions, and metrics tailored to that region. Development of Florida's first estuary-scale oyster recovery plan was piloted by The Nature Conservancy (TNC) for the Pensacola Bay System in coordination with state and community stakeholders. The Oyster Fisheries and Habitat Management Plan was designed using a collaborative and consensus-based process, ensuring all stakeholders had an equal voice and hand in developing a shared roadmap for recovery. The plan includes strategies and actions based on four overarching and interdependent themes: A. Ecological, B. Wild Harvest and Aquaculture, C. Economy, and D. Public Education and Communication. Each Theme has a stated Vision, Goal, and Outcome, and corresponding Objectives, Metrics, Strategies and Actions to help ensure oysters thrive as both a habitat and a fishery throughout the Pensacola Bay System. Finding a 'home' for the implementation of the plan was as important as its development. The Pensacola and Perdido Bays Estuary Program adopted the plan into their Comprehensive Conservation and Management Plan. The program is continuing the community's involvement and inviting diverse voices to the table through a community-based oyster working group to figure out how best to implement the plan's strategies and actions.

Abstract #: 027

Title: ***Update on Water Use Data Management Application for Alabama***

Authors: Michael Harper, Tom Littlepage

Organization: Alabama Office of Water Resources

ADECA's Office of Water Resources (OWR) administers various programs relating to Alabama's water resources including the Alabama Water Use Reporting Program, the Alabama Drought Planning and Response Program, and the Alabama Floodplain Management Program. Specific to water use, OWR has been collecting and developing the data from water users statewide since 1993 to better understand our usage, trends, and needs. This information is collected and processed in our current â€œeWaterâ€application which is a definitive program that has been deemed impossible to upgrade due to age and status of the program code.A much enhanced and technology-driven replacement of eWater is currently being developed specific to OWR and the State of Alabama's water use needs. This effort is being undertaken in partnership with the USGS, the Alabama Office of Information Technology, and the ADECA Information Technology staff and in multiple phases. The enhancements include two main developments, an external portal and a document management component utilizing Laserfiche software. The portal will be accessible by outside water users in all categories (Public Supply, Non-Public and Irrigation) which will allow ease in creating a new account, application for a Certificate of Use (COU), submitting modifications and renewals for a COU, and annual water usage submittal. The document management component will allow OWR staff to develop data reports and queries, process new user documents, and reduce overall impacts of time and resources internally. The new development process and enhancements will be discussed, its advantages for OWR, and possibly other states that require a sophisticated water quantity data management system. This presentation will also provide an update on the development effort and details on the capabilities and benefits that the new application will provide to the Alabama Water Use Reporting Program.

Abstract #: 028

Title: ***Assessing the Temporal Variations in Groundwater Recharge Fluxes in Wolf Bay Watershed***

Authors: Pooja Preetha, Prabhakar Clement

Organization: Alabama A&M University

Water security, which includes the availability of sufficient amount of good quality of water, is vital to human life. Changes in land cover surrounding freshwater bodies play a crucial role in altering regional water security. This study uses a process-based distributed model, Soil and Water Assessment Tool (SWAT), and a modular finite-difference flow model, MODFLOW developed by the United States Geological Survey (USGS) to evaluate the temporal variations in groundwater recharge fluxes with changing land covers. The study area is the Wolf Bay watershed, an estuary in the southeastern part of Baldwin County, Alabama. This study aims to incorporate annual land cover datasets from the national land cover database (NLCD) to develop a temporally updated SWAT_LC model and use the modified model to simulate groundwater recharge fluxes. Next, we develop a MOFLOW model for the study area and predict the volumetric flow budget to obtain annual estimates of groundwater recharges. Later, we evaluate improvements in annual predictions of groundwater recharge fluxes by developing a coupled SWAT_LC_MODFLOW model. The results from SWAT_LC, MODFLOW, and SWAT_LC_MODFLOW models will be validated using estimates derived from two other methods, the classical baseflow separation method and the 1 km-resolution monthly recharge product developed by USGS. We validated the potential use of annual land cover data products between the years 2006 and 2016 for improving the SWAT-derived annual groundwater recharge fluxes. The study provides useful modeling frameworks that can be used to address water security issues catalyzed by temporal land cover variability in watersheds by assessing groundwater recharge fluxes.

Abstract #: 029

Title: ***Generational Funding Opportunity: "Now is the Time to Fund Your Project"***

Authors: John Laney, William Lott

Organization: Alabama Department of Environmental Management

The passage of the Bipartisan Infrastructure Law(BIL) and the America Rescue Plan Act(ARPA) created an opportunity for large communities and Disadvantaged, Rural, Small, and Tribal communities to have both Clean Water and Drinking Water. The BIL program is a five(5) year program. The ARPA program is an one(1) year program. The roll of ADEM's SRF Section is to assist communities in the accessing of these funds. We are there to guide a community as needed through the process to help them have a successful experience. Our presentation is intended to help the listener understand the projects that will qualify, funding sources available, and how to go about qualifying for these funds. The goal of ADEM is to maximize these funds for the benefit of the citizens of Alabama and those most in need.

Abstract #: 030

Title: ***Status of Centralized Wastewater Treatment and Land Applications Sites in the Alabama Black Belt***

Authors: Carey Clark, Tristan Wilson

Organization: Auburn University

The challenges associated with decentralized wastewater treatment in the Black Belt have been documented and are becoming relatively known. However, there are also seventy-two centralized wastewater treatment facilities in the seventeen Alabama Black Belt counties that serve a significant fraction of the region's population. In addition, these facilities are important sources of septage treatment capacity for the region's decentralized systems. Nine (12.5%) of the facilities dispose of treated wastewater via land application while the other sixty-three (87.5%) discharge to surface water bodies. Land application is not often selected as the disposal method of effluent; however, this disposal method is significant since soil and groundwater can be contaminated. Additionally, land applications sites have been unfavorable in the Black Belt Region due to impermeable soils and abundant precipitation. Common types of treatment facilities include mechanical treatment plants, aerated lagoons, and stabilization lagoons. Although economies of scale are possible with centralized treatment facilities, a noticeable disadvantage of these more complicated treatment systems is that they require experienced operators and maintenance crew. In addition, the cost to maintain the system can be a significant cost depending on the condition of the facility and implemented processes. Thus, a centralized treatment system that does not have adequate staff and cannot be properly maintained can lead to noncompliance violations, significant noncompliance violations, and possible failure of the treatment system. Improperly designed treatment facilities and land application disposal sites contribute to noncompliance and sanitary overflows issues as well. Thus, the functionality and lifespan of centralized treatment f

Abstract #: 031

Title: ***Impacts of Tropical Cyclone on Streamflow and Suspended Sediment Dynamics in Large Global Rivers***

Authors: Sera May, Sagy Cohen

Organization: The University of Alabama

Tropical Cyclones (TCs) are an extreme meteorological event that occurs in many locations globally. These events cause high levels of precipitation and flooding as it makes landfall. Extreme flooding events are known to cause increased suspended sediment flux and discharge in nearby rivers, thus altering sediment dynamics in short time periods. This relationship between TC related precipitation and sediment dynamics of impacted rivers has yet to be studied at a global scale. In this project, the WBMsed, a global scale hydro-geomorphic model, is used to simulate sediment and streamflow dynamics at a global scale. The influence of TCs precipitation is isolated and quantified by comparing the model predictions (from 1980-2019) to a set of simulations in which TCs were masked from the input precipitation dataset. Geospatial analysis is used to map and analyze spatial and temporal trends and hotspots of influence. The results show global precipitation datasets show areas globally that are under significant influence of TC influenced precipitation. Coastal areas in Southeast Asia, Northwestern Australia, and Eastern North America have TC precipitation contribute over half of their yearly precipitation in 2016. Results of this research are expected to show that TCs have significant influence on global rivers sediment and streamflow dynamics located in areas that have TC influenced precipitation. A temporal analysis of the results from 1980-2016 are also expected to show an increased amount of TC related influence on sediment and streamflow dynamics as sea surface temperature (SST) increase due to climate change accelerating. The global results of this study will provide a framework for analyzing TC related influence on sediment and streamflow dynamics that can be applied to smaller scale analysis of individual basins.

Abstract #: 032

Title: ***Mapping the Impacts of Climatic Extremes across the CONUS on the cloud and on-the-fly***

Authors: Anuska Narayanan, David Keellings, Brad Peter

Organization: The University of Florida

In recent decades, changes in precipitation, temperature, and air circulation patterns throughout the United States have led to increases in the occurrences of extreme weather events. These events can have devastating effects on communities causing destruction to property and croplands, as well as negative impacts on public health. As changes in the climate are projected to continue throughout the remainder of the 21st century, the ability for a community to plan for and recover from extreme weather events is vital to its survival. Our study focuses on examining the effects of climate extremes on community resilience throughout the Conterminous United States (CONUS) at the county level. We use an established disaster resilience index together with a revised version of the U.S. Climate Extremes Index, which incorporates temperature, precipitation, and drought, to create a combined measure of climate resilienceâ€”the Climate Extremes Resilience Index (CERI). We introduce a Google Earth Engine (GEE) web app to calculate and map the CERI for the CONUS. The application of this tool is demonstrated during the 2021 Pacific Northwest Heatwave, a 1000-year weather event made 150 times more likely due to climate change. We identify the least resilient counties in the Northwestern US, as well as those most impacted by the climatic event. By developing a web application for calculating the CERI, we expand the use of climate-resilience indices beyond theoretical applications. Developing a GEE-based application allows us to lift the requirements for large data inputs increasing its utility; the only requirement for the user is an internet connection and a free web account. We envision this tool and the CERI to be useful for policymakers to plan for climate-related disasters, as well as help the public with understanding and visualizing the impacts of extreme climatic events. By assessing a community's resilience against climate change, aid can be allocated to vulnerable communities that are less resilient and more exposed.

Abstract #: 033

Title: ***Engaging partners and empowering communities: establishing a well water network in Alabama***

Authors: Jessica Curl

Organization: Auburn University Water Resources Center

Cooperative Extension Services serve as a repository of information to a wide breadth of clients nationwide in search of reliable, science-based materials. In Alabama, there were limited resources for private well owners prior to development of the Alabama Private Well Program (APWP) in 2020. Administration and Extension field staff indicated the need for a program to assist county offices in addressing the needs of a client base previously overlooked.PWP follows the precedent of established Extension led well water programs. The AP's purpose is to build capacity to County based Extension professionals through trainings and resources to address frequent questions and concerns from well owners.s the pilot stage of the program continues, entities from across Alabama continue to express interest in well water educational materials. This is evident in the diverse audience that attended the well water webinar series, initially intended for Extension personnel. Professionals from regulatory agencies, non-profit organizations, power utilities, and financial institutions were strongly supportive of the program and aided in the development of a multi-agency and Extension network.pproaching its third year, the APWP will begin hosting workshops throughout the state for private well owners. The APWP workshops will give an opportunity to well owners to have their water tested, while identifying areas where bacterial contamination is most present in the state. APWP directly benefits homeowners who rely on private wells for drinking water while addressing a statewide need for well water resources beyond homeowners. This presentation will explore the approach to collecting well characteristics and the impact of a multi-agency partnership on building a new Extension program.

Abstract #: 034

Title: ***Los Angeles Aqueduct: Geovisualization of Key Infrastructure and Design Phases I, II, and III***

Authors: Philip Chaney

Organization: Auburn University

The Los Angeles Aqueduct is among the oldest and most prominent Interbasin Transfers of Water (IBT) in the U.S. It is a complex, â€œgravity-flowâ€system constructed in three major phases to transport water from the Owens Valley and Mono Lake area in eastern California to the city of Los Angeles. The First LA Aqueduct (LAA1), completed in 1913, consisted of a combination of canals, pipelines, and tunnels to capture water from the Owens River. The Mono Basin Extension, completed in 1941, extended the route over 100 miles farther up the Owens Valley to capture water from the mountain streams flowing into Mono Lake. The Second LA Aqueduct (LAA2), completed in 1970, branches off the First LA Aqueduct at the Haiwee Reservoir and runs parallel to LAA1 to Los Angeles. This addition essentially doubled the capacity for transporting water to the city. The images included in this presentation are from The IBT Water Project (aub.ie/ibtwater) at Auburn University that focuses on mapping major IBTs in Google Earth for helping people to understand their complexity and function. The products are available via the Internet at no cost and include digital maps in KMZ format, instructions for conducting simple analytical tasks in Google Earth, and a glossary of key terms.

Abstract #: 035

Title: ***Spreading awareness and prevention of marine debris through community cleanup events***

Authors: Jessi James, Mandy Sartain, Eric Sparks

Organization: Mississippi Inland Cleanup Program

Marine debris constitutes as any persistent solid material that is manufactured or processed and, directly or indirectly, disposed of or abandoned in the marine environment. The presence of marine debris has been shown to have significant environmental and economic impacts. Unfortunately, the quantity of marine debris is increasing at accelerating rates due to the increased production of single-use items and poor stewardship practices. To address these issues, a team of Extension specialists founded the Mississippi Coastal Cleanup Program (MSCCP). The mission of the MSCCP is to prevent and remove litter from the environment through education, outreach, research, and cleanup events. During cleanup events, relevant information is utilized to create marine debris-focused outreach materials that are distributed through a variety of methods, including social media and direct presentations. Feedback gathered during outreach events has led to several additional activities and materials for the program. These activities include the addition of a July 5th Star-Spangled cleanup, monthly cleanups at peer-suggested sites, as well as the creation of the Mississippi Inland Cleanup Program (MSICP). This new program will extend the cleanup efforts inland to serve a total of twenty-one counties across the southeastern region of Mississippi by promoting trash-free education and additional cleanup events.

Abstract #: 036

Title: ***Water Availability in HUC06 Basins Under the Changing Climate Using Budyko Framework***

Authors: Fitsume Teshome Wolkeba, Mesfin Mekonnen, Mukesh Kumar

Organization: The University of Alabama

Climate change alters water availability. In this study, we used the Budyko framework and climate predictions from five climate models (GFDL, IPSL, MPI, MRI, and UKESM) for SSP126 and SSP585 scenarios to study which HUC06 basins will be vulnerable to reduced water availability because of climate change from current to 2100. The study calibrated Fu's parameter for HUC06 basins in the Conterminous United States using twenty years of data from MODIS and NLDAS-2. The calibration used a nonlinear objective function that minimizes RMSE between Budyko predicted and MODIS actual evaporation. The study estimated the vulnerability of basins to the percent of change of precipitation and potential evaporation from the climate models used. It also used an exploratory vulnerability analysis to show the possible ranges of vulnerabilities. The analysis shows vulnerability ranges to different combinations of percentage changes in precipitation and potential evapotranspiration including vulnerability ranges between the lower and the higher projected climate scenarios. The results of the study indicate that HUC06 basins in Upper-Midwest, West Ohio Valley, and South will be vulnerable to both lower and higher scenario climate changes predicted by the average of the five climate models used. This study also used E/PET vs E/P space to show the collective response of basins to their respective climate change. The space shows not only a change in water availability but also a change in the aridity of the basins. We believe this study will benefit water managers and policymakers by providing information on where water availability will be negatively affected by the projected climate change

Abstract #: 037

Title: ***Ensuring safe drinking water quality in Northern Haiti: Financial sustainability of drinking water laboratory related to Operating Costs, User Demand, and Economic Conditions***

Authors: Lonege Ogisma, Frances O'Donnell, Joseph Molnar, Wendiam Sowadgo, Gobena Huluka

Organization: Auburn University

Safe drinking water availability is a central concern in Haiti. Public systems have limited coverage and reliability. Private wells and local water sources are often of unknown or poor quality. Public health events such as the cholera outbreak of 2010 demonstrate the vulnerability of Haitian populations to water contamination. The ubiquity of acute contaminants such as E. coli, lead, and arsenic can cause severe waterborne diseases. Whereas the cost of treating a case of typhoid in Haiti is typically US $300 very high for the households. To address these concerns a drinking water laboratory was established at the Campus Henri Christophe in Limonade, a branch of the State University of Haiti (CHCL-UEH) to support regular water testing from local clients such as for-profit kiosks, institutions, industries, and municipal water systems operating in the Northern Corridor. This study used sensitivity analysis to appraise the financial viability of a university-based drinking water laboratory in the Northern Corridor of Haiti. To be sustainable, the drinking water lab must cover its operating costs. We assessed the potential clients and simulated the future demand for water testing and other factors what will impact the operation costs. To achieve an acceptable profitability level, the laboratory must perform microbial testing for any water sample received and test an average five samples per day. Price-based incentives for new clients have relatively small impacts on profitability whereas lowering the number of daily samples performed has a high impact on the projected Internal Rate of Return. Finally international and Haitian inflation cause substantial variation in laboratory profitability. These economic factors will be among the key challenges to laboratory operation costs. The results underscore the main factors that must be considered for the laboratory to be successful.

Abstract #: 038

Title: ***A quantitative PCR-based approach to assess fecal pollution sources in the Lake Martin Watershed***

Authors: Wenjing Ren, Yucheng Feng

Organization: Auburn University

Lake Martin is a popular recreation area in Alabama and the only Treasured Alabama Lake in the state. However, recent land-use changes and the presence of an impaired stream due to high E. coli concentrations in the watershed have raised water quality concerns. The objectives of this study were to determine the effects of significant rainfall events on microbial water quality and to assess the sources of fecal contamination in both water and sediment in the Lake Martin Watershed. Fifty-five water and 50 sediment samples were collected and analyzed from 2021 to 2022. Quantitative polymerase chain reaction (qPCR) was used to determine the abundance of human-, cattle- and chicken-associated genetic markers in the water and sediment samples. The results showed that fecal contamination from humans and cattle was consistently present regardless of the weather conditions; chicken fecal contamination, on the other hand, was primarily detected after significant rainfall events. High concentrations of E. coli in water samples were observed after significant rainfall events, and E. coli concentrations in sediment samples were higher than in the overlying water. Our results suggest that the stormwater runoff can contribute considerable loads of fecal contamination to the streams. Sediments should be considered when evaluating stream water quality since sediment resuspension after significant rainfall events may negatively impact the quality of the overlying water.

Abstract #: 039

Title: ***A Status Check of Groundwater Data Management in the Southeastern U.S.***

Authors: Eliane Volk, Leigh Terry, Prabhakar Clement, Melika Mani, Mukesh Kumar

Organization: The University of Alabama

Groundwater contributes approximately 40 percent of freshwater usage in the conterminous US, and its contribution in oneSoutheastern state, Mississippi, is 75 percent. Groundwater also indirectly sustains surface water resources, and hence its actual contribution to freshwater usage is even larger than reported. The goal of this project is to develop a comprehensive GIS-based web database that will harness publicly available data from various state agencies and water utilities across Alabama, Mississippi, and Louisiana while addressing critical data gaps and differences.The information included in the database can then be used to develop science-based water management and policy decisions. The comprehensive GIS-based web database will provide opportunities for research investigations to utilize various data analysis applications for potable water resources and utilities information, as well as support effective water management. It is essential to develop a more holistic understanding of freshwater usage from both surface and groundwater resources in the Southeastern United States. Over a hundred studies have assessed specific research topics and sub-regions in the Southeastern US, such as saltwater intrusion and the Mississippi River Valley alluvial aquifer system; however, the idiosyncratic approach to most research investigations can limit how we understand groundwater. Integrating science and policy is essential for advanced research investigations and developing comprehensive state water management plans that will support water sustainability. Alabama, Mississippi, and Louisiana do not have comprehensive state water management plans, while all the states surrounding this region have comprehensive state water management plans in place. Understanding current water management and previous water disputes provides a strong background perspective on the water resources issues that can form in this region. The lack of source water monitoring severely impacts data-driven research efforts in these three states. The database can be used in support of future management developments to enhance water sustainability.

Abstract #: 040

Title: ***Karst features and aquifer systems in Alabama***

Authors: Gheorghe Ponta

Organization: Geological Survey of Alabama

Carbonate strata containing numerous karst features, such as caves, sinkholes, and springs, underlie approximately 25 percent of Alabama. In the northern half of the state, the Interior Low Plateaus, the Appalachian Plateaus, and the Valley and Ridge physiographic provinces, carbonate rocks underlie many areas, and groundwater is contained mainly in karstified aquifers with high secondary porosities. In the Coastal Plain physiographic province, in the southern half of the state, 7.5 percent of the aquifers are comprised of carbonate rocks. Wells installed in carbonate rocks and karst springs obtain water from solution cavities developed in these strata or from the regolith above them. Solution cavities are not uniformly distributed, making prediction of their occurrence extremely difficult. In order to understand the geologic framework of karst aquifer systems in Alabama, a series of hydrogeological cross sections were constructed to depict the stratigraphy and the hydrostratigraphy along the section lines (for example, Tuscumbia Limestone and Fort Payne Chert as major aquifers). The selection of cross-section lines was based on the locations of key wells, with preference being given to wells having greater total depth and having supporting geophysical and sampling logs. These cross sections are used to identify geologic structure, aquifer characteristics and their productive intervals and to determine where potential deeper aquifers may be located (for example, Silurian Limestones). The economic future and quality of life for Alabamians, as well as sustainable ecosystem functions and services, are dependent upon the availability and protection of the state's water resources. Therefore, future water source development will require significant scientific research, substantial logistical planning, and infrastructure development to find and manage adequate sources.

Abstract #: 041

Title: ***Enhancing the Hydraulic Performance of Wattles for Erosion and Sediment Control***

Authors: Jannell Clampitt, Michael Perez

Organization: Auburn University

Suspended sediment in waterbodies can have many consequences that include deplete the oxygen levels resulting in fish kills, loss of aquatic plant life due to lack of sunlight and serve as a catalyst for other pollutants to bond to the soil particles resulting in a range of affects to the environment that may be toxic to aquatic plants and animals. Wattles are a popular practice due to the availability of the variety of materials within the wattle and their various applications through ditch checks, sediment barriers, and inlet protection practices. Past wattle research has found that even though a wide variety of materials can be used within wattles, only a few materials are effective at minimizing erosion, assuming proper installation methods are utilized. Recent studies at Auburn University have looked into the best installation methods for wattles to minimize product failure, developing a standardized evaluation method for various types of fill materials, density of the fill materials, and encasement materials. The various fill materials assessed include excelsior, synthetic as recycled carpet fiber, wood fiber, wheat straw, coconut coir, chipped wood, and miscanthus fiber. This presentation will report results from modifications made to the encasement material and density of fill material within the wattle. Encasements were made up of natural fibers (i.e., coconut coir and cotton), and synthetic fibers (i.e., high-density polyethylene, polypropylene, polyester, polyester polypropylene mix, and plastic netting). The results from each wattle evaluated were normalized by creating a depth ratio and a length ratio. The depth ratio comprises the water impoundment depth at the wattle over the height of the wattle once installed. The length ratio consists of the impoundment length from the wattle to the center of the hydraulic jump over the standing pool length. Installation techniques found that utilizing a geotextile underlay, sod staples, and teepee staking were the most advantageous installation method. Excelsior fill material was used to evaluate the density and encasements of wattles due to its low impoundment abilities. It was found that when the density of the excelsior wattles was increased, it had no improvement on hydraulic impoundment. When assessing the encasements, triple layered cotton fabric netting had the greatest enhancement to the hydraulic performance relative to the impoundment length and depth.

Abstract #: 042

Title: ***Diverse farmer behaviors lead to complex food-water-energy interactions***

Authors: Nicholas Magliocca, Ruchie Pathak

Organization: The University of Alabama Dept of Geography

Food, energy, and water systems (FEWS) can interact in complex ways with increasing demands for one resource impacting the supply of another. These interactions, often referred to as the FEW nexus, present a pressing societal and policy challenge. Computational approaches for analyzing and understanding FEWS interactions are now well established. However, individual and social factors that influence FEW resource use patterns, such as cognitive biases and social network interactions, are not well represented in FEWS modeling and research. In particular, spatial and temporal heterogeneity in resource users' behaviors are typically reduced or ignored in FEWS models, but the interaction of diverse behaviors can lead to unexpected stresses or trade-offs among FEWS resources. This study presents the findings from an innovative agent-based model (ABM) applied to crop type and irrigation choices among farmers in Alabama. building-block processes (BBPs) approach was used in combination with evolutionary programming to explore diverse combinations of farmer decision models and social network influences on farm management decisions. Model structural uncertainty was assessed in comparison with observed land use patterns, and spatially and temporally explicit outcomes of farm management decisions were used to derive FEWS interaction metrics, such as water stress ratio, financial and energy returns on investment, and yield gaps. Preliminary results that profit-maximizing strategies increased farming efficiency for some farmers, but had the largest impact on water stress and created the greatest inequalities among farmers. Conversely, subjective risk-based strategies were slightly less efficient but had overall more desirable social and environmental outcomes. Social network influences tended to amplify outcomes regardless of the farm management strategy employed. These findings are a first step in the development of behaviorally rich computational approaches to FEWS analysis, which are necessary to produce more realistic scenarios of potential FEWS resource growth and stresses in the future.

Abstract #: 043

Title: ***Assessment of the impacts of land use change and future climate change on water quantity and quality in the Perdido Watershed***

Authors: Dongjun Lee, Latif Kalin

Organization: Auburn University

Climate change is likely to increase the intensity and frequency of extreme events, such as hurricanes and tropical cyclones. In particular, these events can adversely affect hydrological systems in coastal areas by damaging forests. There is evidence of forested land being converted into pastures and other agricultural crops along the northern Gulf of Mexico (GOM) due to the increased hurricane activities and strengths. This study aims to assess the impacts of future land use and climate change on water quantity and quality in the Perdido Bay watershed. The Soil and Water Assessment Tool (SWAT) was used to assess the potential impacts on future water quantity and quality (TSS, nitrogen, phosphorus, and carbon) for the period 2050-2100. The model was first parameterized for dominant forest species and subsequently calibrated and validated with monitored flow and water quality data from 2001 to 2020. Downscaled climate data under four Representatives Concentration Pathways (RCPs) emission scenarios from five global circulation models (GCMs) were used to force the SWAT model for future conditions. Hypothetical land use scenarios were considered to understand the combined impacts of land use and climate change. This study is part of a larger project funded by the National Academy of Science. Future efforts will extend this work to the whole Northern Gulf of Mexico, spanning from Perdido Bay to the Apalachicola Bay.

Abstract #: 044

Title: ***Evaluating the Synergistic Effects of MIEX Resin and Coagulation on the Removal of Disinfection Byproduct Precursors in a Pilot-Scale Water Treatment Plant***

Authors: Melanie Vines, Leigh Terry, Jaquice Boyd, Jeff Cochran, Ashlyn Manzella

Organization: The University of Alabama

Water security is one of the biggest problems facing the world today, and it hinges not only on water availability, but on the ability of utilities to produce clean and safe drinking water. One pressing issue currently facing drinking water treatment utilities is the prevention and mitigation of disinfection byproducts (DBPs). During the drinking water treatment process, water is disinfected to prevent waterborne illness. DBPs are compounds that form as a result of disinfectants reacting with organic matter and other constituents present in the water, and some DBPs are carcinogenic or otherwise toxic to human health. Two such classes are the trihalomethanes (THMs) and haloacetic acids (HAAs), both of which are regulated in the United States. With deteriorating global water quality and increasing water scarcity issues, many utilities are having to blend water sources with increasing frequency, which leads to complex water chemistry that can make treatment more complicated. To produce clean, safe water, utilities may need to adjust their practices to optimize organics removal, thus preventing and mitigating DBP occurrence in the future. One novel treatment technology on the market is magnetic ion exchange (MIEX) resin. MIEX consists of a magnetic resin to destabilize and adsorb organic matter in the water and is intended to either supplement or replace traditional coagulation practices. Bulk organic measurements, such as total organic carbon (TOC), reveal some information about what compounds are removed by these processes, but they do not provide characterization into the organic matter removed and therefore do not inform an understanding of the underlying chemistry. However, fluorescence spectroscopy is a tool that has been used in recent years to characterize organic matter. A small portion of organic matter fluoresces when excited by light, and the wavelengths at which this organic matter is excited and at which it reemits light via fluorescence can be used to learn more about the character of the organic compounds that are present. This study will take place in a pilot-scale water treatment plant in Birmingham, AL. The pilot plant utilizes water blended from two different sources and experiences seasonal peaks of DBPs during the summer. A pilot-scale MIEX resin mobile unit will precede two tandem pilot-scale traditional treatment trains. One train will employ aluminum sulfate as a coagulant, and the other will employ ferric sulfate. Fluorescence spectroscopy will be used to assess whether organic matter of a specific character is preferentially removed. THM and HAA formation potentials will also be tested after MIEX treatment alone and after MIEX treatment combined with each coagulant. The results of this study will assist the Shades Mountain Filter Plant as well as other utilities in determining an optimal treatment train for the removal of DBP precursors.

Abstract #: 045

Title: ***Reimagining Public Participation in Watershed Stewardship***

Authors: Laura Bell

Organization: Auburn University Water Resources Center

This talk will outline the lessons learned about meaningful public engagement from the Alabama Watershed Stewards Program. Many organizations and academic initiatives have a public engagement component, but it is not always clear how to involve communities in substantive dialogue about choices concerning watershed improvement. This talk explores the importance of public participation in local watershed stewardship and draws upon examples of how public participation methodologies can used at varying scales depending on project intentions and needs. The Alabama Watershed Stewards program is a statewide education and outreach initiative housed under the Auburn University Water Resources Center intended to bring citizens, agencies, and city governments together in learning about water quality issues and identifying ways to address them.

Abstract #: 046

Title: ***Investigating physical drivers of stream intermittency in Alabama***

Authors: Delaney Peterson, Nate Jones, Michelle Wolford, Shannon Speir, Arial Shogren

Organization: The University of Alabama

Non-perennial streams (i.e. streams that regularly dry) comprise over 50% of the global river network, and play an important role in influencing the physical, chemical, and biological characteristics of downstream waters. In the Southeast, non-perennial streams occur in the headwaters of river networks. In these systems, heterogeneity of watershed structural features (i.e., stream slope, subsurface architecture, and preferential flowpaths) play a key role in spatial and temporal variation in stream intermittence. Our goal is to develop a predictive understanding of spatiotemporal patterns of stream drying across three distinct physiographic regions inAlabama (i.e., the Coastal Plain, Piedmont, and Appalachian Plateau). We have paired empirical water presence data, collected using Stream Temperature Intermittency and Conductivity (STIC) loggers dispersed throughout the watersheds, with physical stream network surveys. We also characterize watershed structural features (including elevation, slope, soil depth, soil structure) using publicly available data. Combining these data sources allows us to develop predictive models of stream intermittence using a Spatial Stream Network (SSN) modeling framework. Our initial results suggest that each physiographic region has a unique drying regime. Generally, drying occurs hierarchically where portions of the network with steeper slopes and smaller contributing areas dry most frequently and earliest. Our work will build a better understanding of the processes that drive stream drying in the Southeast and add necessary context to the structure and function of these important stream networks.

Abstract #: 047

Title: ***Alabama Center Pivot Irrigated Acreage Survey: 2006-2021***

Authors: Krel Haynes, Lee Ellenburg, Phil Chaney, Cameron Handyside

Organization: University of Alabama in Huntsville

As part of efforts to both promote irrigation and protect our water resources, detailed information about water users and their locations is critical. Alabama Irrigation reports are sparse and information coarse, typically only reported at the County or State level. The Center Pivot Survey is a project to address the lack of specific irrigation data in Alabama. Spatial crop models designed to estimate irrigation demand and pass this to water availability studies require such specific data. Using data from the USDA National Agricultural Imagery Program (NAIP), we were able to identify center pivot systems due to the high-resolution of the images. The initial survey data is processed through ArcGIS to extract pivots that the researchers identified through visual interpretation. This allowed for the extraction and evaluation of all identified center pivot system locations. After evaluation, further processing was done to have the calculated acreage of the center pivots at the county level and Hydrologic Unit Code 8 and 12 watershed levels. Surveying the entire state of Alabama for the center pivot systems allows for a benchmark to be established for other future methods of identification to be tested. While center pivot systems are not the only irrigation method, it is the most common when working with commodity row crops such as corn, cotton and soybeans. This survey does not identify all of the irrigated acreage in Alabama, however it does go a long way for identifying the scale and trend for irrigation in the state. This survey looked at the timeframe from 2006 (first available NAIP survey) to 2021 (most recent NAIP survey), allowing for a 15 year time period for trend development in irrigation expansion or contraction.

Abstract #: 048

Title: ***Research Update for the Auburn University - Stormwater Research Facility***

Authors: Wes Donald, Mike Perez

Organization: Auburn University

This presentation will provide an overview of topics and some results related to research at the Auburn University - Stormwater Research Facility (AU-SRF, formerly the AU-ESCTF). This facility is a 10 acre research facility located in Opelika, AL as part of the Department of Civil and Environmental Engineering at Auburn University. The goal of this facility is to provide the industry with the ability to scientifically analyze products and practices related to construction and post-construction erosion, sediment, and stormwater controls. These assessments may be through research and development or product testing from sponsoring agencies or private companies/individuals as well as training and outreach that is based upon research and testing results. This has provided the AU-SRF 10 years worth of research and product testing that has helped change the way Alabama and other states/regions approach controlling sediment, erosion, and stormwater on their construction sites and beyond. The research projects to be included in this presentation overview will be from sponsored studies from the Alabama, Nebraska, and Iowa Departments of Transportation. Research topics will include: 1) sediment basin performance based upon different basin setups, 2) flocculant implementation and effluent residual findings, 3) simulated rainfall research, 4) sediment barrier performance testing, and 5) the use of Unmanned Aerial Vehicles (UAVs or drones) for vegetative establishment determination on construction sites. A brief overview of the research topics will be discussed, proposed outcomes will be provided, and available research results will be reviewed. Attendees should come away with a better understanding of the capabilities of the AU - SRF, performance results of different practices used to manage erosion, sediment and stormwater, and be aware of project goals for future works.

Abstract #: 049

Title: ***Saltwater Disposal Wells: An Economic Search to Recover Valuable Metals from Produced Waters***

Authors: Ann Compton Arnold

Organization: Geological Survey of Alabama

With the skyrocketing demand for lithium for battery production, potential metals sources are being evaluated throughout the country. The Groundwater Assessment Program of the Geological Survey of Alabama, in coordination with the State Oil and Gas Board of Alabama, conducted a pilot investigation of produced waters from oil and gas fields for the purpose of evaluating the potential economic benefit of these waste streams for lithium and bromine production. The Upper Jurassic Smackover Formation in the southeastern states contains productive zones for oil and gas production. Water is often produced in conjunction with oil and gas, thus generating high volumes of produced water with the potential for mineral enrichment. In southwest Alabama, Smackover fields have saltwater disposal (SWD) wells permitted for underground injection of produced fluids removed during oil and gas production. Fifteen SWD wells from these fields were selected to collect produced water samples for lithium and bromine characterization. The fields are located in the southwestern part of the state in Baldwin, Monroe, Escambia, Choctaw, Clarke and Mobile Counties. The produced water samples were tested in the field for pH, temperature, conductivity, and turbidity. Temperature and turbidity are useful indicators of in situ water quality in the formation at depth. Both parameters are â€œperishableâ€after sampling, and obtaining an instantaneous accurate reading is vital for the overall data interpretation. Produced water samples were then analyzed by Inductively Coupled Plasma (ICP) spectroscopy for the presence of metals, particularly lithium, barium, and strontium. Salinity in all the water samples ranges from 10,000 to 100,000 parts per million (ppm). Preliminary analytical results indicate that the wastewaters produced from the Smackover Formation have similar geochemistry despite the geographic span of the sampled localities. Strontium concentrations are approximately 1,000 ppm, lithium concentrations are on the order of 100 ppm, and barium concentrations are less than 100 ppm. Although lithium and bromine at these dissolved concentrations are not likely viable for stand-alone commercial production, there may be a cost-effective method to synergistically recover and reuse valuable metals along with co-production of another resource or process. The â€œotherâ€natural resource could be recycled clean water made available for irrigation or other industrial applications. Commercial viability depends upon the volume of extractable water. The value of the filtered produced water will depend on scarcity and proximity to fulfill an internal use or to provide to a neighboring industry at a cost or other benefit.

Abstract #: 050

Title: ***Extreme weather threat and watershed land use change: A study of forest landowners on the northern Gulf of Mexico***

Authors: Anna Brown, Wayde Morse, Kelly Dunning, Chris Anderson

Organization: Auburn University

Landowner decisions leading to forest loss by conversion to urban or agricultural use impact coastal water quality and reduce ecosystem services. Inland coastal forest cover provides critical ecosystem services by acting as a buffer for sustaining water quantity and quality to the coast. Forest conversion to other land uses, even when completed at moderate levels, can increase freshwater flows and water yield to coastal ecosystems. These inland occurrences have consequences for downstream water quality and clarity which are critical factors for human preference and ecological function. Along the northern Gulf of Mexico coast, hurricane impacts leave forests damaged to a point where landowners do not have the financial capacity to restore them. Additionally, rising land values, increased road accessibility, and higher opportunity costs for maintaining forest land all increase the potential for coastal landowners to convert forest land to urban. Extreme weather events are likely to increase in frequency and intensity, due to climate change, along the northern Gulf of Mexico coast and landowner perceptions of this weather threat has yet to be studied. It is imperative to understand LULC change due to weather threat perceptions because the combination of damaging weather and changing LULC would adversely impact watersheds and their downstream coastal systems. During summer 2022, we will survey forested landowners, with properties greater than 50 acres, who reside in 10 HUC-8 watershed basins across the Alabama and northern Florida coastline. With the survey, we will assess responses to potential future weather risk to build greater understanding of what socio-economic and risk factors lead to LULC conversion or prevent it. We will record perceptions in the survey by listing scenarios of hurricane frequencies over 20-year periods and providing response options with LULC choices. At this conference, we will present these spatially explicit data as results from factor analysis and ANOVAs differentiating landowner characteristics, risk perceptions, forest and market policy perceptions, and the impact of potential land cover incentives. From our results, modelers may utilize perception and location responses to project the future forest cover, target critical areas for sustaining water resource integrity, and analyze forest cover implications for the hydrology of the watersheds encompassed in the study area.

Abstract #: 051

Title: ***Effect of cover crop and tillage practices on soil pore characteristics***

Authors: Preetika Kaur, Jasmeet Lamba, Vishawjot Sandhu, Thomas Way

Organization: Auburn University

Cover crops and conservation tillage have been used as an effective soil management practices that enhance soil health. However, these practices can create connected macropore networks which can cause preferential transport of contaminants to the groundwater or surface water via subsurface flow pathways. The main objective of this study was to compare the effect of cover crop and tillage practices (conventional vs. no tillage) on the pore size and shape distribution in the soil profile. The study was conducted at EV Smith Research Center, Shorter, Alabama. Two varieties of cover crops were mixed namely Cereal rye (Secale cereale) and Crimson Clover (Trifolium incarnatum) and planted in late fall and the main crop growing on the field was cotton (Gossypium). There were four different treatments i.e., Conventional till and cover (TC), no-till and no-cover (NTNC), Conventional till and no cover (TNC), and No-till and cover (NTC) under 2 seasons (fall and spring). Six replicates of intact undisturbed soil cores (15 cm diameter and 50 cm deep) were collected, and all the soil samples were then subjected to non-invasive computed tomography scanning which gave images of 0.35mm resolution. Soil pore characteristics such as porosity, mean curvature of pores, Euler density, specific surface area, and number of pores were derived from the CT scanned images. Results on comparison pore characteristics as a function of tillage and cover crops will be presented.

Abstract #: 052

Title: ***Blindly Seeking the Blind: Assessing the Efficacy of an Environmental DNA (eDNA) Metabarcoding Approach For The Detection Of Subterranean Crayfish.***

Authors: Nathaniel Sturm, Alexander Huryn, Kevin Kocot, Matthew Niemiller

Organization: Geological Survey of Alabama - Ecosystems Investigations Program

The State of Alabama has an incredible amount of aquatic biodiversity including a high number of endemic cave-dwelling species of conservation concern. Surveys for cave fauna present unique challenges, as subterranean habitats often extend well beyond what surveyors can physically or safely access. These obstacles can be overcome through collection and analysis of environmental DNA (eDNA) by providing information on occupying species without requiring extensive physical surveys and further anthropogenic disturbance of these delicate ecosystems. The term eDNA refers to genetic material that can be retrieved from bulk environmental samples and used for species detection. This study assessed the efficacy of an environmental DNA (eDNA) metabarcoding approach for the detection of blind, depigmented, obligate cave-dwelling crayfishes using a custom general crayfish primer pair to target the 16S mitochondrial ribosomal RNA (rRNA) gene and Illumina sequencing. To our knowledge, this is the first study that employs eDNA metabarcoding for the detection of subterranean crayfish. Crayfish eDNA was successfully detected at 15 of 22 sites, including four of the seven target subterranean crayfish species of the genera Cambarus and Orconectes, all of which are of conservation concern due to their presumed rarity and the specificity of their habitat. Detection was verified through phylogenetic analyses of amplicon sequence variants (ASVs), a custom reference database containing all publicly available crayfish 16S sequences, and full-length 16S sequences from six newly sequenced, complete mitochondrial genomes. Results not only indicate that these methods are effective for the detection of cave crayfishes, but also provide new information on the distributions of the cave species Cambarus speleocoopi and C. jonesi, which may influence future conservation efforts. This research also provided insights on the taxonomy of the obligate cave crayfish Orconectes sheltae, and the cave associated species C. tenebrosus. Furthermore, results showed the utility of these methods for detection of various other crayfish species such as the widely invasive Procambarus clarkii, in addition to revealing potential future directions for research involving Alabama's remarkable subterranean biodiversity.

Abstract #: 053

Title: ***Water Use in the Tennessee Valley for 2020 and Projected Use in 2045***

Authors: Jenny Sharkey, Gary Springston

Organization: Tennessee Valley Authority

INTRODUCTION The quality of life in the Tennessee Valley depends on ample water for homes, businesses, farms, meeting places, and recreational activities. Dependable water and low-cost electricity are fundamental to the economic growth of the region. It is anticipated that water supply and water-quality issues, coupled with emerging water use conflict over the fixed supply will continue to increase across the southeast. APPROACH The Tennessee Valley Authority implemented their current reservoir operating policy in 2004. One of the objectives of the operating policy was to meet the off-stream water needs of the Valley until at least 2030. TVA inventories water use every five years to project water demand in the Valley and to examine trends in water use. These results are used to determine how well the assumptions behind the operating policy are holding up. The data are also used for a variety of purposes, including the siting and permitting of new power plants and as an aid for TVA in its efforts to promote economic development in the Valley. Water use estimates focus on four categories of off-stream water use: thermoelectric power, industrial, public supply, and irrigation. Each record in the database is labeled as a withdrawal or return transaction. Each water use transaction is assigned to a Water Use Tabulation Area (WUTA) and Reservoir Catchment Area (RCA). RESULTS AND DISCUSSION This presentation describes 2020 water use for industry, public supply, irrigation, and power generation. It also presents the projection for 2045 water demand. Trends in water use and their implications will be discussed. This presentation will provide information for the water use in the entire Tennessee River Basin as well as a focused discussion about data specific to the Alabama portion of the Tennessee River Basin.

Abstract #: 056

Title: ***Effect of Image resolution and soil core size on soil pore characteristics***

Authors: Preetika Kaur, Jasmeet Lamba, Vishawjot Sandhu, Thomas Way

Organization: Auburn University

Image resolution and size of the soil core can impact the X-Ray Computed Tomography derived soil morphological properties. The soil physical properties (e.g., soil pore size, connectivity) can substantially influence contaminant transport through the soil profile. Improved understanding of soil physical properties can help elucidate contaminant transport processes through the soil profile. The main goal of this study was to compare the influence of CT scanning resolution and soil core sample size on the soil pore properties. Specific objectives were: 1) determine impact of core size diameter (6 inches vs. 3 inches) on soil macropore properties, and 2) quantify the effect of scan field of view on soil physical properties. The results of this study help understand how size of the core and resolution at which the cores are scanned can impact soil physical properties. Image J was used to analyze all the images attained from CT scanning. Results on change in soil pore properties as a function of soil core size and resolution will be presented.

Abstract #: 057

Title: ***Sediment Transport and Storage in Geographically Isolated Wetlands within Agricultural Fields in the Southeastern USA***

Authors: Chloe Eggert, Matthew Waters, Stephen Golladay

Organization: Auburn University

The coastal plain of Southeastern United States has karst geology that promotes the formation of Geographically Isolated Wetlands (GIWs). The dominant land cover of the region is intensive row-crop agriculture producing high yields of peanuts, cotton, and soybeans; however, little is known of land-water connections between fields and adjacent GIWs. Here, we used paleolimnological techniques to quantify nutrient deposition and storage in GIWs located in agriculturally dominated watersheds. Results showed that sediment delivery can be high in agricultural GIWs with sedimentation linked to both land use and precipitation changes. Furthermore, P deposition traced historic farming practices demonstrating increases at the onset pivot agricultural followed by decreases in P storage likely attributed to management practices implemented in recent decades. Storage calculations suggest that C storage in GIWs rival that of hypereutrophic lakes and reservoirs and could be a future source of carbon management in agriculture lands. Sediment storage within GIWs can prevent degraded water quality downstream. These results are also compared to a forested control GIW as well as surface sediment samples collected from GIWs encompassing a variety of land use practices. Finally, this study is designed to provide recommendations on best practices for managing runoff and promoting the importance of wetland function in biogeochemical processing.

Abstract #: 058

Title: ***Spatial and temporal changes of flash flood occurring precipitation events (FOPE) in the Southeastern United States***

Authors: Mohammad Siddiqur Rahman, Jason C. Senkbeil

Organization: The University of Alabama

Recent research has shown that the Southeastern United States (SeUS) is becoming increasingly vulnerable to extreme hydrological events like flash floods, floods, and droughts. The damage associated with flash flood occurring precipitation events (FOPE) is significant because these events are harder to predict and give less time to prepare and take action. FOPE are defined in this research as â‰¥1 in. h-1 rainfall rates occurring over less than or equal to 3 hours. Archived hourly precipitation data was collected from the National Climate Data Center for the SeUS. Stations which had at least a temporal coverage of 40 years or more with missing data â‰¤ 5 percent were used for this study. The time periods of 1981-2000 and 2001-2020 were compared to understand the changes in probability density function of FOPE frequency in the study area. Tests were also run to detect potential monotonic trends in the FOPE frequency time series for SeUS. Results revealed that 2001-2020 had a significantly greater frequency of FOPE . Findings indicate that 21 stations out of 61 stations observed significant increasing trends while only 1 station observed a significant decreasing trend.

Abstract #: 059

Title: ***Water Quality Analysis and Habitat Threats Concerning the Slenderclaw Crayfish on Sand Mountain in Northeast Alabama***

Authors: Rebecca Bearden

Organization: Geological Survey of Alabama

Understanding habitat threats for species of concern is paramount for establishing effective conservation strategies. Following a series of faunal surveys and habitat threats analyses, in September 2021, the U.S. Fish and Wildlife Service officially listed the Slenderclaw Crayfish, Cambarus cracens, as endangered, making it the first crayfish in Alabama to be federally listed. While studies in the 1970s recorded the species at five sites in Scarham, Short, and Town Creeks on Sand Mountain in northeast Alabama, surveys in 2011 found the species at only a single site in Scarham Creek. Subsequent surveys from 2015 to 2017 found the species in low abundance at five sites in Scarham and Town Creeks. The invasive Virile Crayfish, Faxonius virilis, has been recently collected in Short Creek, revealing a possible recent threat to the status of C. cracens. Water quality surveys in Scarham, Short, and Town Creeks in 2015 and 2016 showed elevated levels of ammonia, nitrate and phosphorus, concentrations of lead and zinc that exceeded aquatic life criteria, the presence of pesticides, and concentrations of bacteria that exceeded established limits. Ongoing water quality studies in Short and Scarham Creek watersheds continue to show elevated nitrate and phosphorus levels and pathogen levels exceeding state guidelines. Land use analysis has confirmed intense poultry production and high levels of human disturbance in watersheds draining Scarham, Short, and Town Creeks. In order to conserve remaining populations of C. cracens, we recommend continued efforts at establishing watershed projects to reduce pollutant loads, promoting best management practices for agriculture, and monitoring future water-quality trends to help assure the integrity of water quality in these tributaries and to assist in improving habitat quality throughout the Scarham, Short, and Town Creek watersheds.

Abstract #: 060

Title: ***Effects of Poultry Litter with Flue Gas Desulfurization Gypsum Bedding on Nutrient Release and Water Quality***

Authors: Anna Powell, Rishi Prasad, Dexter Watts, Debolina Chakraborty, Allen Torbert

Organization: Auburn University

Alabama produced an estimated 2 million tons of broiler litter in 2020. Broiler litter has been historically disposed onto pasturelands. Repeated land disposal of litter can result in nutrient losses, eutrophication to freshwater aquatic ecosystems, and degradation of water quality. Gypsum (CaSO4 â€¢ 2 H2O) has recently been explored as a poultry litter bedding to reduce ammonia losses from poultry houses, a compounding environmental issue. Additionally, previous studies have shown that gypsum reduces phosphorus runoff losses land applied with litter. Flue-Gas Desulfurization Gypsum (FGDG) is a man-made byproduct gypsum from powerplant SOx emission scrubbers. Using FGD gypsum bedding will reduce phosphorus runoff losses from land applied litter. The objective of this study was to compare nutrient losses from litter with FGD gypsum bedding to traditional and industry standard bedding materials. Two rainfall simulations events were conducted 5 weeks apart on a Pacolet-Rion complex at the Piedmont Agricultural Research Station in Camp Hill, AL in June/July of 2021. The litter treatments selected for the study received an initial bedding (1st flock) of either gypsum + decaked litter, shavings + decaked litter, or decaked litter alone, each initial bedding then received either no gypsum or 1,600lbs/1000ft2 of gypsum at flock clean-out for flocks 2-5 to compare traditional and gypsum bedding treatments. Additionally, a bedding treatment used for reduction of ammonia volatilization, Poultry Litter Treatment (PLTÂ®), (initial bedding of decaked litter with 100lbs/1000ft2 of PLTÂ® for flocks 1-5) was chosen to compare gypsum bedding. The seven litter treatments and a control (no litter) were replicated thrice in random complete block design just before the first simulated rainfall (70 mm/hr). Samples were taken at initial runoff and at 10-minute intervals for 40 minutes. The samples were analyzed for total phosphorus (TP), dissolved phosphorus (DP), NH4-N, NO3-N, Al, B, Ca, Fe, K, Mg, and Zn using standard protocols. All gypsum bedding treatments were found to significantly reduce TP and DRP loads (56-90%) in the â€œfirst flushâ€□event (simulation 1) compared to the litter treatment with industry standard bedding, PLTÂ®. In the second simulation, gypsum litter bedding did not reduce DP and TP loads but were not significantly greater than other bedding treatments. Nitrogen loads for treatments which received gypsum after clean-out (shavings + decaked and decaked) (8-11 kg/ha) were significantly greater than the control as NH4-N in the first simulation and as NO3-N (0.2-0.24 kg/ha) in the second simulation. Gypsum litter bedding is effective for reducing phosphorus runoff losses compared to the industry standard bedding for ammonia losses. While gypsum litter bedding resulted in more nitrogen runoff losses than the control probably due to less uptake by the grass, it served as an excellent alternative bedding to reduce phosphorus runoff losses to the environment.

Abstract #: 061

Title: ***Conservation Practice Adoption and Disadoption in the U.S.***

Authors: Wendiam Sawadgo

Organization: Auburn University

Nonpoint source nutrient pollution from agriculture has been a crucial issue across the U.S., with detrimental effects including harmful algal blooms, increased drinking water costs, and the hypoxic zone in the Gulf of Mexico. Cover crops and no-till are two in-field conservation practices that have potential to reduce nitrogen and phosphorous pollution from agriculture. Another off-farm benefit from these practices is increased carbon sequestration, which has received increased attention with the emergence of carbon markets. In addition to the off-farm benefits, long-term use of cover crops and no-till can result in on-farm benefits, such as reduced soil loss, increased soil organic matter, and enhanced water-storage capacity (Snapp et al. 2005). Between 2012 and 2017, the percentage of U.S. cropland in cover crops and no-till increased from 2.6% and 24.8% to 3.9% and 26.4%, respectively. However, while these values show overall progress in adoption of conservation practice use, they hide valuable information on gross adoption and disadoption of conservation practices at less-aggregated levels. This is important because disadoption of conservation practices might not only limit the immediate potential of soil health systems to benefit farmers and society (Stevens, 2019) but also erase accumulated environmental benefits from years of regenerative practices. Thus, this research summarizes county-level adoption and disadoption of cover crops and no-till across the U.S. These insights may be useful in understanding the likelihood of farmland remaining in continuous use of conservation practices to maximize environmental benefits. We also introduce an indicator to evaluate the efficiency with which conservation practices expand within regions while accounting for disadoption. We find that 863 counties, or 28.3% of all counties in the contiguous U.S. states, saw decreases in cover-crop acres. For no-till, 1,084 counties, or 35.5% of all counties saw a decrease in no-till acreage. Future policy design could lead to more cost-effective conservation policies if a concerted effort were made to calibrate the optimal mix of adoption-promoting versus disadoption-abating conservation programs. Our hope is that this research will raise key issues and motivate future research that will inform the design of policies to foster sustained adoption of regenerative practices in agriculture. This presentation would generate discussion among researchers, policymakers, and environmentally minded individuals. References Snapp, SS, Swinton, SM, Labarta, R, Mutch, D, Black, JR, Leep, R, Nyiraneza, J and O'Neil, K (2005) Evaluating cover crops for benefits, costs and performance within cropping system niches. Agronomy Journal 97, 322â€“332. Stevens, A. 2019. â€œEconomic Theory Provides Insights for Soil Health Policy.â€ Choices 32(2): 1â€“6.

Abstract #: 062

Title: ***Quantitative Microbial Risk Assessment to determine the level and source of fecal pollution, nutrients and water quality for various land uses and characterization in NW Florida aquatic systems***

Authors: Ronell S. Bridgemohan, Mathew Deitch, Tesfay Gabremichael , Dave Bachoon

Organization: Watershed Management Laboratory, UF WFREC

Quantitative microbial risk assessments (QMRA) is a modelling tool that has been developed to efficiently and effectively estimate the severe health risks associated with fecal contamination and associated pathogens.Fecal contamination of watersheds especially urban streams is of increasing concern along the Gulf of Mexico. The potential risk to human health and degradation of water quality from fecal pollution is one of the greatest threats to the stability and resilience of coastal communities. Northwest (NW) Florida has a thriving coastal tourism community that also serves many other purposes, such as recreational, commercial, shellfish harvesting and fisheries. However, increasing levels of fecal pollution pose a potential economic constraint and hardship for NW Florida as their economy primarily depends on a thriving coastal tourism industry. Understanding the dynamics of contaminants in streams represents an important first step for identifying their sources and methods to mitigate their delivery from the landscape. The aim of this study was to determine, to quantify the level of fecal indicator bacteria concentration (E. coli) and perform microbial source tracking to determine if sources of fecal contamination are human or animal host origin. Pensacola aquatic systems draining into Pensacola and Perdido bay are significantly impaired by fecal pollution. Water samples form baseline study indicate levels of E. coli exceeding limits considered safe for human health. IDEXX Colilert-18 was used to enumerate Escherichia coli in the samples and 3 sites exceeded the USEPA limit, 10-mile site (461.1 MPN CFU/ 100 ml) Mills Avenue site (410.6 MPN CFU/ 100 ml) and Villa Venyce site (613.1 MPN CFU/ 100 ml). DNA was extracted from each sample and qPCR was used for microbiological source tracking (MST) to detect host specific Bacteroides DNA. Microbial Source tracking detected human (HF183) fecal pollution at (44.45%) sites, dog (33.33%) and birds (CP1F/R) at (11.11%) sites and no sites were positive for ruminant. No sites were found positive for the pathogen helicobacter pylori. The high incident of fecal pollution and pathogenic bacteria in NW Florida is particularly alarming and represent a serious public health risk.

Abstract #: 063

Title: ***Evaluating Ecosystems Services for Irrigated versus Rainfed Agricultural Land in Watershed Plans***

Authors: Maury Estes, Lee Ellenburg, James Cruise, Adam Newby, Wendiam Sawadgo

Organization: University of Alabama in Huntsville

Managing water resources requires consideration of both environmental and socio-economic benefits to effectively balance the benefits and costs. This includes identifying ecosystem services (ES) of concern and how to evaluate the project or proposed changes effect on these ES. ES are the benefits to humans provided by the natural environment and from healthy ecosystems including agroecosystems, forest ecosystems, grassland ecosystems and aquatic ecosystems. The purpose of this effort is to describe how ecosystem services are being evaluated in a project to provide expanded irrigation to existing agricultural lands in Alabama. A case study has been undertaken on the Middle Alabama watershed in central Alabama and methods have been developed and applied to evaluate ES in terms of how irrigated versus rainfed fields will affect sediment retention, fertilizer usage and the effect of the subsequent discharges of sediment and nutrients on water quality. For both the sediment and nutrient ES methods, baseline conditions were estimated to evaluate the impact of the expansion of sustainable irrigation practices on sediment and nutrient loads affecting rivers and streams. The sediment method uses the modified Universal Soil Loss Equation (MUSLE) that combines erosion-influencing land use characteristics to estimate soil loss from upland slopes for a wide range of rainfall, slope, vegetation cover, and management conditions. The MUSLE replaces the rainfall energy factor in the Universal Soil Loss Equation (R factor) with a runoff energy factor to generate sediment load estimates. Potentially the use of conservation practices such as no till agriculture, contour farming, and crop rotations could reduce sediment loads and improve water quality. Scenarios are evaluated by modifying the cover management and farm practices to evaluate potential benefits of reduced sediment loss from sustainable agricultural methods. For the nutrient method, loads from fertilizer applications for irrigated (250 lbs./acre) and rainfed fields (180 lbs./acre) are used with efficiency factors and delivery ratios to determine total fertilizer loads affecting water quality. Efficiency ratios of 25% for rainfed and 75% for irrigated fields determine the efficiency of each type field to use fertilizer for plant growth and subsequently the residual nutrient loads in runoff (NRCS 2022). Applying a landscape delivery ratio of 30% to the nutrient loads in runoff provides a resulting nutrient load that reaches the hydrologic system (Hoos and McMahon, 2009). Both sediment and nutrient load estimates are combined with estimates of the value of load changes to estimate the ES benefits. The results of case studies in the Middle Alabama watershed indicate positive ES benefits from sustainable agricultural practices and the irrigation of agricultural lands versus rainfed fields.

Abstract #: 064

Title: ***Understanding Socio-technical Barriers to Decentralized Wastewater Management in the Rural Alabama's Black Belt***

Authors: Amal Bakchan, Kevin White

Organization: University of South Alabama

Over the past few decades, the Black Belt region of Alabama has been struggling from a lack of access to adequate wastewater management. The soil condition (impermeable shrink-swell clays) prevents infiltration of effluent and consequently causes hydraulic failure in conventional septic systems (e.g., septic tank drainfield). While ongoing research efforts are investigating decentralized clustered wastewater systems as promising cost-effective technological solutions to the wastewater challenges in these communities, how to best manage these small systems is largely unknown. If improperly managed, decentralized systems do not provide the level of treatment necessary to adequately protect public health and water quality. As such, establishing a responsible management entity (RME) that conducts the operation and maintenance (O&M) can ensure more reliable system performance; with an RME being defined as a legal organization with the technical, managerial, and financial capacity to operate and maintain viable decentralized wastewater systems. As a prerequisite to identifying adequate RMEs, this study (1) explores possible socio-technical barriersâ€”spanning the technical, financial, regulatory/institutional, social, and environmental dimensionsâ€”that may hinder RMEs' operations in the Black Belt communities; and (2) provides practical and policy recommendations that could best overcome these barriers. The study is enabled by a survey questionnaire administered to various public and private management entities (e.g., public water, sewer, natural gas, and electric utilities; electric cooperatives; solid waste management; and community development corporations). Using descriptive statistics and statistical inferencing, preliminary results indicate that the financial and regulatory/institutional barriers are the most critical issues that the targeted RMEs are concerned about. The â€œcommunity's limited financial capacity to pay for O&M servicesâ€ and â€œdifficulty to obtain fundsâ€are highly rated barriers by the respondents. As such, to further support the urgent need for decentralized wastewater management in rural, underserved communities, federal and state policy needs to address gaps in these systems' funding. For instance, more funds should be prioritized for the O&M of these systems, thereby enabling RMEs to ensure continuous system operations and reliability. Building off of this empirical understanding to the socio-technical barriers, the study contributes to practice by providing practical and policy recommendations that could best overcome the identified barriers, thereby contributing to addressing the wastewater issues in the underserved Black Belt's communities.

Abstract #: 065

Title: ***Respecting Public Priorities & Protecting Water Resources***

Authors: Scott Rogers

Organization: Alabama Department of Transportation

The understanding, support, and involvement of laypeople are integral in confronting the twenty-first century challenges that threaten water resources. Ordinary citizens can serve by reporting to appropriate authorities the suspected pollution of water and potential sources of pollution, educating fellow citizens regarding issues that can negatively impact water quality, and working with fellow citizens to resolve issues. Also, citizen buy-in allows for more acceptance of environmental practices implemented near homes, businesses, and roadways as well as stormwater taxes or fees levied. For these reasons, water resources professionals must be able to communicate in ways that account for the realities and priorities of ordinary citizens. In this presentation, findings from a Gallup survey that indicate how concerned U.S. citizens overall are with respect to multiple environmental topics will be discussed, and differences in concern corresponding to demographic factors and political ideology will be noted. The national survey findings will inform discussion about public perceptions regarding water resources-related issues and other environmental issues in Alabama. With an overall understanding of the water resources-related issues garnering more concern from Alabamians, general guidelines for functional communication with state citizens will be proposed. To demonstrate the need for and effectiveness of the guidelines, several representative cases where the Alabama Department of Transportation interacted successfully with citizens to address water resources-related issues will be explored.

Abstract #: 066

Title: ***Examining the effect of salinity on dolphin mortality by Lagrangian particle tracking in a hydrodynamic model***

Authors: Mehrzad Shahidzadehasadi, Anna Linhoss, Mark Lawrence, Debra Moore, Stephen Reichley

Organization: Auburn University

Numerous dolphins are found dead on the beaches of the Mississippi Sound every year. Based on observations of freshwater skin lesions, one potential cause of some of these deaths is low salinity from freshwater inflows and seasonal variation. Since the dolphins' carcasses are mostly found stranded on beaches days after they died, their initial place of death is unknown. In this study, a Lagrangian particle tracking module was used within a 2-D hydrodynamic model (EFDC+) of the Mississippi Sound. The Lagrangian particles were used to represent the movement of dolphin carcasses. A large number of particles (virtual dolphin carcasses) were seeded throughout the model domain and tracked forward for a range of days. These results were used to hindcast the original location of each dolphin's death. The anticipated results will indicate the primary place of death for dolphins found in 2019 on the beaches of Mississippi, and the salinity of the dolphins' place of death. These results will be compared to the average salinity of the Mississippi Sound and help to understand the role of salinity in dolphins' mortality.

Abstract #: 067

Title: ***Development of A Cross-scale Hydrodynamic Model for Perdido Bay***

Authors: Zhilong Liu, John Lehrter, Brian Dzwonkowski, Lisa Lowe

Organization: University of South Alabama, Dauphin Island Sea Lab

Reginal climate in Gulf of Mexico is changing with air temperature increasing and sea level rise. Meanwile, the lack of flushing due to weak tides together with eutrophication would make the ecosystem in estuaries along northern Gulf coast even vulnerable to climate change. Yet the impacts of future climate conditions on estuarine physical and biogeochemical processes are not well characterized. Hence, to understand the impacts of climate change on the physical-biogeochemical processes in Perdido Bay along northern Gulf of Mexico, we developed a three-dimensional hydrodynamic model using the Semi-implicit Cross-scale Hydroscience Integrated System Model (SCHISM). The model domain covers downstream portion of Perdido River, Perdido Bay, Wolf Bay and nearby coastal waters. Complex features in lower part of the bay including narrow tidal inlet Perdido Pass, Old River, Big Lagoon as well as associated channel systems are well resolved using cross scale grid resolution. The model performance is validated by hydrodynamic and hydrographic data from observation. This model together with an upcoming advanced biochemical model will be applied to predict the response of estuarine processes including tidal and subtidal circulation, vertical stratification, transport and mixing of nutrient, organic matter, and phytoplankton concentrations, and hypoxia development to rising temperature, changing river discharge and wind patterns. The results from this work will reveal the relevant importance of climate change in relation to natural variability and improve our understanding and predictions of how the Perdido Bay's physical and biogeochemical characteristics evolve in the future.

Abstract #: 068

Title: ***The Georgia Flow Incentive Trust (GA-FIT) - Protecting Farmers and Streams***

Authors: Mark Masters

Organization: Albany State University Georgia Water Planning & Policy Center

GA-FIT is designing a new tool to improve drought response to protect Georgia's streams while also protecting the economic well-being of Georgia farmers. The project is capitalizing on recent data and research to design a more targeted, quantified, and effective approach to agricultural interventions during drought, with a focus on incentives for voluntary irrigation suspension. By field-testing new incentives for drought response, we aim to attain benefits for endangered species and water users when water is most scarce â€“ and most needed.In Southwest Georgia, water forms the foundation for unique natural systems and a robust agricultural economy. Water from the region's rivers and aquifers is abundant in most years and supports farmers with irrigation water and unique aquatic species with habitat conditions that they depend upon for survival. Irrigation has supported this region in becoming one of the most highly productive agricultural regions in the United States. However, in some years, drought has led to water scarcity, reduced stream flows, and lowered aquifer storage and created threatening conditions for the farm economy as well as for the region's most sensitive and rare species.At the center of Southwest Geor's agricultural economy, the Ichawaynochaway Basin is a major tributary of the Flint River Basin which has faced particularly severe water constraints in recent periods of drought. Ichawaynochaway Basin has significant irrigated acreage and an agricultural community that is economically dependent on the availability of water from the streams and aquifers of the region. Over 90% of farmers in Ichawaynochaway have installed efficient low-pressure irrigation systems, and over 70% have adopted drop nozzles, which further increase efficiency.During recent droughts, in-stream flows in Ichawaynochaway Creek have dropped to extremely low levels and threatened the availability of water for aquatic habitat and for use by farmers and communities downstream. During the 2011-2012 drought for example, flows reached historic lows in Ichawaynochaway Creek.Work conducted by scientists at the Jones Center at Ichauway under a grant from The Nature Conservancy indicates that relatively modest reductions in irrigation water withdrawals in the Ichawaynochaway Basin during times of severe drought would result in ecologically significant increases in stream flow. This project seeks to intervene at that point of impact by focusing on incentives for water use reductions during severe drought.

Abstract #: 069

Title: ***Into the deep: How far into the water column can a drone actually measure?***

Authors: Kelly Kaye, Stephanie Rogers, Edna Fernandez-Figueroa

Organization: Auburn University

Unoccupied aerial systems (UASs), or drones, are becoming a useful tool for monitoring water quality, harmful algal blooms, and submerged aquatic vegetation. However, it is still unknown how far into the water column UAS sensors are able to collect reliable spectral data. Secchi depth is a measure of the transparency of water and is determined by lowering a black and white disk (i.e., Secchi disk) into the water until it is no longer visible to the user. Although it is assumed that UAS sensors can collect reliable data up to the Secchi depth, this has not been systematically tested. Thus, the objectives of this research were to determine how deep into the water column two different UAS sensors were capable of penetrating and whether spectral values correlated with measured Secchi disk depth. Data were collected in freshwater, estuarine, and marine environments to test the UAS' ability to monitor aquatic systems with different substrates and transparencies. Prior to UAS data collection, longlines with nine evenly distributed Secchi disks at three different depths were placed into the waterbody. The three depths were dependent on the respective Secchi depth of the waterbody and were calculated as ~x0.30, x0.60, x0.90 the current Secchi depth. In situ chlorophyll-a (estimate of phytoplankton abundance), phycocyanin (estimate of cyanobacterial abundance), total suspended solids (estimate of suspended solids), phytoplankton (estimate of phytoplankton species abundance and diversity) samples were collected up to the Secchi depth immediately after image collection. These parameters can affect the spectral properties of water, thus allowing us to better understand various parameters that can potentially interfere with the sensor. Aerial images were collected using an integrated red, green, blue (RGB) sensor onboard a DJI Phantom 4 Pro V 2.0 and a MicaSense Altum multispectral (red, green, blue, near-infrared, red-edge) and thermal sensor onboard a DJI Matrice 200. Aerial images were processed in Pix4D and ArcGIS Pro to create 2D orthomosaics and calculate spectral band algorithms. Preliminary results from a freshwater system suggest that the UAS sensors are not able to collect spectral information up to the Secchi depth. Rigorous data collection from various systems will allow us to determine various UAS sensor capabilities, as well as develop best practices for collecting reliable aquatic ecosystem data.

Abstract #: 070

Title: ***Assessing the spatial variation of wave climate in a fetch-limited estuary with clustering methods***

Authors: Ramin Baghbani, Anna Linhoss, Eric Sparks, Prem Parajuli, Matthew Virden

Organization: Mississippi State University

Spatial variation of wave climates in fetch-limited estuaries are determined by wind properties, fetch length, water depth, and vessel traffic. It is important to understand how wave climate varies across these waterbodies since it can be a major factor driving erosion, sediment transport, other processes, and, eventually, the design of management actions. Even with the known importance of understanding how wave climate varies spatially, there are few studies in fetch-limited estuaries that address this need. To address these issues, the main objectives of this study were to 1) perform cluster analysis to compare the behavior of wave climate and 2) determine important factors on spatial variations of wave climate in a fetch limited estuary. In this study, 29 wave gauges were deployed between August and September 2019 in Back Bay Biloxi, Mississippi. Raw and processed data were then clustered using two hierarchical clustering algorithms: Euclidian and Dynamic Time Wrapping (DTW). Three combinations of algorithms and data were compared to find the most effective approach for clustering wave gauges: 1) Euclidean algorithm on raw data, 2) Euclidean algorithm on processed data, and 3) DTW algorithm on processed data. Results from this study reveal that the dendrogram trees of Euclidean and DTW algorithms on processed data indicate that their clustering has a similar performance where most of the wave gauges fell in one cluster. Using the Euclidian algorithm on the raw pressure data resulted in wave gauges being more evenly distributed between the clusters. Additionally, using the Euclidean algorithm on the raw pressure data distinctly identifies that water depth has a clear influence on wave clustering and therefore wave behavior. This study can help in developing wave climate mitigation plans for the coastal communities.

Abstract #: 071

Title: ***Wetland Accretion Rate Model of Ecosystem Resilience (WARMER) and Its Application to Coastal Transportation Infrastructure Along Alabama State Route 180***

Authors: John Anderson

Organization: Auburn University

With over 60,000 miles of roads existing within coastal regions of the United States, surface transportation infrastructure is often found within unique ecological settings that are vulnerable to natural disasters and long-term climate impacts. Alabama State Route 180 located in Gulf Shores, AL is a coastal roadway impacted by severe coastal storms, high groundwater tables and future sea level rise. AL-180, also known as Fort Morgan Road, has great relevance as it serves as an evacuation route, enables local tourism, and is a route via the ALDOT ferry system. The area surrounding AL-180 supports a wide variety of ecological habitats for natural and nature-based features (NNBF). This project will focus on the effects of sea level rise on surface transportation infrastructure and the ability of NNBF to mitigate those effects in a manner that leads to more resilient pavements while simultaneously enhancing socioecological outcomes. Unlike conventional features such as levees, NNBF and hybrid features can be expected to change substantially over their lifespan through processes of sediment deposition, erosion, and plant growth. These processes in turn are responsive to hydrologic conditions such as inundation, water table fluctuations, and wave action. In order to inform hydrological and hydrodynamic modeling under NNBF and hybrid feature scenarios, we will apply the Wetland Accretion Rate Model of Ecosystem Resilience (WARMER), to the vegetated areas of proposed NNBF designs. This simple 1D model of marsh accretion should capture the dynamics of critical accretion processes for the individual sites along AL-180. WARMER predicts changes in elevation relative to mean sea level due to sediment deposition, primary productivity, decomposition, and soil compaction. We will parameterize WARMER using data on sedimentation rates and vegetation productivity collected by previous studies in the northern Gulf Coast and use the model to predict elevation changes under the inundation frequency scenarios developed by hydrological and hydrodynamic models as part of a larger project. This will allow us to predict how the hydrological function of the NNBF will evolve with time. This research directly addresses the overall goal of the NOAA Effects of Sea Level Rise (ESLR) program: to facilitate informed adaptation planning and coastal management decisions through the creation of integrated models and tools that enable the evaluation of vulnerability and resilience under a range of expected future SLR and extreme event scenarios. The outcomes of this project are highly relevant to State, Local, and Federal Departments of Transportation (i.e., Federal Highway Administration, FHWA), as well as other state and federal agencies.

Abstract #: 072

Title: ***Ethics in the field: evaluating the environmental impacts of field research.***

Authors: Shelby Rinehart, James D. Peabody, Jacob M. Dybiec, Janet B. Walker, Parker Richardson

Organization: The University of Alabama

Observational and manipulative field studies are essential for understanding the processes governing ecological systems under natural environmental conditions. Long-term field experiments are especially valuable for predicting and monitoring the impacts of climate and environmental change on ecosystems. However, field studies can be a substantial source of environmental damage resulting from the establishment of plots and installation of equipment (e.g., plot markers, data loggers, flux towers, etc.), collection of soil, plant, and animal samples, and trampling during site visits. These environmental disturbances can have long-term effects on study sites, with visible evidence of field studies sometimes present >5 years after a studies completion. Despite the known effects of field studies on the environment, ecologists often do not consider the extent of their environmental damage and there is no established framework for implementing ethical and responsible field practices. Here, we present a case study highlighting the environmental impacts of manipulative field studies on the edaphic conditions of salt marshes along the Alabama and southern California coastlines. We paired this case study with a survey of environmental scientists that evaluated 1) the scale of environmental damage inflicted by field studies, 2) how scientists perceive the environmental impacts of their work and their openness to adopting ethical practices, and 3) the impact of ecological studies on underserved human communities and habitats particularly sensitive to climate change. We found that experimental field manipulations had legacy effects on plant and animal community composition in Alabama and southern California marshes. For example, habitat trampling associated with field study maintenance resulted in up to 100% loss of aboveground plant communities and visible soil compaction that persisted for over one year after the original manipulative study. Given the frequency and intensity of researcher impacts on the environment and the clear need for robust field studies, scientists need to focus on implementing ethical field practices that increase the sustainability of environmental studies.

Abstract #: 073

Title: ***Geographical Distribution of Perceptions: Identifying and Mapping Barriers to Climate-Smart Agriculture in Alabama.***

Authors: Ruchie Pathak, Nicholas Magliocca

Organization: The University of Alabama

Today, multiple interacting pressures on agricultural production, such as growing food demands, environmental degradation, and climate change, call for the need to rethink our conventional agriculture practices. Shifts to climate-smart agricultural (CSA) practices including crop rotation, crop diversification, and (farm) water management, have demonstrated progress towards achieving economic, environmental, and social sustainability of farming operations. However, the factors conducive to their adoption and implementation are often context-dependent, therefore, a more regional focus on these factors constraining or influencing their adoption can be quite informative. Alabama in the southeastern United States provides an ideal test case to study how different socio-economic and biophysical characteristics determine the adoption of such practices. Since no single solution will be appropriate for all farmers within a region, there is a need to promote the adoption of a combination of technological and agroecological solutions. Using a perception geography approach and data collected from multiple survey questionnaires and face-to-face (semi-structured) interviews with both farmers and non-farmer stakeholders, this exploratory study attempts to understand and map the perceptions of these different stakeholders about the factors that are perceived as drivers and/or barriers to the adoption of such practices in the state. A regional understanding of the geographical distribution of differences in the drivers of and perceptions towards CSA adoption will facilitate the identification of the challenges and incentives needed to spur farmers in the Deep South to adopt these practices.

Abstract #: 074

Title: ***Robust Changes in North America's Hydroclimate Variability and Predictability***

Authors: Sanjiv Kumar, Candida Dewes, Matthew Newman

Organization: Auburn University

Climate change adaptation planning requires a robust understanding of the projected change in hydroclimate variability and predictability. Two large ensemble datasets have been used to quantify the hydroclimate variability and potential predictability changes. Then, a â€˜reddened El NiÃ±o-Southern Oscillation (ENSO™ framework is employed to partition the annual land hydroclimate variability, represented by root-zone soil moisture dynamics, into ENSO, land surface memory, and internal variability. Global warming increases ENSO and precipitation variability in North America. However, the corresponding change in soil moisture variability is relatively small and even decreases. The reddened ENSO framework suggests that the smaller change in land hydroclimate variability is attributable to the projected reduction in land surface memory due to increasing atmospheric water demand. The mean state change drives future drought and pluvial risks, suggesting infrastructure planning can incorporate robust mean state changes despite uncertainty in the variability projections. We also find a concomitant shift in the frequency of drought and pluvial events, with a higher power on annual time scales but less power on decadal time scales, enhancing inter-annual hydroclimate predictability.

Abstract #: 075

Title: ***Impacts of change in landscape composition and configurations on the water quality of Pensacola watershed-bay systems***

Authors: Tesfay Gebremicael , Matthew Deitch

Organization: University of Florida

Changes in landscape composition (land use type) and configuration (spatial structure) patterns are the main factors triggering water quality degradation. Many studies have been conducted to investigate the impact of landscape composition on water quality whereas the attention given to quantifying the association of water quality to landscape configuration is very limited. However, it is vital to understand the association of water quality with changing patterns of both land-use types and their spatial structures. This study aimed at a comprehensive investigation of how landscape compositions and configuration patterns affected the water quality in the great Pensacola bay-catchment system. The catchment was divided into 26 sub-catchments based on the location of water quality monitoring stations and seasonal (July to September) water quality indicators at the outlet of each sub-catchment were obtained from the Water Quality Portal (WQP). Land use/cover maps of the catchment from 2001 to 2019 were acquired from the National Land Cover Database (NLCD) and the spatial structure of each map was extracted using FRAGSTATS 4.3 software. The correlation and association of each landscape composition and configuration variables to water quality indicators were analyzed using a Partial Least Square Regression (PLSR) model. Results showed that the interaction between landscape composition (Evergreen Forest, urban and agricultural development, shrub and herbaceous) and landscape configurations (size, shape, density, fragmentation, aggregation and interspersions of patches) accounted for most of the variations in water quality (total nitrogen, total phosphorous, NO3NO2, NH4, DO, EC). The water quality of the catchment was affected both negatively and positively; however, the magnitude and direction of influences were not consistent at multiple spatial scales. The impacts were more amplified at a smaller spatial scale. Although both composition and configurations of the landscape impacted the water quality, significant changes were more explained by the composition. While the change in landscape patterns contributed to water quality degradation in multiple locations, positive effects were also observed in some sub-catchments. The findings of this study provide key information for improved land-use planning and protection of water quality at multiple scales of a catchment.

Abstract #: 076

Title: ***Modeling Organic Carbon Loading with the Soil Water Assessment Tool: Application to the Big Creek Watershed***

Authors: Sabahattin Isik, Latif Kalin, Henrique Haas, Xinzhong Du

Organization: Auburn University

Organic carbon (OC) entering streams and other water bodies can cause degradation of water quality, subsequently having negative impacts on both human and aquatic ecosystem health. Watershed models are useful tools that can help in understanding the fate and transport of OC in watersheds as well as identify the critical sources so that abatement strategies can be developed. In this study, we tested a newly developed OC transport module to the widely used Soil Water Assessment Tool (SWAT). The model was applied to the 81 km2 Big Creek watershed (BCW) in southern Alabama to estimate the total OC (TOC) loading to the Big Creek Lake, which is an important source of drinking water for the city of Mobile. The BCW is dominantly covered by evergreen forests. In hydrologic models, forest dynamics can substantially influence the hydrologic cycle, soil loss, nutrient cycling, and carbon sequestration. In the current study, the representation of forest dynamics in SWAT was also improved using species-specific re-parameterizations. Streamflow, sediment, and OC-related parameters were calibrated on monthly basis using the SWAT-CUP calibration software for the 1996-2003 period. The annual average TOC load from BCW was 328 tons/y which was 26% particulate OC (POC) and 74% dissolved OC (DOC). The model performances were measured with Nash-Sutcliffe efficiency coefficient (ENS) and the model percent bias ratio (PBIAS) statistics. Model predictions yielded ENS and PBIAS values of 0.83 and 7%, respectively, for streamflow and 0.84 and -0.1% for TOC. The results achieved here rely on an enhanced model representation of in-stream carbon dynamics and an accurate representation of forest processes in a widely used watershed model and may open new avenues for investigating carbon fluxes in forested watersheds.

Abstract #: 077

Title: ***Exploring and Mitigating Pathogen Pollution in Our Waters through Youth-Focused Citizen Science***

Authors: Mona Dominguez

Organization: Auburn University Water Resources Center

Alabama Water Watch (AWW) is a statewide volunteer water monitoring program that was established in 1992, and is based at the Auburn University Water Resources Center. AWW has a youth-focused partnership program, 4-H Alabama Water Watch that prepares educators to teach students about water monitoring and stewardship. In 2021, 4-H AWW launched the project, Exploring and Mitigating Pathogen Pollution in Our Waters, which is focused on pathogen pollution and bacteriological monitoring of local waters. The project is supported by a NOAA Bay Watershed Education and Training (B-WET) grant. Through the project, AWW developed a new curriculum, Exploring Pathogens in Our Waters (EOW), which lays out a path for educators to provide their students (grades 4-12) with meaningful watershed educational experiences (referred to as MWEEs by the NOAA B-WET Program) that are focused on understanding, detecting, and mitigating pathogen pollution in local waters. It also prepares educators to encourage students to synthesize knowledge and skills gained throughout the entire curriculum by creating final projects that focus on their bacteriological monitoring findings. Students present their final projects through research posters to other students, teachers, and community members. Following their participation in a project supported Professional Development Training, around 15 educators at 13 different schools in six Alabama counties piloted the project curriculum with their students during the 2021-2022 school year, regularly monitoring bacteria of local waterbodies and submitting their data to AWW. A small group of students participated in a project sponsored Student Project Forum at Blakeley State Park where they were able to present their research posters to AWW Staff. Students completed pre and post-tests that included questions related to their connection with water, knowledge of actions, science inquiry skills, science engagement, outdoor experiences and satisfaction, and knowledge and skill building. Results will be included during this presentation.

The project is effectively addressing the Gulf of Mexico Ance's Education and Engagement Priority by increasing environmental literacy and encouraging watershed stewardship by providing training and support that promotes effective education, outreach, and engagement related to water quality in the Gulf of Mexico Region. Furthermore, it contributes significantly to the goals of the Water Resources Priority, which include the use of science and technology to protect human, aquatic, and economic health in the Gulf Region. For these reasons, we feel that other educators and outreach professionals could benefit from learning more about the project. We also hope that they will consider how they might incorporate it into their work, support educators who are implementing the projects, or partner with AWW to enhance project outcomes.

Abstract #: 078

Title: ***Using Analytical Hierarchy Process to Quantify Survey Data for GIS Modeling***

Authors: Aaron Blackwell, Mark Elliott

Organization: The University of Alabama

GIS modeling is used extensively to forecast and predict phenomena in the world, ranging from surface runoff to forest health. In order to use or build a model, variables and weights must be given numerical values that a computer can process. This can be difficult when the subject to be modeled has a dearth of hard data. In situations where ground truthing is infeasible, calibrating the weights of variables can't be done reliably. In order to circumvent this obstacle, we've generated surveys for local experts to gather their opinions on the impact of various variables on a problem. The Analytical Hierarchy Process (AHP) is then used to mathematically evaluate the survey data and evaluate weights for use in modeling. While we have used this process to model rural wastewater problems, this technique can be applied to any modeling situation that can make use of expert opinion surveys.

Abstract #: 080

Title: ***Using hydrogeomorphic characteristics to predict tree species distribution and resulting ecosystem functions in a bottomland hardwood forest***

Authors: Matthew Shockey, Nate Jones, Carla Atkinson, Lisa Davis, Christina Staudhammer

Organization: The University of Alabama

Floodplain forests are an important and integrated component of river corridors. They reduce downstream flooding, store carbon, and are hotspots for biodiversity. While contemporary restoration and management efforts often aim to restore and enhance these critical ecosystem functions, key uncertainties associated with feedbacks between inundation regime and ecosystem function limit those efforts. In this study, we are beginning to address this challenge by examining the relationships between the abundance and distribution of tree species, inundation regimes, and cascading ecosystem functions. We characterized tree species abundance and distribution by establishing 50-0.04 ha experimental plots, where we identified tree species and hydrogeomorphic characteristics. We then characterized inundation regimes using a raster-based inundation model paired with 93 years of streamflow data from an adjacent USGS gage. Finally, to characterize ecosystem function, we used the TRY Plant Trait Database to collect physiological traits such as Leaf Mass per Area (LMA) and leaf Nitrogen-Phosphorus ratio (N/P ratio), which are commonly associated with ecosystem function. Our results highlight strong linkages between hydrogeomorphic characteristics, species distribution, and resulting ecosystem function. We found that both inundation duration and height above nearest drainage (HAND) were good predictors of species distribution ($p=0.001$, $p=0.002$ respectively). Similarly, we found both inundation duration and HAND were strongly associated with LMA and N/P ratios. Although more research on the predictive powers of HAND is needed, this study suggests it could be an effective metric that can improve current and future floodplain restoration projects.

Abstract #: 081

Title: ***Hyporheic Zone Temperatures as an Indicator of Surface Water-Groundwater Interactions***

Authors: Mary Hastings Puckett, Yong Zhang, Greg Guthrie

Organization: Geological Survey of Alabama

Hyporheic heat transport has received increasing interest in the last two decades because soil or fluid temperatures provide useful signals in hydrological processes and temperature itself affects river corridor ecosystems. Interpretation of temperature time series data even at the local scale hyporheic zone, however, remains a challenge, due to the complex interactions of local heat fluxes with groundwater discharge and subsurface heterogeneity. To obtain insights into spatial patterns and temporal dynamics of hyporheic exchange, this study applied the distributed temperature sensing approach to build hyporheic zone temperature profiles along the Magnolia River, Baldwin County, Alabama. The Magnolia River is a spring-fed river system, with significant interactions between groundwater and surface water. The riverbed is predominately comprised of sand and silt, making it highly conductive, both hydraulically and thermally. Three temperature sensors were deployed at each of three locations of varying depths (total of nine sensors) on a reach of the river for approximately three days in May 2022, where fluid temperatures were measured quickly, easily, and reliably. Data show a consistent temperature of 21.5 °C at the deepest depth below the sediment-water interface (~12 inches), a range of temperatures from the middle sensor varying from 21.5 °C to 23 °C at a shallow depth below the sediment-water interface (~4 inches), and a range of temperatures from the uppermost sensor in the water column from 21 °C to 23.5 °C. The high-resolution temperature time series data may identify the location of the hyporheic zone and, subsequently, the zone of interaction between surface water and groundwater, and may reveal the impact of phase lag and amplitude attenuation of temperature with depth. Models will be developed using this data to interpret the spatiotemporal exchange of surface water and groundwater interactions in the hyporheic zone by using a state-of-the-art subordinated heat flow model that can capture non-Fourier heat flux due to medium heterogeneity.

Abstract #: 082

Title: ***Temperature Tolerances of Threatened Organisms in the Cahaba River and how Future Climate Conditions May Impact Them***

Authors: Jonathan Carpenter, Latif Kalin, Henrique Haas

Organization: Auburn University

The Cahaba River is one of the most biodiverse rivers in the United States, providing habitats for 131 species of fish alone. This is also partly due to the Cahaba River being the second-longest, free-flowing river in the country. Unfortunately, 12 species of fish, mussels, and snails, as well as 6 terrestrial species of plants and animals, are listed as endangered or threatened. One vital factor for stream health, besides streamflow, is stream temperature, which drives both biochemical and ecological processes. Many organisms have a maximum temperature range where they cannot survive past and ranges that they prefer during their breeding season. For example, The Plicate Rocksnail (Leptoxis plicata) is a federally endangered snail that inhabits shallow, slow-moving streams. These snails rely on temperature cues to begin egg laying, with temperatures ranging between 24°C and 29°C. Temperature changes could cause these snails to have an earlier or shorter spawning period. Similarly, the Pygmy Sunfish (Elassoma zonatum) has been recorded laying eggs between 18°C and 20°C, with individuals dying off at higher temperatures. Future climate conditions stand to disrupt these populations by changing hydrologic conditions over large areas. In this study, we assessed the potential future changes in stream water temperature at various order streams within the Cahaba River watershed. We used the Soil Water Assessment Tool (SWAT) which has recently been improved with a physically-based Equilibrium Temperature model. The Equilibrium Model factors in the heat transfer from the atmosphere to water via solar radiation, wind speed, and stream water depth while also including surface-water interactions. The model was calibrated for streamflow and water temperature at a daily time step at a site where USGS has been making measurements. The calibrated model was forced with downscaled and bias-corrected climate data to forecast the future water temperature at various order streams. We will present how those projected changes in water temperature may affect threatened organisms in the Cahaba River watershed.

Abstract #: 083

Title: ***Use of Indicator of Reduction in Soils (IRIS) in Wetlands***

Authors: Thorsten Knappenberger, Joey Shaw, Eve Brantley

Organization: Auburn University

Federal laws protect wetlands in the United States. Indicator of Reduction in Soils (IRIS) tubes or films are used with coatings of iron or manganese oxide to observe the depth or occurrence of reducing conditions. The IRIS technology emerged over the past fifteen years. Initially, PVC tubes were coated with iron oxide and installed in wetlands. Soil saturation, a carbon food source, and microbes reduce the iron oxide into a soluble form, effectively removing the oxide coating from the tube. Reducing conditions can then be confirmed by a simple visual assessment of the PVC tube after extraction from the soil. Over the years, the technology emerged, and today coatings of iron and manganese are used on tubes or flexible films. After field installation, tubes or films can be scanned, and the percent reduction is then calculated using image analysis. The latest development is in situ use of cameras to study reduction dynamics in real-time.An overview of the IRIS technology will be presented with two case studies conducted by the authors. The first case study is on newly constructed wetlands and how the IRIS technology has helped to confirm wetland status in comparison to an adjacent undisturbed reference wetland.The second case study is on the development of the in situ method and the consequent image analysis. For that, a rhizosphere tube was coated with iron and manganese oxide and inserted into a saturated column filled with a surface horizon from a wetland soi. Images were taken hourly over 28 days. Reducing conditions were observed for manganese and iron after 1 and 4 d, respectively. This technology can be used to evaluate real-time reducing soil conditions with IRIS and improve oxide coating composition and tube/film development (e.g., coating thickness).

Abstract #: 085

Title: ***Soluble recalcitrant phosphorus removal and recovery from wastewater using micro-algae systems***

Authors: Giacomo DeLuca III, Kaushik Venkiteshwaran

Organization: University of South Alabama

Phosphorus is an essential nutrient for agriculture, but enormous concentrations can trigger eutrophication within nearby surface water sources. This can cause detrimental environmental and economic damage. Phosphorus is known to exist as several different forms within wastewater. Soluble recalcitrant forms are resistant to conventional removal technologies and can account for >50% of the total phosphorus in the effluent of a treatment plant, proving that they are the most difficult to remove. The objective of this research is to study microalgae's enzymatic ability to convert soluble recalcitrant phosphorus to soluble inorganic phosphorus forms that can be removed by using existing technologies and reused as fertilizers. Organic beta glycerol and inorganic triphosphate, two model forms of recalcitrant phosphorus, show promise during initial testing. More than 80% of the compounds were successfully converted into the inorganic phosphorus forms. These results could establish microalgae as an option for converting, removing, and recovering recalcitrant phosphorus from wastewaters. More complex forms of recalcitrant phosphorus and organophosphorus pesticides are being tested against the microalgae.

Abstract #: 086

Title: ***Future Project Timelines in the Changing Landscape of FEMA's Risk MAP Program***

Authors: Jeff Zanotti

Organization: Wood Environment & Infrastructure Solutions, Inc.

Pre-COVID initiatives and post COVID adjustments have collided to make a perfect storm in the world of Risk MAP. Watershed floodplain mapping project schedules were delayed and shuffled around as the world shut down. Some projects have been stuck in preliminary phase for years awaiting the necessary administrative approvals to move forward with the proper FEMA protocols. During this time though the landscape of official FEMA review priorities and definition of due process have changed. Studies entered preliminary under one set of rules and now are being held to a different set of rules to go effective. This new shift has caused many of these studies to go back through a revised preliminary phase again, delaying the projects by over a year. This presentation will focus in on what changed with the reviewing priorities between what is required to go preliminary and what is required to go effective. Is the benefit of a more stringent definition of what requires due process a good thing for the communities or outweighed by the harm of a delayed timeline of the final effective maps? Should projects that entered under one set of rules be grandfathered into those same rules or still go through the revamped process? I will also go over the future of mapping projects in a time when Base Level Engineering studies are occurring in abundance with studies being performed but new maps not being released until later projects. The new role of the database being paramount over actual maps due to FEMA's new Automated Map Production tool becomes required for future studies will be discussed.

Abstract #: 087

Title: ***Carbon Dynamics in Headwater Wetlands of the Weeks Bay Watershed***

Authors: Ana Flavia Brancalion Costa, Latif Kalin, Sabahattin Isik

Organization: Auburn University

Wetlands are widely distributed around the world and are characterized by a plant community adapted to saturated soil conditions. These ecosystems can provide environmental services such as pollutant removal, flood regulation, and coastal protection. Wetlands can also provide an optimum ecosystem for carbon sequestration. However, wetlands are also natural sources of greenhouse gas emissions, being considered the greatest individual source of methane to the atmosphere. Wetlands can act as a source or sink of carbon and other nutrients depending on their characteristics such as age, type, location, and climate. Human alterations in these ecosystems can also be an important driver of the carbon dynamics in wetlands. In this context, the main objective of this study is to present the preliminary results to analyze the export, retention, and storage of dissolved organic carbon in headwater forested wetlands located in the Weeks Bay watershed, which is part of the Mobile Bay estuarine system. Simulations were performed at selected headwater wetlands with a process-based wetland model to address the potential of carbon sequestration in the study area and the function of these wetlands as a carbon sink or source. Freshwater, N, P, and C loading to the wetlands were provided by the Soil Water Assessment Tool (SWAT). The carbon cycle in the wetlands was simulated with WetQual-C, which is an extension of a well-studied wetland nitrogen and phosphorus cycling model. Initial runs with typical parameter values generated unrealistic results for the concentration of DOC over time. Sensitivity analysis revealed three key parameters impacting the carbon processes. Since there are no observed carbon measurements in any wetlands or streams in the study area, model parameterization was performed using various soft data sources, such as tree biomass estimates in forested wetlands. Although this study focuses on only a handful of headwater wetlands in the Weeks Bay watershed, the results can provide important information regarding the carbon sequestration potential of these understudied freshwater forested wetland systems in the Weeks Bay, and the coastal plains of the Northern Gulf of Mexico in general.

Abstract #: 088

Title: ***Investigating the impacts of longleaf pine (Pinus palustris) restoration on water quantity and quality in the Mobile River Basin-AL***

Authors: Henrique Haas, Latif Kalin

Organization: Auburn University

Longleaf pine (Pinus palustris) restoration (LLPR) is an important land management objective in the Southeastern U.S. (SE-US). Longleaf pine is considered to have superior water use efficiency and lower stocking than commercial pine stands such as loblolly pine (Pinus taeda). These characteristics may reduce the amount of water lost through evapotranspiration and consequently increase the water yield of areas dominated by longleaf pine ecosystems. The Mobile River Basin (MRB), which is largely covered by loblolly pine, contributes approximately 95% of the freshwater discharged to the Mobile Bay estuary. Freshwater inflow to the Mobile Bay has seen a declining trend in the last few decades. It is hypothesized that increasing the extent of longleaf pine stands in specific areas of the basin could counteract these ongoing trends and increase regional water yield. To assess the effects of LLPR on basin-level water quantity/quality, this study applies the Soil and Water Assessment Tool (SWAT) model to the MRB under two modeling scenarios: (i) current basin conditions (baseline model), and (ii) a LLPR model. A physically meaningful parameterization of longleaf pine will be presented for SWAT and predictions of streamflow, total suspended solids (TSS), nitrate (NO3-), and phosphate (PO4+) from the baseline and LLPR models will be compared. The baseline model was calibrated for daily discharge and monthly water quality loads using the automated calibration software SWAT-CUP. Our findings could be extremely valuable in guiding watershed-scale LLPR plans in the SE-US and shed light on the effects of LLPR on watershed-scale discharge, water yield, sediment loss, and nutrient loads.

Abstract #: 089

Title: ***Watershed Network Dry Down Effects on Dissolved Gas Concentrations (N2, Ar, O2) in a Prairie Stream***

Authors: Christopher Wheeler, Jessica Wilhelm, Erin Seybold, Sam Zipper, Amy J. Burgin

Organization: The University of Alabama

Global changes to the hydrologic cycle are projected to increase the frequency of stream intermittency, likely resulting in changes to stream biogeochemistry and ramifications for downstream water quality. Dissolved gasses are products of biological processes as well as controlled by physical drivers (e.g., temperature, water movement) in the stream network. Yet, the effects of declining stream network discharge and network contraction (i.e., network dry down) on dissolved gas concentrations remains understudied, particularly with regards to ecosystem processes. Therefore, we investigated the effects of network dry down on dissolved gasses (e.g., excess N2 and excess O2) in the headwaters of Kings Creek, an intermittent stream in Konza Prairie (Kansas, USA), during summer 2021. We asked: How does a drying stream network affect in-stream dissolved N2, O2 and Ar concentrations? We hypothesized that network drying would lead to more isolated pools, which would create biogeochemical hotspots on the landscape. We continuously measured the presence and absence of water using Stream Temperature, Intermittency and Conductivity (STIC) sensors at 50 sites in the ~500 ha watershed. Each month, we collected dissolved gas samples from any surface water present at all 50., We analyzed gas samples via a Membrane Inlet Mass Spectrometer. Only 14% of sites were dry at some point during the 30 days prior to June sampling compared to the 50% and 66% of sites dry prior to July and August sampling, respectively. Excess dissolved N2 indicated our drying stream network had both hotspots of denitrification (N2 production) and N-fixation (N2 conversion to biomass). Furthermore, excess O2 indicated areas of potentially high photosynthesis and respiration. Areas of highest biogeochemical potential were associated with groundwater features, such as springs and seeps. While our sampling method does not allow us to discern if the gas signatures result from in-stream processes or groundwater inputs, it does allow us to understand the resulting surface water chemistry that may interact with downstream perennial waters. Ultimately, our findings can inform understanding of intermittent stream network contraction effects on stream biogeochemistry and downstream water quality.

Abstract #: 090

Title: ***Stream temperature prediction using a machine learning approach in the Mobile River Basin, AL***

Authors: Henrique Haas, Sabahattin Isik, Latif Kalin

Organization: Auburn University

Stream water temperature is an important regulator of aquatic life influencing the health and productivity of aquatic ecosystems, riverine processes such as nutrient cycling, and socio-economic sectors such as hydropower generation and drinking water supply. Direct measurements of stream water temperature are usually scarce, discontinuous, and/or lack high spatial/temporal resolutions. In this context, models can be powerful tools to predict historical water temperatures and estimate how stream temperatures may respond to future climate variabilities. Stream water temperature is usually modeled using either statistical models or process-based models. Statistical models are known to be oversimplistic and rely solely on the empirical relationship between air temperature and water temperature, without the consideration of other climate variables (e.g., solar radiation) and hydrological variables (e.g., streamflow, baseflow, surface runoff). On the other hand, process-based models can be complex and require large amounts of input data and deep knowledge of the physical processes at play. Machine-learning models such as Artificial Neural Network (ANN) can bridge the gap between simplistic statistical models and overly complex process-based models. In this study, ANN models are developed to predict daily water temperature at seven major rivers across the Mobile River Basin (MRB), Alabama, using readily and publicly available weather and hydrologic data. Results from a correlation analysis show a strong and positive correlation of air temperature and solar radiation with stream temperature. Additionally, results indicate a strong and negative correlation between streamflow/baseflow and water temperature. Stormflow generally showed a weak correlation with water temperature. The performances of the ANN models in predicting daily stream temperatures were good at all sites, with coefficient of determination (R2) > 0.9 at all sites, except for the Tombigbee River. Overall, results consistently demonstrate that ANN models driven by readily available input data have powerful predictive skills in estimating daily stream water temperatures at major rivers across the MRB. More importantly, the input information utilized here consists of simple climatological and hydrological variables that can be readily and freely acquired. This facilitates the application of similar ANN models to other river systems and makes our findings easily reproducible by stakeholders and decision-makers.

Abstract #: 091

Title: ***Improved Stormwater Management through Zeolite Amended Bioretention Media***

Authors: Shelton Griffith, Thorsten Knappenberger, Eve Brantley, Joey Shaw

Organization: Auburn University

Bioretention cells are depressed landscape features filled with permeable media designed to address stormwater toxicity in urban settings. A well-designed bioretention soil medium must consider aspects of both soil physics and soil chemistry to ensure proper infiltration rates are met while removing dissolved and particulate pollutants. Although bioretention cells are traditionally composed of sand, silt, clay, and organic matter, research on the incorporation of alternative materials has gained popularity. Ecolite is an aluminosilicate and microporous soil amendment with the potential to increase the infiltration rate and cation exchange capacity of the soil. The purpose of this study was to determine the ability of Ecolite amended media to remove lead, zinc, copper, nitrate, ammonium, and phosphorus from water through column experiments. One mixture of 85% sand, 11% fines, and 4% organic matter (ALMIX) by volume was included and modified by replacing sand with zeolite at 2% (AUMIX2), 10% (AUMIX10), and 20% (AUMIX20) volume. A control of 100% sand was included. Each mixture was placed in four columns, resulting in a total of 20 columns arranged in a randomized complete block design. Synthetic stormwater with known concentrations of pollutants was applied to the columns and the effluent was collected. Pollutant concentrations of the effluent will be measured with inductively coupled plasma mass spectrometry and spectrophotometry. Results from four simulated storm events will be presented. AUMIX20 had the highest nutrient removal rates and a significantly higher infiltration rate than ALMIX.

Abstract #: 092

Title: ***Spatio-temporal variation of nitrogen biogeochemistry in a forested intermittent watershed***

Authors: C. Nathan Jones, Delaney M. Peterson, Shannon Speir, Carla L. Atkinson, Amy J. Burgin

Organization: The University of Alabama

Non-perennial streams, or streams that go dry on a regular basis, make up the majority of stream miles in Alabama despite nearly 56 inches of precipitation on average in a year; and these systems play an important role in supporting downstream water resources, biodiversity, and water quality. However, non-perennial streams are understudied with regard to their physical, chemical, and biological functions when compared to their perennial counterparts. Therefore, our study asks: How does spatial and temporal variation in stream drying impact nitrogen removal via denitrification? To begin to understand this question, our study examines the spatial and temporal variation in nitrogen biogeochemistry across a forested intermittent stream in a piedmont physiographic province (Alabama, USA). At the reach-scale, we will examine the spatio-temporal variation of denitrification hotspots by using a combination of synoptic sampling campaigns and seasonal experiments (e.g., reach-scale uptake experiments or in-situ rate measurements). At the watershed scale, we plan to examine the dynamics of nitrogen export by using continuous nitrogen measurements at the watershed outlet. In conducting this cross-scale comparison, we will connect upstream hydrologic and biogeochemical processes to downstream water quality dynamics. Our findings will allow us to better understand stream drying effects on downstream water quality and ecosystem health, giving us a better grasp on the spatio-temporal controls on N removal and export dynamics in drying stream networks.

Abstract #: 093

Title: ***SipSafe Program: Findings from our first year of lead testing in drinking water at child care facilities***

Authors: Jason Barrett

Organization: Mississippi Water Resources Research Institute

Lead in drinking water has had heightened attention since the Flint Michigan crisis even though lead has been an issue for years. The EPA has passed the lead and copper rule that regulates and dictates testing for lead in drinking water systems but does not specifically address the most at-risk individuals which are youth under the age of six. This research and extension effort focuses on child care facilities with a goal of determining best practices to reduce and/or eliminate the expose of lead in drinking water by testing for lead at each faucet within each facility. Protecting children from lead exposure plays a critical role in ensuring they develop into healthy adults. Children under the age of 6 have shown slowed growth, learning disabilities and other physical and mental impairments after prolonged exposure to environmental lead. The SipSafe Program seeks to limit children's exposure to lead via drinking water by screening water in qualifying schools and childcare facilities across Mississippi, as well as offering remediation assistance and educational materials on the dangers of lead.

Mississippi State University Extension with assistance from the Mississippi State Department of Health, Mississippi Department of Education, Mississippi State Chemical Laboratory, and other cooperating partners, SipSafe has developed into a program that: rains staff and operators at participating facilities how to protect their children from lead exposure. ests drinking water in participating facilities for lead and its soues. akes action to help facilities reduce the amount of lead in their drinking water and further raise state-wide awareness of lead exposure in children. tilizing public water system water quality data and elevated blood lead level data, SipSafe has identified 14 counties in Mississippi to focus its initial screening activities. It is anticipated that data collected from these counties will be beneficial in future school and childcare drinking water screening efforts. This presentation will display and discuss the findings from one year of testing approximately 60 child care facilities in 19 different counties throughout Mississippi.

Abstract #: 094

Title: ***Evaluation of Atmospheric Land Exchange Inverse model (ALEXI) Evaporative Stress Index (ESI) utilizing Soil Climate Analysis Network (SCAN) stations across Alabama***

Authors: Corey Walker, Lee Ellenburg, Vikalp Mishra, John Mecikalski

Organization: University of Alabama in Huntsville

The Atmospheric Land Exchange Inverse (ALEXI) model uses Geostationary Operational Environmental Satellite (GOES) thermal bands to derive daily evapotranspiration estimates at the continental scale (5 km spatial resolution). This data is used to derive a weekly Evaporative Stress Index (ESI) representing standardized anomalies of the actual to potential evapotranspiration ratio. ESI was developed as a remote sensing indicator of agricultural drought, representing the deficit in actual ET to the potential due to vegetative stress. ESI is functionally related to the rootzone moisture content. As the AET/PET ratio approaches unity, the greater the available water at the rootzone is for agricultural fields, whereas the opposite is true during periods of drought. However, the relationship between the ALEXI ESI and rootzone soil moisture may not be linear or consistent across space (horizontal/vertical) or time. Therefore, there is a desire to better understand the relationship between ALEXI ESI and real SM values, as well as an empirical knowledge of what ESI means in relation to point measurements of SM on the ground. This talk will provide such discussion on the relationship between ALEXI-based ESI with weekly-corrected, in-situ, volumetric SM values from a collection of SCAN stations across Alabama. The implications of this research will lead to a better understanding of how ALEXI ESI can be used as an indicator for agriculture and flash drought in the Southeastern U.S.

Abstract #: 096

Title: ***Long Short-Term Memory (LSTM) Model for Predicting Groundwater Level in the State of Alabama***

Authors: Victoria Robinson , Sahar Tabatabaei Sadeghi, Mojdeh Rasoulzadeh, Gregory Guthrie

Organization: The University of Alabama Dept of Mathematics

A predictive tool to forecast the groundwater response time to precipitation events and other major climatic parameters can be beneficial to evaluate the short- and long-term impacts of natural and anthropogenic stresses on groundwater resources. It will also be beneficial for stakeholders and decision makers to effectively estimate the key factors controlling groundwater availability/quality in the area. We investigated the applicability and ability of a Long Short- Term Memory (LSTM) neural network model for predicting fluctuations of groundwater levels by using widely available and easy to measure input features such as maximum/minimum air temperature, daily precipitation, and groundwater level data. Continuous time-series data collected over eight years, from January 2012 to May 2020, from 8 monitoring wells located across the state of Alabama have been used in the model. The wells are located outside of the known area of influence of any other groundwater sources and are not affected by usage stress. The LSTM model parameters were selected and initialized according to the insights we gained from a preliminary statistical analysis prior to the application of LSTM. A continuous wavelet transform (CWT) analysis was performed to estimate the lag in response time of groundwater levels to precipitation events and was used further to select the dropout for the model. Based on the CWT analysis outcome the short-term response time of groundwater levels can be expected within 15-30 days after a precipitation event, depending on the well locations. This outcome was used to construct the 30-day sequences for short term memory training. The performance of our prediction was compared with different prediction dates and prediction training datasets. Our results suggest that the proposed LSTM network can be an efficient tool for forecasting the groundwater level fluctuations in the corresponding monitoring wells. The predicted data offered a Nash Sutcliffe efficiency (NSE) that ranged from 0.85 to 0.96. Our proposed model is able to provide predictions within a 95 percent confidence interval of the actual measured groundwater levels.

Abstract #: 097

Title: ***Public knowledge and understanding about groundwater***

Authors: Ann S. Ojeda, Stephanie Rogers, Karen S. McNeal

Organization: Auburn University

In the Southeast US, about 40% of drinking water comes from groundwater supplies. However, there are widely held misconceptions about the nature of groundwater, the quality of groundwater, and the quantity of groundwater in the Southeast, and there are limited available tools to accurately measure people's understanding of these facets. To address this assessment gap, we developed and validated a groundwater concept inventory (CI) to measure a person's knowledge. The CI was grounded in item-response theory, which models test-taker ability against question difficulty to produce a scaled score for each individual. The CI was designed iteratively to reflect feedback from a range of skill levels in geoscience and engineering. The pilot survey was deployed through Mechanical Turks, an Amazon web service (n=385). A Rasch model was applied to the survey results and reliability thresholds were also considered. Ultimately, the initial set of 17 questions was reduced to 10, meeting generally accepted survey metrics for the Rasch model and item-response theory approach. Then, we explored relationships between the scaled CI score and other factors using multiple linear and logistic regression. We found that residential setting (urban versus rural), education, political affiliation, and age were statistically significant predictors for CI scores. However, there was not a significant difference in CI score related to drinking water supply (public versus private well), and private well users did not form a distinct pattern of correct or incorrect answers for individual questions compared to those that rely on public supply. Overall, the most difficult questions about groundwater were about practical aspects of groundwater use (e.g., target lithology for productive wells), and we can use this information to create more targeted educational resources for the general public and well users, specifically.

Abstract #: 098

Title: ***The Rise and Fall of Native Black Bass Diversity in the Southeastern U.S.***

Authors: Steve Sammons

Organization: Auburn University

Black bass Micropterus spp. are one of the most important sportfishes in the U.S., but until recently the full range of their biological diversity has been unappreciated. Most of the research and management activities have been directed at the two most widely distributed and therefore popular species, namely Largemouth Bass and Smallmouth Bass. However, there may be as many as 15-16 more species of black bass currently extant in North America, and for the most part the ecology, distribution, and ecology of these species is poorly understood. For years, biologists working in areas where these fishes were found operated under the concept that â€œbass were bassâ€i.e., that they were resilient, adaptable, and largely unaffected by anthropogenic activities happening around them. However, recent work on some of these species has revealed that this is not the case. Many of them are obligate fluvial specialists, but knowledge of what components of fluvial systems are necessary for continued persistence is lacking. One pervasive threat for all of these species is competition and introgression with introduced non-native congeners, most commonly stocked by anglers. Several stocks of these fluvial bass species have undergone rapid declines after non-native congeners have been introduced, and recovery of these fishes is questionable. More troubling, over the last two decades sudden, unexplained local extirpations or steep population declines have been documented for these species, most notably Shoal Bass in the Chattahoochee River Basin, which is one of the most-studied fluvial bass species over the last 10 years. Given the vast lack of ecological knowledge for most of these species, and the resulting uncertainty of their habitat needs, these unexplained losses are likely to continue in the future. Thus far, recovery and research efforts have been occurring at a much slower pace than the declines caused by anthropogenic disturbances, non-native introductions, or unknown causes. Many of these species live in hard-to-access areas and inhabit habitats that are difficult and/or dangerous to sample, further hampering efforts to understand ecological needs of these fishes. As we enter the third decade of the 21st Century, the immediate fate of several species hangs in the balance of our ability to find innovative ways to sample these species and garner sufficient resources to increase the capacity of restoration efforts. Otherwise, it appears likely that these black bass species face imminent, effective extinction.

Abstract #: 099

Title: ***An Overview of FEMA Flood Risk Products Available for Communities in Alabama***

Authors: Kelley Rich

Organization: Wood Environment & Infrastructure Solutions, Inc.

When the FEMA Risk Mapping, Assessment, and Planning (Risk MAP) program was implemented a decade ago as the successor to the Flood Map Modernization program, FEMA expanded their flood risk-related deliverables to include a set of non-regulatory Flood Risk Products (FRP) produced in conjunction with the regulatory Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) for the purpose of increasing awareness and engaging communities regarding flood risk. The FRP dataset includes the Flood Risk Database (FRD), Flood Risk Map (FRM), and Flood Risk Report (FRR) and is an enhanced dataset that serves as a companion to the regulatory Risk MAP products, consisting of information used and created during the development of the regulatory FIRM and FIS products. In this presentation we will explore the more frequently utilized FRP elements, including Changes Since Last FIRM (changes to floodplain designation since the previous effective products were created), flood depth and water surface elevation grids for all modeled flood events, information about structures located within the floodplain as defined in the regulatory products (including estimated financial loss due to flood for all modeled flood events), and Areas of Mitigation Interest (e.g. at-risk community facilities, past claims hotspots, stream flow constrictions). As FEMA and their mapping partners began receiving feedback on the utility of the FRP dataset from FRP users, FEMA revised the FRP production guidelines to streamline the product development process, resulting in some FRP elements being eliminated, combined, or renamed. Here we will clarify the revisions FEMA specified in their FRP guidance updates since production of these datasets initiated, and we will demonstrate where FRP data can be found and downloaded online. FRP datasets are not yet available to all communities within Alabama, as not all areas in the state have been restudied since FRP production began, so this presentation also serves to define the areas in Alabama that currently have FRP datasets available and areas for which these datasets are currently in production or are currently queued for production.

Abstract #: 100

Title: ***Using the BCG and measures of watershed condition to improve Alabama's Surface Water Quality Program***

Authors: Lisa Huff, Pat O'Neil, Susan Jackson, Ben Jessup, Jen Stamps

Organization: Alabama Department of Environmental Management

Over the past four decades, ADEM has strategically built a comprehensive biological monitoring and assessment program for streams. As part of this long term commitment to strengthening the technical capability of its biological monitoring program, ADEM developed quantitative Biological Condition Gradients for streams in all regions of the state. In conjunction with its existing, well-established biological indices, ADEM is using the BCG to characterize reference condition, assess current condition, identify high quality streams and watersheds, monitor improvements in degraded streams as BMPs implemented, and more clearly communicate to the public on the status of their streams.

Abstract #: 101

Title: ***Evaluation of wood-chip bioditch reactors as a nutrient reduction conservation strategy***

Authors: Geoffrey Payne, Matthew Moore, Kevin Krajcir, Jerry Farris

Organization: Arkansas State University

The increasing demand for agricultural products continues to negatively impact water quality in the Mississippi River Basin. Conservation strategies such as wood-chip bioreactors have used in tile drainage systems to effectively reduce nutrient runoff into receiving aquatic ecosystems. Based on the concept of these bioreactors, flexible and dynamic erosion control logs filled with standardized recycled wood chips packed into nylon compost socks were assessed as bioditch reactors using outdoor tub mesocosms (1.25 X 0.6 X 0.8 m). Mesocosms were dosed with nitrate (NO3-N) and phosphate (PO4-P) enriched municipal well water to simulate runoff events. Fluid Metering Inc. (FMI) piston pumps and vinyl tubing were used to deliver nutrient enriched and control water to each assigned system for 12 h and pump flow rates adjusted to target hydraulic retention times of 6 h before water exited mesocosms. We then measured exiting nitrate (NO3-) and orthophosphate (PO4)3- concentrations hourly for 12 h and then at 24, 48, and 72 h from 16 mesocosms, 12 containing two bioditch reactors atop 0.2 m of soil and four controls with only 0.2 m of soil in each. Early results indicate that this practice could reduce NO3- concentrations in agricultural ditches, although there was a release of phosphorus associated with use of the wood chips, suggesting selection of appropriate compost or recycled products will require further research to enhance nutrient mitigation at appropriate system scales.

Abstract #: 102

Title: ***Understanding the interacting effects of climate and land use on sedimentation rates in geographically isolated wetlands in agricultural landscapes***

Authors: Frances O'Donnell, Coleman Barrie, Chloe Eggert, Matthew Waters, Steven Brantley

Organization: Auburn University

Geographically isolated wetlands (GIWs) are widespread in many agricultural regions, but their role in mitigating non-point source water pollution is poorly understood and they lack the legal protections of riparian and floodplain wetlands. It is likely that healthy GIWs store sediment, reducing the impact of disturbance from agriculture on water quality. Strategies for protecting or improving wetland function while maintaining agricultural productivity are needed. We are investigating these issues in an ongoing study in southwest Georgia, a karstic region with numerous GIWs and intensive irrigated row crop agriculture. The agricultural GIWs in the study are on working farms and are compared to reference wetlands within forested watersheds. Rain gauges, water level loggers, and sediment traps were installed in each wetland and samples are collected regularly for water quality analysis. We are using these data to develop a watershed model of the contributing area of each wetland based on the model mechanics of the Soil Water Assessment Tool (SWAT) to simulate water, sediment, and nutrient transport. We also collected long cores from each wetland, which were analyzed using paleolimnological techniques to quantitatively reconstruct sediment dynamics throughout the 50-100 year period of agricultural expansion in the study area. Our results show good agreement between average wetland sedimentation rates produced by paleolimnological analysis of long cores, sediment trap measurements, and event-scale modeling, indicating that it is valid to make comparisons between the outputs of these methods. Sedimentation rates were much higher for the agricultural wetlands than the reference forested wetlands. Sediment core analysis showed distinct spikes in sedimentation rate that appear to coincide with extended droughts during times when the contributing area was disturbed by agriculture or forestry. These spikes were not replicated by a historical run of the SWAT model, indicating a need for improved representation of the interaction between climate and land use in hydrological and sediment modeling. The goal of this study is to identify management practices, such as maintaining vegetated buffers or improving wetland connectivity, that improve GIW health and function for water quality with minimal impact on agricultural productivity. Local agricultural stakeholders are engaged in the research activities. The collaborative process of discovering the presence and value of GIWs on working farms will be documented in video format for wider distribution.

Abstract #: 103

Title: ***Documenting change in the Coosa Bypass using the High Definition Stream Survey***

Authors: Brett Connell

Organization: Trutta Environmental Solutions

Alabama Power Company (APC) requested Trutta Environmental Solutions conduct a High Definition Stream Survey (HDSS) below the Weiss diversion dam to evaluate potential habitat changes that may be occurring due to the introduction of a minimum flow to the system. The flow introduction was a requirement of the Federal Energy Regulatory Commission (FERC) Coosa River license that APC is continuing to implement. The FERC relicensing process is required every 30-50 years to continue operating hydropower facilities. During this process, FERC must conduct an environmental assessment which includes documenting baseline conditions. FERC typically then incudes in a new license, requirements for continued monitoring of any operational changes. HDSS in the Coosa Bypass was completed in 2013, 2018 and 2021, which enabled stream corridor data to be compared after a variable environmental flow was introduced to the bypass in 2014. HDSS data was used to determine if modified hydropower operations helped flush fine sediments out of the Coosa Bypass resulting in more habitat for T&E mussels. Data from the survey included depth, left and right bank condition, habitat type (pool, shoal, run, riffle), surface water velocity, substrate type/bottom structure, instream cover/LWD, embeddedness and was used to address multiple water resource issues. In addition to a longitudinal High Definition Stream Survey, bathymetric cross sections were collected at Community Sampling Stations used by APC.

The HDSS data reduced costs and proved extremely beneficial to APC in several aspects of the FERC licensing process. The longitudinal HDSS data can be used to support targeted restoration, habitat improvement or other water management projects whereas the cross-section transect information can be used to better understand the quantity of water available at different discharges. To date, Trutta has completed over 800 miles of river for federal, state, and local government agencies, numerous hydropower facilities, private consulting firms, non-profits, and public stakeholder groups to collect and organize a wide range of data. The HDSS approach was created to rapidly gather continuous, meter-resolution GIS data in a single pass for a broad range of stream corridor metrics by integrating GPS, video, depth, side scan sonar, and other sensors. Once the data are collected, the videos are combined into four simultaneous views of the river. Each second of video is linked to a specific GPS point which allows for the identification, selection, and prioritization of streambanks for restoration. The results may also be used to monitor restoration results, determine the extent and distribution of instream habitat, define the geomorphic condition for the stream, identify infrastructure impacts, and provide a powerful â€œvirtual tourâ€ experience.

Abstract #: 104

Title: ***Turning a Plan into Action: Working alongside stakeholders to restore the Pensacola and Perdido Bays***

Authors: Whitney Scheffel, Matthew Posner, Anne Birch, Laura Geselbracht, Bryan DeAngelis

Organization: Pensacola and Perdido Bays Estuary Program

The Pensacola and Perdido Bays Estuary Program (PPBEP) is a non-regulatory program that was established to help inform the needs of local communities, educate the public on key issues affecting the Pensacola and Perdido watersheds, and build consensus among groups to set achievable measurable goals and objectives for long-term success. PPBEP drafted their first Comprehensive Conservation and Management Plan (CCMP), a blueprint based on the best available science to guide future decisions and establish priorities for the restoration and protection of both watersheds. The CCMP Action Plan was collaboratively developed with community stakeholders and the goals and objectives include priorities for communication and data sharing, improving water quality, community resilience, reducing sedimentation, restoring habitats, and protecting fish and wildlife. A few key objectives focus on restoring oysters for wild harvest, aquaculture, and ecosystem services in the Pensacola Bay System (PBS) and the continuation of monitoring. Oyster restoration along the northern Gulf of Mexico is being implemented to restore key ecosystem services that have been lost due to declining oyster populations. PPBEP participated in a stakeholder working group to develop Florida's first estuary-scale oyster recovery plan piloted by The Nature Conservancy (TNC) for the PBS in coordination with state and community stakeholders finalized in May 2021. PPBEP committed to implementing the plan by continuing the community's involvement and convening an Oyster Sub-Committee made up of researchers, state and federal representatives, oyster harvesters, aquaculture farmers, community groups, and local businesses to assist with target setting and project development. PPBEP and partners have recently collected data on oyster reef extent and condition, bottom type, and larval recruitment to provide critical baseline information for future efforts. Next steps include hosting a workshop for stakeholders to provide feedback on site selection for the future bay-wide scale oyster restoration initiative throughout the PBS and securing funding to design and implement this innovative approach.

Abstract #: 105

Title: ***An irrigation potential index for sustainable surface water withdrawals***

Authors: Lee Ellenburg, James Cruise , Eric Rice , Maury Estes

Organization: University of Alabama in Huntsville

Though the plentiful rainfall across the State (>55 in/year on average) diminishes the amount of irrigation needed, supplemental irrigation has been shown to significantly increase yields, reduce risks of crop losses, and enhance farmers' resilience. Alabama is host to an abundant amount of water resources, with rich, productive aquifers below and 4 major river systems flowing through the State collectively discharging some 90 million acre feet of water each year. However, in terms of surface water, the timing of water availability is not evenly distributed across the year, and more importantly, not all agricultural areas are adjacent to the larger rivers. To fully assess the impact of irrigation and a sustainable increase in irrigation, smaller streams and low flows, specifically flows during the growing season, must be considered. A flow duration methodology was employed to provide an initial assessment of the impact of irrigation on in-season low flows. The approach implements common low flow metrics and estimates the amount of surface water available for irrigation during the time when irrigation is most likely to occur (May, June, July). A flow duration curve is used to determine the streamflow volume that is exceeded above a potential threshold (e.g. 90%) of the time, then the minimum 7-day,10-year average flow (7Q10) is subtracted from the 90% duration flow to ensure the natural low flows are maintained. The result provides an estimate of the potential surface water available for irrigation (Irrigation Potential Index -IPI) at each HUC 12 while ensuring ecosystem viability. The IPI is applied spatially across the Middle Alabama Basin to provide an initial assessment of where surface water is available for irrigation. Streams near the watershed boundaries and stream orders that are less than 4 are not generally suitable for direct in-season surface water withdrawal.The IPI identifies areas where a more sustainable water source should be considered (i.e. groundwater or surface storage).

Abstract #: 106

Title: ***Developing Water System Climate Resilience with Research to Operations Stakeholder Engagement***

Authors: Ryan Johnson, Steven Burian, Danyal Aziz, Courtenay Strong, Paul Brooks

Organization: The University of Alabama

Changing winter rain/snow partitioning and variable winter water storage coupled with increased April to October evapotranspiration from warmer temperatures in the Western US challenges water resources management from basin to municipal domains. In Salt Lake City, Utah, population growth further compounds these hydroclimate challenges. Addressing the supply-demand challenges with a climate resilience action plan, this work highlights the benefits of a collaborative research-to-operations (R2O) partnership between the Salt Lake City Department of Public Utilities (SLCDPU), the University of Utah, and the University of Alabama. We develop a comprehensive understanding of the driving climate, hydrological, and water system dynamics influencing seasonal to decadal planning and management activities. This involved five years of extensive stakeholder engagement that led to key scientific discoveries surrounding winter precipitation anomalies, hydro-geophysical attributes improving surface water yield estimates, and key hydroclimate mechanisms influencing municipal demands. Leveraging a systems model to replicate the SLCDPU water system and operations, we integrated the discoveries into the water systems setting to identify vulnerabilities and create preemptive (vs. reactionary) mitigation protocols at multiple forecasting horizons. This includes the development of a decision-making timeline with operational tools to prevent system deficits, characterize source vulnerabilities, and estimate conservation measures to mitigate supply deficits. The case study analyses highlight the decision-making influence the R2O workflow provides the utility, spotlighting the capacity to guide water resources decision-making over a range of hydroclimate phenomena to build water system-climate resilience.

Abstract #: 107

Title: ***Evaluation of LSTM Networks for Forecasting Multi-season Streamflow in a Mountain Catchment***

Authors: Savalan Neisary, Danyal Aziz, Ryan Johnson, Steve Burian

Organization: The University of Alabama

Streamflow deficit due to hydrological drought can adversely affect the performance of a water supply system. The demand-supply gap, especially in the high demand periods of the summer season, can worsen amid below normal water availability. An abundance of information on seasonal streamflow forecasting is available, and recent efforts have targeted the sub-seasonal to seasonal time frame. Because of the great uncertainty of existing techniques, there remains a need for approaches to guide water managers in analyses across multiple seasons. The purpose of this study is to evaluate the capability of long short term memory (LSTM) networks to predict streamflow amounts for multiple years into the future. An LSTM network is developed to evaluate its capability to estimate April-July streamflow for two to five years into the future for a water supply creek in a snowpack-driven mountain catchment in Salt Lake City (SLC) Utah. Three versions of LSTM networks, namely vanilla, stacked, and bi-directional, are tested using the Nash-Sutcliffe efficiency and root mean squared error. The results found the bi-directional LSTM to outperform the other two. The findings indicate, as expected, great uncertainty in modeling for multiple years. Yet, using the estimates provides an alternative for scenario planning and helps decision-makers plan ahead for the current season. The estimates will be further evaluated against bulk projections of streamflow yield from the Natural Resources and Soil Conservation Service to indicate the relative errors associated with the forecasts for multiple years.

Abstract #: 109

Title: ***Comparison of a rectangular grid and hybrid curvilinear grid EFDC hydrodynamic models in Biscayne ay***

Authors: Nathaniel A. Nwogwu, Anna C. Linhoss, Vladimir J. Alarcon, Paul F. Mickle, Christopher R. Kelble

Organization: Auburn University

The geographical and temporal dynamics of the freshwater and saltwater interface in coastal waters can be simulated using hydrodynamic models. Environmental Fluid Dynamics Code (EFDC) is a hydrodynamic model that simulates currents, tides, temperature, and salinity. This study evaluates the importance of grid resolution on the accuracy of modeling the spatial and temporal distribution of salinity in northern Biscayne Bay, Florida, using the EFDC model. This study compares two EFDC models (MODRec and MODCurv) with different grids. MODRec has a rectangular grid with a uniform dimension of 300 Ã— 300 m2 and 9,367 cells throughout the spatial domain. MODCurv has a curvilinear grid that is coarser in the south (270 Ã— 270 m2) and finer in the north (120 Ã— 120 m2), summing to 10,678 cells. The two model grids cover the entire Biscayne Bay area, from the upper north to the lower south. The results indicate the importance of grid shape and resolution in hydrodynamic modeling. The findings reveal that a finer curvilinear grid resolution is more efficient in simulating water surface elevation and salinity in the northern portion of the Bay where the bathymetry is more complex. Keywords: Biscayne Bay, Salinity, EFDC, Grid resolution, Hydrodynamic model

Abstract #: 110

Title: ***Are elevated E. coli concentrations in Choccolocco Creek related to onsite wastewater treatment systems and land cover?***

Authors: Mallory Jordan, Ann Ojeda, Eleanore Larson, Stephanie Rogers

Organization: Auburn University

The objectives of this study are to 1) determine if there is a relationship between E. coli concentrations in surface water with both land cover type and modelled susceptibility to onsite wastewater treatment system (OWTS) failure, and 2) elucidate how altering the unit of analysis, i.e., watershed boundaries, affects the existence and significance of relationships in the Choccolocco Creek watershed, Alabama. The Choccolocco Creek, a tributary to the Coosa River, is on the Alabama 303(d) List of Impaired Waterbodies for elevated levels of E. coli, a fecal indicator bacterium. However, the source(s) and relative contributions of E. coli are unclear. There are potential point sources (e.g., wastewater treatment facilities) and nonpoint sources (e.g., agriculture, urban areas, and OWTSs), and typical of mixed-use watersheds, it is difficult to identify E. coli source(s) without advanced chemical analyses. However, geospatial methods can assist in estimating potential sources by exploring the geographic relationships between source areas and E. coli concentrations. For this study, E. coli concentrations were measured monthly from April to September 2021 at nine water sampling locations along the Choccolocco Creek. These water sampling locations were used to delineate nine sample point watersheds (SPWs) and 63 distance derived watersheds (DDWs) to summarize potential sources and assess how results vary with watershed scale. Additionally, GIS-based multi-criteria decision analyses (MCDA) were used to determine locations that have increased susceptibility to OWTS failure based on environmental characteristics (soil characteristics, proximity to surface water, and slope) and OWTS characteristics (age and density). Then, results from OWTS failure models and distribution of land cover type were summarized within each delineated watershed and correlated to E. coli concentrations. The analysis yielded several key results: 1) significant, positive correlations between E. coli concentrations and OWTS failure models for both SPWs and DDWs; 2) a significant, positive correlation between E. coli and OWTS count; and 3) significant, positive correlations between E. coli and wetland land cover for several DDWs. Our results suggest a relationship between OWTSs and elevated E. coli concentrations observed in Choccolocco Creek. Moreover, variation in the presence and type of correlation (positive or negative) with differing watershed scales demonstrates the importance of selecting an appropriate unit of analysis. Nonpoint source attribution challenges are not unique to the Choccolocco Creek watershed and methods outlined here could be applied to other watersheds to assist in the understanding of how OWTSs may contribute to surface water E. coli contamination at broad scales.

Abstract #: 111

Title: ***Pensacola East Bay Oyster Restoration Project***

Authors: Anne Birch, Jeff DeQuattro, David Stejskal

Organization: Jacobs Engineering

Pensacola East Bay Oyster Restoration Project is the largest oyster restoration project having been constructed in Florida. It includes 33 oyster reefs, made of 4 different designs that consist of a protective outer breakwater reef, and the string reefs behind which will house the growing oysters. The project extends along 6.5 miles of shoreline in the East and Blackwater Bays of Santa Rosa County. The reefs consist of limestone rock and seasoned oyster shells. The project contributes to the local ecosystem by providing habitat for fish, crabs, shrimp, and birds while also providing a home to the oysters that will filter the water. Jacobs Engineering served as the engineer, completing the design, permitting, and currently handling construction management/observation for the project. Permitting was coordinated through the Florida Wildlife Commission, Florida Department of Environmental Protection and USACE, Jacksonville District. The construction cost for the project was 9.7M and funded by a National Fish and Wildlife (NFWF) grant through the Gulf Environmental Benefit Fund. Construction started in the Spring of 2021 with final construction ending Fall of 2022. The project also includes 2 years of pre-construction and 5 years of post-construction monitoring being performed by WSP.

This presentation will provide a high-level review of the design and then provide an in-depth look at the successful construction approaches and progress to date. The reef is being constructed completely from the water using various barges to bring rock to the site and then transferring the rock to smaller barges for deployment to create the reef. Due to the depth of the reef, construction has been scheduled to reduce work effort during low tide/seasonally low water levels. In addition to water levels, the project construction progress has also been impacted by bridge closures that have prevented barges from reaching the site, a global pandemic impacting worker availability and supplies, and severe weather events. Despite these challenges, the project is progressing ahead of schedule because of the great team effort put forth by all parties. To help gain endorsement for the project, an active stakeholder engagement plan was implemented including establishment of a stakeholder working group and several public relation outreach activities including a digital rendering of the proposed reefs at the beginning of construction, several boat tours, and coordination with local oystermen and anglers. As the project moved forward with construction, wildlife was observed to quickly take notice of the new oyster reef features. Bald eagles and osprey, speckled trout, and sheepshead, to crabs and sting rays and dolphins have all been observed taking advantage of the new construction. It is the goal of TNC to continue to revitalize oysters in the panhandle and hopefully, one day, see Pensacola Florida knows as the oyster capital of the US.

Abstract #: 112

Title: ***Assessing the benefits of different GIPs for improvement of stormwater runoff quality from a parking lot***

Authors: Gianlucca Nicolaico, José Vasconcelos, Frances O'Donnell

Organization: Auburn University

Green infrastructure practices are a sustainable solution to treat and control runoff volumes generated by large precipitation events. The water quality benefits of adopting these practices have been reported in the literature, but few studies address multiple practices used on the same site. In this context, the present research aims to analyze the water quality in different points of a parking lot in Auburn, AL that is fitted with porous pavers and a bioretention. This fieldwork involved sampling various points in the green infrastructure practices. These included two points inside the bioretention, two points from shallow groundwater taken from two wells that were installed near or at the bioretention, and within an apparatus that collects water that infiltrates the pervious pavers of the parking lot. The water quality parameters that will be analyzed by experimental procedures are Turbidity, Total Suspended Solids (TSS), and the concentration of Chromium, Copper, Zinc, and Nickel. These results provide more insights on the benefits of using this type of treatment train from stormwater management.

Keywords: stormwater management, water quality; bioretention, pervious pavements.

Abstract #: 113

Title: ***How-To Guide for Wastewater Management of Rural, Underserved Communities in the Black Belt Region of Alabama: A Resource for Local Stakeholders***

Authors: Jillian Maxcy-Brown, Kevin White, Mark Elliott

Organization: The University of Alabama

Conventional septic systems rely on soil as a treatment matrix which is prevented from functioning properly in some soil and geological conditions, including impermeable clay layers, high water tables, rocky soils, shallow bedrock, karst topography and steep gradients. These conditions are common throughout the U.S. In the Black Belt region of Alabama, shrink-swell clays are the most common surface soils and become practically impermeable when wet which makes a septic tank drainfield unable to operate properly. Some households are unable to afford alternative, advanced onsite treatment systems and resort to surface discharging raw wastewater into nearby trenches, forested areas, or other surfaces which is a practice known as straight piping. A study in Lowndes County of 2,100 homes found that 13.1% of homes with septic tanks experience problems and 190 homes had straight pipes. A 2005 study of 4,000 unsewered homes in Bibb County found that 15% of the homes had no septic tank/drainfield and relied on straight pipe while an addition 35% of homes with septic tank/drainfield had clear evidence of hydraulic failure with raw sewage currently or recently on the ground surface. A more recent survey of unsewered homes in Wilcox County found only 7% had permitted systems, 60% had straight pipes visible on inspection and 33% had an unpermitted system, but no visible straight pipe. A concurrent survey of unsewered homes in Hale County found that 35% had permitted systems, 6% had visible straight pipes and 59% had an unpermitted system, but no visible straight pipe. The resources needed to comprehensively address these wastewater problems are scattered in numerous sources and are typically written for an audience that has ample wastewater background knowledge rather than the homeowners, local officials, and other stakeholders who are key to mobilizing solutions. For this project, we are developing a â€œhow-toâ€guide for onsite wastewater management in the Black Belt region of Alabama to serve as a comprehensive resource for stakeholders interested in addressing the wastewater management challenges in this underserved area. It explains (1) the importance of proper wastewater management, (2) available treatment technologies, (3) relevant laws and regulations, (4) opportunities for involving and educating the local communities, (5) potential management strategies, and (6) available funding sources. The resource will guide stakeholders on how to identify the right funding source for a community's specific needs and how to successfully apply for these funding mechanisms. This resource guide will serve as a one stop spot for the knowledge needed to practically address these long standing public health threats.

Abstract #: 115

Title: ***Differences in tolerance and responses to thermal stress between diploid and triploid oysters in the northern Gulf of Mexico***

Authors: Kayla Boyd, Will Kleist Constantino, Scott Rikard, James Stoeckel

Organization: Auburn University

The oyster industry in the northern Gulf of Mexico (nGOM) has been experiencing a renaissance over the last decade. The majority of eastern oysters (Crassostrea virginica) harvested for the half-shell market are triploid, single set oysters. Growers typically prefer triploid, as opposed to diploid, oysters due to their higher growth rates and sterility, which allows them to retain superior meat quality during the summer spawning season. However, triploid oysters have been experiencing higher mortalities in many portions of the nGOM compared to their diploid counterparts. The main drivers of increased mortality are not well understood but are suspected to be related to a lower tolerance of triploids to environmental stressors such as high temperatures. Ongoing climate change may continue to raise surface water temperatures, decimating triploid oyster crops in the coming decades. We conducted a series of experiments to test for differences between diploids and triploids in terms of physiological and behavioral responses to thermal stress; ability to recover from sublethal stress; and upper thermal limits to acute thermal stress. We utilized half-sibling diploids and triploids to minimize confounding effects of genetic differences between groups. Oysters were subjected to acute thermal stress by raising temperatures from a baseline of 25â„ƒ at a rate of 2â„ƒ/h. As temperatures increased, physiological response was measured via intermittent respirometry. Behavioral response was measured via observations of closing, gaping, and mantle retraction. As temperatures increased, subsets of oysters were periodically removed and cooled back down to 25â„ƒ to test for ability to recover from thermal stress. The remaining oysters were subjected to increasing temperatures until they reached their critical thermal maximum (CTmax) as evidenced by a combination of gaping, mantle retraction and unresponsiveness to touch. Preliminary results suggest that triploids reach CTmax ~3â„ƒ earlier than diploids. This decrease in thermal tolerance was associated with delayed metabolic depression (point at which metabolic rate begins to decrease with further increases in temperature), and earlier onset of valve closure followed by valve gaping behavior. Ongoing experiments are testing for differences between diploids and triploids in ability to recover from various stages of acute thermal stress as defined by physiological and behavioral endpoints. Results of this study will assist with ongoing efforts to develop thermally tolerant genetic lines of oysters by identifying thermally-related differences between triploids and diploids and potential physiological and behavioral characteristics to select for.

Abstract #: 116

Title: ***Hurricane Patterns on the Emerald Coast and the Risk They Pose***

Authors: Christopher Whatley, Sanjiv Kumar

Organization: Auburn University

This project is part of a larger project on land development along the Emerald Coast, which is coastal Alabama and the Florida panhandle immediately south of Alabama. The part of the project that my professor and I are doing is to see how hurricanes may be relevant to land development: more particularly, we are seeking to analyze how hurricane patterns may have changed in the past, and how they could change in the future. This is important because hurricanes are powerful storms that cause significant economic damage. Up until this point, we have found that since 1800 there has been an increase in cyclones of lower intensity, but not of moderate or greater intensity. We believe this is likely due to poor data before the satellite era since cyclones of lesser intensity often were not found long ago. Another metric we used in the southeastern united states was accumulated cyclonic energy (ACE), a numerical way of representing the destructive potential of a cyclone, and in this, we found a slight increase. Another phase of our analysis investigates how decreasing cyclone translation speeds may be driving more severe precipitation events, with hurricane Harvey in Texas being the best example. The most recent and ongoing phase of our research investigates how land-use change correlates with what areas hurricanes strike. After the current phase, we intend to use the CESM2 large ensemble community model to predict how hurricane patterns may change in the future.

Abstract #: 117

Title: ***Uncertainty of Multiple-Machine Learning Statistical Daily Salinity Forecasting for Bays and Estuaries of the Gulf Coast***

Authors: William Asquith

Organization: USGS Oklahoma-Texas Water Science Center

The U.S. Geological Survey, in cooperation with the Gulf Coast Ecosystem Restoration Council and the U.S. EPA is researching methods for uncertainty estimation in statistical daily-salinity forecasting for a continuous period 1980-01-08 to 2020-12-31. Multiple-machine learning (MML) methods are used to predict daily salinity, in parts per thousand (ppt), for 92 monitoring sites operated by numerous agencies for bays and estuaries spanning the Gulf Coast. Some 454,563 daily values are available within the period of 1986-12-08 to 2018-09-07; an average of about 4,900 days of data per site (about 13.5 years). MML methods include Cubist, RandomForests, and Support Vector Machines, which are optimized to attain numerical congruence of normalized Nashâ€“Sutcliffe for both even- and odd-year hold-out training regimes, are trained on a multitude of predictor variables (covariates) of climatology and daily in-land streamflows. These covariates represent drivers of salinity trends. The MML methods, separately trained on even and odd years, result in six predictions per day. Inverse root-mean-square errors (iRMSEs) are used in weighted-mean computations from even- and odd-year training for "even- and odd-year pooled estimates." Next, additional iRMSEs are used to pool the even- and odd-year estimates to "final estimate" for each day. Through combinations of daily residuals, the L-moments of the "daily error distributions" are computed. The model error, a computed statistical error from even- and odd-year residuals, and covariance between these two errors provide a "total uncertainty" in standard deviations for each day. The 90th-percentile prediction bounds are created, and numerical optimization is used to make minor adjustments to total uncertainty to enforce 90th-percentile coverage probability on the observed data. The polynomial density-quantile4 (PDQ4) distribution, in lieu of the Normal, is used as the structural form of the daily error distributions because the PDQ4 can attain shapes consistent with the information contained in the L-kurtosis of the errors. Terminal products by site for each day from this research are data products of final predictions, both model and total uncertainties, 90th-percentile prediction bounds, and time-series visualization. Focusing on the errors and the 18 salinity sites in the Mississippi Sound group, the group has a median daily total error width in standard deviations of 0.10 log10(ppt) and a median daily model error width in standard deviations of 0.046 log10(ppt); the model error thus is about one-half of the total error. The average normalized Nashâ€“Sutcliffe model efficiency of the log10-predictions is 0.66 for the Mississippi Sound.

Abstract #: 118

Title: ***Citizen-Science approach to testing private well water quality***

Authors: Sharaf Anika Hoque, Natalia Malina, Ann S. Ojeda

Organization: Auburn university

Ensuring clean and stable water supply to all is one of the most important objectives of the United Nation's Sustainable Development Goals. Lack of proper monitoring and management of groundwater can deteriorate the drinking water quality and contaminated groundwater can pose a greater threat to the health of people. In Alabama, approximately 40% of the population relies on groundwater for drinking, agricultural, and household purposes among which 11% extract drinking water from private wells. As private wells are under the well owner's authority and they are responsible to ensure their water safety, it is often very difficult and costly to assess the water quality of domestic wells. The aim of our research is to use the citizen science approach to understand stresses on groundwater quality using a commercially available water testing kit. We have evaluated 5 water testing kits and down-selected them from the pool based on accuracy, reliability, and ease of use by calibrating them against different concentration points in the lab. These testing kits can measure a wide range of water quality parameters including- nitrate, nitrite, lead, pH, iron, copper, manganese, fluoride, chloride, sulfate, mercury, zinc, and pesticides. We also evaluated another kit specifically for arsenic. The testing range of the kits was compared to the EPA maximum concentration level and the range of water quality results extracted from the National Water Quality Portal to ensure the usefulness and relevancy of the kits for water quality management. In the future, the most suitable kits will be distributed to 250 well users in Mobile and Baldwin County, Alabama as a part of a two-year water quality study. Additionally, we will also collect routine water samples from participants' wells. Finally, the water quality data generated by local citizens will be statistically evaluated and correlated with the data produced in our lab by using statistical correlation and analysis of covariance (ANCOVA). Results from our research will establish the credibility of the testing kits as well as the inference of citizen involvement in producing scientifically reliable data. One of the objectives of the research is to educate and make the homeowners capable to detect primary water quality issues with their well water. This participatory and collaborative approach will be helpful in building local capacity, knowledge, and awareness in understanding and assessing their well water quality along with the assurance of continuous monitoring and sustainability of the groundwater resources.

Abstract #: 119

Title: ***The effects of dams and invasive species on community structure and trophic interactions of stream crayfishes***

Authors: Riley Egan, Zanethia Barnett, Brian Helms

Organization: Troy Univeristy

The effects of dams and invasive species are two leading threats to freshwater biodiversity. The most obvious effect of dams is the disruption of the natural flow regime, which is a major determinant of physical habitat, species life histories, and connectivity in streams. Invasive species, often as a function of their density or behavior, can reduce the fitness of and displace native species. The effects of both dams and invasive species can have major ecological impacts leading to alterations in aquatic community structure and trophic pathways, particularly in systems with imperiled taxa. Crayfish are among the most imperiled freshwater taxonomic groups with nearly one third of all species being threatened with extinction globally. Alabama, in particular, has the highest diversity of crayfishes in the world with 99 species, nearly half of which are of conservation concern. Crayfish have become one of the most widely introduced freshwater organisms and their impacts on receiving ecosystems has been well studied. Alternatively, the impacts of dams on native crayfishes has received little investigation despite dam prevalence and the extreme alterations caused by these structures and their impoundments. The Upper Cahaba River drainage, one of the most diverse rivers in North America, has been invaded by a widespread invasive crayfish (Faxonius virilis) that has become the dominant species in parts of the drainage. With 117 dams reported in the National Inventory of Dams throughout the Cahaba River drainage, the interaction between the invasive species and habitat alterations caused by dams could be significant. By taking a food web approach to investigate the interactions between invasive species and dams, we can better understand the underlying mechanisms driving changes in crayfish assemblages and potential species extirpation. This study aims to assess the effects of these two drivers of environmental change on native crayfish assemblages and their roles in associated food webs. Crayfish assemblages and associated habitat will be quantified in approximately 16 streams (8 with dams, of which 4 contain F. virilis; 8 without dams, of which 4 contain F. virilis) using standard multi-pass backpack electrofisher and habitat assessment techniques. By using stable isotope analysis and confirmatory gut content analyses, we will quantify trophic position and niche breadth of native and invasive crayfishes in sampled stream reaches. Sampling efforts for this study will provide updated occurrence data on stream crayfishes throughout the Upper Cahaba River drainage, including valuable information on the spread of F. virilis throughout the Upper Cahaba River Drainage. The findings from this study will help to elucidate the impacts dams and invasive crayfish have on native crayfishes as well as how these two drivers of environmental change can act synergistically to affect community structure and trophic interactions of stream crayfishes

Abstract #: 120

Title: ***Comparing sediment dynamics between a natural and constructed tidal marsh of the Gulf of Mexico***

Authors: Jacob Dybiec, Shelby Rinehart, Julia Cherry

Organization: The University of Alabama

Reductions in sediment delivery from adjacent watersheds have been identified as a potential driver of recent tidal marsh loss. These alterations in sediment supply combined with climate change-induced sea-level rise are likely to accelerate future marsh loss. As such, evaluations of sediment dynamics are critical to assess the vulnerability of tidal wetlands to loss from sea-level rise and erosion. Restoration and creation projects are commonly used to offset tidal marsh loss, yet these projects generally fail to achieve structural and functional equivalency with natural marshes. However, the development of sediment dynamics like those of natural systems is rarely assessed during post-project monitoring, representing a critical knowledge gap in our understanding of the long-term stability of these marshes. To address this gap, we compared sediment dynamics between a natural and nearby 34-year-old created tidal marsh in the northern Gulf of Mexico. Due to the general failure of restored/created marshes to reach structural and functional equivalency, we hypothesized that sedimentation and surface organic matter accumulation, which both aid in promoting resiliency, would be lower in the constructed marsh. We also hypothesized that surface scour, which may exacerbate losses, would be higher at the natural marsh, due to greater hydrologic connectivity to a nearby river.

In July 2021, we set up a series of permanent sampling points along the first 150 m of one tidal creek in each marsh. At each sampling point, we installed PVC poles to assess monthly changes in surface scour and sedimentation plates to determine the rates of surface sediment accumulation and organic matter accumulation. In partial support of our hypotheses, both sedimentation and organic matter accumulation were lower in the constructed marsh. In addition, while relationships between distance from the mouth of both tidal creeks and organic matter accumulation were similar between the two marshes (positive), they showed strong contrasting relationships with sedimentation (positive in the natural marsh, negative in the constructed marsh). Despite these differences in the magnitude and spatial patterns of sediment accumulation, we found that both marshes followed similar seasonal trends in sediment accumulation (highest in summer, lowest in winter). Lastly, unlike we hypothesized, surface scour did not vary significantly between the two marshes. Our results are consistent with literature demonstrating that structural and functional equivalency is not often reached during wetland restoration/creation, and that proper design, not simply time, is required to ensure ecosystem longevity.

Abstract #: 121

Title: ***Assessment of a modified evaporation method used for evaluating unsaturated soil properties***

Authors: Mahlet Kebede, Sama Memari, Prabhakar Clement

Organization: The University of Alabama

Soil water retention (SWR) and unsaturated hydraulic conductivity (UHC) relationships are two important functions used for characterizing unsaturated soil properties. Experimental data for developing these functions require a complex laboratory tests. The evaporation method is one of relatively simple approaches used for obtaining these functions. In this study, we propose two improvements that could further simplify the conventional evaporation experimental setup, as well as simplify and the data analysis procedure. We present a relatively low-cost setup that can simultaneously determine water retention and hydraulic conductivity functions. We used commercially available miniature tensiometers and a relatively small capacitance soil moisture probe to directly obtain the data needed to construct both SWR and UHC functions. The two miniature tensiometers were able to provide a good estimate for soil tension, and the soil moisture probe was able to estimate average moisture level changes over the entire sample volume. Use of soil moisture probe eliminated the need for a balance to keep track of changes in the sample weight. The data obtained from the experiments were analyzed using multiple approaches. Our results show that the inverse simulation approach using the HYDRUS-1D software is the most simple and robust approach for analyzing evaporation experimental data to evaluate various unsaturated soil properties. The proposed experimental setup was used to test various silty soil samples with varying amount of sand content. The data show that soil hydraulic properties form the simplified evaporation method (SEM) and Hydrus-1D demonstrated good match for most of the measured pressure range.

Abstract #: 122

Title: ***Investigating the Differences in Severity and Frequency of Multi-year Streamflow Deficits Using Instrumental and Reconstructed Data: A Case Study of the Wasatch Mountain Basins***

Authors: Danyal Aziz, Ryan Johnson, Savalan Neisary, Steve Burian

Organization: The University of Alabama

Multi-year streamflow deficits can adversely affect the regular operations of water supply systems, particularly in semi-arid mountainous regions dependent on snowpack-driven surface water. Proactive planning and adaptation to these surface water deficits need a standard protocol for the frequency analysis of persistent deficits. However, a standardized surface water supply-deficit framework directed toward the application in assessing the water system's performance remains absent. Also, the length of the instrumental streamflow record prohibits performing a frequency analysis covering events of several hundred years. This study addresses these research needs by leveraging the concept of run theory to calculate streamflow differences relative to a defined threshold flow, incorporating the frequency information through a fitted probability distribution, and investigating the differences in the severity and frequency of multi-year streamflow deficits between the instrumental and reconstructed streamflow records. We apply this framework to three rivers in the Wasatch Mountains in Northern Utah and analyze the decadal and vicennial streamflow deficit events. The findings indicate that the reconstructed record contains more severe decadal as well as vicennial events compared to those in the instrumental record, highlighting the value of including the reconstructed streamflow record with the instrumental record for an improved understanding of possible multi-year streamflow deficit events and a broader range of scenarios for evaluating water system's performance.

Abstract #: 123

Title: ***Overview of Alabama's Growing Envirothon Competition***

Authors: Courtney Curenton

Organization: Alabama Association of Conservation Districts

The Alabama Envirothon, coordinated by the Alabama Association of Conservation Districts in cooperation with multiple partner organizations, is an environmental and natural resource conservation problem-solving, teambuilding and leadership experience for high school students. It incorporates classroom training and hands-on outdoor field experiences to focus learning in the areas of aquatics, forestry, soils, wildlife, and an annually chosen current environmental issue, which for 2023 is, "Adapting to a Changing Climate". During this three-day event, teams of students from throughout Alabama receive training from industry professionals, take written exams, develop a full plan for solving a comprehensive complex problem, and present their plan to a panel of judges. The complex problem is developed at the state level, using information and expertise from environmental professionals working throughout Alabama. The state-level winning team advances to compete at the international level in the NCF-Envirothon. This presentation will provide an overview of the rapidly growing Alabama Envirothon Program, including outreach efforts and opportunities to get involved, and encourage water resources professionals to provide information that may be used in both student training and development of the 2023 complex issue challenge.

Abstract #: 124

Title: ***Performance of a Hybrid Sand Filter for Onsite Wastewater Treatment Applications in the Alabama Black Belt***

Authors: Rachel Chai, Harry McCaskill IV, Kaushik Venkiteshwaran, Kevin White

Organization: University of South Alabama

25% of the United State's population uses onsite wastewater treatment. A large population of the Alabama Black Belt uses onsite wastewater treatment. However, this region has difficulties due to the vertisol soils, which do not allow water to percolate through the soil. This causes wastewater disposal issues, which ultimately make disposal options largely unaffordable for the residents of the Alabama Black Belt. Considering these conditions, for this region, the hybrid evapotranspiration/ lateral flow sand filter is a potential treatment/disposal option for this region. After the septic tank, wastewater moved laterally and upwards via capillary reaction within the system. Additionally, the wastewater is treated within the microbial sand layer. Evaporation of the treated effluent is the aim of the hybrid sand filter. A 8.5-ft x 12-ft x 3-ft lab-scale model of the hybrid sand filter was built by the Civil Engineering Department at the University of South Alabama. This bench scale sand filter is designed to treat 51-GPD. Evaporation, feasibility, and treatment are being tested on this bench scale model. Preliminary findings show that discharge rates are directly proportional to ambient temperature and humidity. Higher humidity and temperatures lead to lower discharge rates.

Abstract #: 125

Title: ***A GIS Analysis of Individual On-Site Wastewater Disposal Systems and their Vulnerability to Climate Change in Coastal Regions***

Authors: John Cartwright, Kate Grala, Renee Collini

Organization: Mississippi State University

Individual on-site wastewater disposal systems (IOWDS) or septic systems are an ever-increasing source of non-point source pollution along the coast of Mississippi. Inventories of these systems are not always complete or simply non-existent. This project utilized geospatial technologies, specifically geographic information systems (GIS), to identify land parcels that are potentially using an IOWSD. The approach used existing service utility provider records, land parcels, and improvement values to identify properties that are likely to have on-site waste disposal for a specific service area. The methodology was developed around geocoding techniques coupled with multi-criteria selection for property identification. The project area had a total of 83,863 parcels and 22,976 were identified as non-serviced parcels. Using a threshold improvement value of $7,500 resulted in 9,550 parcels that potentially have an IOWDS. These identified parcels were assessed for vulnerabilities based on groundwater depth, high-tide flooding for current and future sea level rise, and current and future storm surge under future sea level rise scenarios. 6,232 (65%) of these were found to be at some level of risk over the next several decades due to changes in groundwater, high tide, and/or storm surge as seas rise. Additional spatial analyses were performed and identified 1,621 parcels were near existing infrastructure to help prioritize transitioning from on-site disposal to a service utility.

Abstract #: 126

Title: ***Septic Tank Inventory: A GIS approach to base line data collection***

Authors: Casey Fulford

Organization: AL Association of Conservation Districts

The Weeks Bay Watershed Implementation Team began to prioritize management measures from the Weeks Bay Watershed Management Plan in 2018. Through this prioritization, conducting an inventory of septic tanks or onsite sewage disposal systems (OSDS) within Baldwin County was among the top four priorities for the group to accomplish. This effort intended to create a baseline data set that could yield locational information for focusing resources and education to areas with high density septic infrastructure to potentially reduce pathogens in waterways. Partners utilized GIS to overlay known sewer connections with existing parcel information to identify parcels that could potentially house septic infrastructure. This presentation looks to provide a brief overview of the GIS tools and layers used in the creation of the data set, the analysis conducted to create a robust report, and the next steps being taken by partners to utilize this data set to strategically target funding opportunities for future water quality projects.

Abstract #: 127

Title: ***Ecological limit functions relating 2000-2020 streamflow statistics to benthic macroinvertebrate multimetric index in Mississippi, USA.***

Authors: Sarah Banks, Elena Crowley-Ornelas

Organization: U.S. Geological Survey

The U.S. Geological Survey, in cooperation with the Gulf Coast Ecosystem Restoration Council and the U.S. EPA are collaborating on a project to analyze the timing and delivery of freshwater to the Gulf of Mexico. Part of this larger project is an effort to relate the benthic macroinvertebrate multimetric index (MMI) created by Mississippi Department of Environmental Quality (MDEQ) to streamflow statistics. MDEQ oversaw the categorization of ecological data and calculated the ecological metrics used in MMI score development (Stribling et.al., 2016). Of the more than 1500 ecological samples collected by MDEQ from 2000-2020, 1184 were used in the final analysis. Streamflow statistics (hereafter referred to as hydrologic metrics) were calculated with the R package EFlowStats (Mills and Bladgett, 2017). Initially, a subset of 77 ecological sampling sites were chosen by creating 3 km buffer zones around USGS stream-gaging stations with flow values for the sampling period. Streamflow data from the closest streamgage was used for the ecological sites and used to calculate 180 possible hydrologic metrics at the ecological sites. Hydrologic and ecological metrics for the 77 sites were analyzed using the bvStep function from the R package sinkr (Taylor, 2020). Results from this analysis showed variability of monthly flow values for January and June to be the most important hydrologic predictor for statewide analyses. For individual bioregions results varied, with variability of monthly flow values in December and June ranking as most important for the east bioregion, variability in Julian date of annual maxima, variability across monthly flows, and skewness in monthly flows as most important for the west bioregion, and average high flow duration as most important in the southeast bioregion. The number of sites that could be analyzed was initially limited to the 77 that were paired with gaged reaches. The drainage area ratio method was used to expand the analysis by modelling daily streamflow at ungaged sites, thereby allowing evaluation at 1184 ecological data collection sites. A principal component analysis of the hydrologic metrics identified a minimum subset of variables in order to decrease the size of the matrix used for relating hydrologic metrics to the MMI scores. The best subset of hydrologic metrics with maximum correlation to a dissimilarity matrix of MMI scores was identified using the bioenv function within the R package vegan (Oksanen et.al., 2022). Ecological limit functions were created using quantile regression to model the relationship between the most important predictor hydrologic metric and the MMI. This process was repeated on the three bioregions delineated by MDEQ. Preliminary results have identified hydrologic metrics related to duration and magnitude components of the flow regime as the most important predictors for the MMI scores within individual Bioregions in the state of Mississippi.

Abstract #: 128

Title: ***Tidal creek ecosystem structure and function changes associated with coastal watershed development.***

Authors: Samuel Bickley, Sabahattin Isik, Christopher Anderson, Latif Kalin, Dennis DeVries

Organization: Auburn University

Understanding how coastal development alters tidal creeks, recognized as the aquatic linkage between upland areas of the watershed and coastal waters, is important because these systems are under increasing development pressure. Salinity is understood to be an important measure of estuaries and critical to fisheries and other aquatic habitats. Freshwater runoff into tidal creeks along the northern Gulf of Mexico has been shown to increase with coastal watershed development, leading to increased variability in the magnitude and frequency of salinity variation. We examined 12 tidal creeks (2nd to 3rd order) along the Alabama and west Florida coast across an urban watershed gradient. We used field data and watershed models to examine creek response to urban development by measuring changes in salinity variation, gross primary production (GPP), ecosystem respiration (ER), and fish abundance, diet, and caloric density. We hypothesized that more urbanized creeks would experience greater freshwater input, increased salinity variation, and higher rates of ecosystem metabolism (GPP and ER). We expected development would lead to decreased abundance of Fundulus grandis (a resident salt marsh fish) and that F. grandis diets would be less diverse and dominated by less calorically-rich materials, in turn leading to lower measures of caloric density in F. grandis. As predicted, we found that salinity in more developed tidal creeks was “flashier”, as measured using a modified Richard-Baker (RB) index ($p < 0.01$, $r2 = 0.39$). Salinity flashiness was related to decreased GPP ($p < 0.01$, $r2 = 0.44$) and ER ($p < 0.01$, $r2 = 0.31$) in creeks (n=6). We found that F. grandis catch per unit effort decreased with salinity flashiness ($p = 0.03$, $r2= 0.18$) and estimated $NO3^-$ concentration ($p = 0.05$, $r2 = 0.11$), both measures of watershed development. F. grandis diets were broad and dominated by fish, but we detected no relationship to watershed development. Likewise, F. grandis caloric density was not related to watershed development, although a negative correlation between creek flow and caloric density ($p < 0.001$, $r2 = 0.75$) and a positive correlation between temperature and caloric density ($p = 0.02$, $r2 = 0.43$) were noted. There were weak relationships between dietary items and the caloric density of F. grandis, with caloric density decreasing with the prevalence of empty stomachs ($p = 0.12$, $r2 = 0.22$) and the frequency of macroinvertebrates as prey items ($p = 0.08$, $r2 = 0.26$) while increasing with the frequency fish as prey items ($p = 0.15$, $r2 = 0.18$). These results suggest that coastal watershed development, even at low to moderate levels typical for many parts of Alabama and west Florida, is leading to some changes in tidal creek ecosystem structure and function while other functions persist. As coastal development continues in the region, research on the effects of urban runoff are still needed to improve management and protections designed to minimize urban effects.

Abstract #: 129

Title: ***Developing an Ecosystem Services Framework in Watershed Plans***

Authors: Adam Newby, Eve Brantley, Maury Estes, Lee Ellenburg, Jessica Curl

Organization: Auburn University Water Resources Center

A project focused on developing watershed plans for the sustainable expansion of irrigation on Alabama farms has recently pivoted to developing plans with an ecosystem services (ES) framework. Federal funds for the project are provided by USDA through Public Law 83-566, and USDA guidance for federal water resource investments requires the use of an ES framework. ES can be described as the tangible and intangible benefits humans get from healthy ecosystems, and they include provisional services (e.g., crops, water for human use), regulating services (e.g., hydrological cycle, climate regulation), and cultural services (e.g., cultural heritage, sense of place, recreation). Governments and institutions are increasingly adopting an ES framework in project planning considering the recognition that ES provide real value, and projects in the past that ignored or devalued ES had harmful economic and environmental effects in the long-term. Project planning with an ES framework requires work to identify, describe, and quantify the impact the project will have on ES. For development of the current watershed plan in the Middle Alabama River Basin, scoping meetings were held in fall of 2020 and spring of 2021 to identify issues, concerns, and potential impacts important to stakeholders. Additionally, a stakeholder questionnaire is being distributed to determine ES most valued by stakeholders. Since the number of ES in an area can be vast, ES most important to stakeholders and most impacted by the project are selected. Stakeholder engagement in the process is critical since local cultural perceptions and circumstances shape preferences and values. An overview of how an ES framework was developed for this watershed plan will be presented.

Abstract #: 130

Title: ***Drought Impacts on Reservoir Retention Time in Alabama and the Southeastern United States***

Authors: Ben Webster, Matthew Waters, Stephen Golladay

Organization: Auburn University

Reservoir retention time is traditionally considered a static number, but during prolonged extreme drought periods, we observe increases in retention time and an increase in depositional efficiency. Alabama is a surface water state with over 2000 dams, and both water supply and water quality are extremely important to the residents. Climate change has already begun to constrain both water quantity and quality, drought periods specifically limit water availability and increased frequency of harmful algal blooms. During periods of drought dam and reservoir managers are forced to abide by critical yields and base flow regulations to maintain reservoir water storage and supply a minimum dam release flow downstream thus increasing water retention times. Retention time is a function of water storage in a reservoir and the rate of outflow, which can be considered as the rate the reservoir empties. Retention time is an important quality that drives many ecological mechanisms and is normally understood to remain constant throughout time. Despite the importance of both the water supply budget and quality for local stakeholders, there has yet to be a study on the indirect impacts of these altered drought management practices. Using long-term reservoir flow datasets, federal long-term drought indices, geographic information systems, and classical paleolimnological techniques (i.e. sediment core analysis), the retention time for reservoirs in Alabama was found to increase during periods of extreme drought up to 47%.

Abstract #: 131

Title: ***The importance of agency-academia partnerships in training aquatic biologists of the future.***

Authors: Lori Tolley-Jordan, Lisa Huff, Brian Helms

Organization: Jacksonville State University

Freshwater systems in Alabama are considered global hotspots of biodiversity due to the high species richness of aquatic insects, crustaceans, mollusks, fishes, amphibians, and reptiles. Yet, many students from the region are unaware of this phenomenon and equally unaware of the importance of trained taxonomists and field biologists employed by state and federal agencies that document and manage these species. Unfortunately, there is a global decline of trained taxonomists and a lack of early career biologists to continue this work. In academic settings, we provide taxonomic courses such as entomology, ichthyology, and herpetology along with field-based courses such as freshwater biology to introduce students to approaches in measuring and managing biodiversity. However, the practical application of the combined skills can be difficult to instill in the relatively short time of a college degree. All states employ biologists who are taxonomic experts and experienced field biologists to provide biomonitoring assessments efficiently and accurately. Yet, many of these biologists are nearing retirement age and the lack of qualified graduates entering the field is problematic. Paid, summer internships provided by state agencies that partner with Alabama universities provide an intensive, immersive experience in taxonomy and fieldwork to undergraduate and graduate students. This meets the needs of universities with goals to provide career paths for students and state and federal agencies to hire qualified, workforce ready graduates. We provide details of successful agency-academic partnerships with ADEM and regional universities designed to address these state needs as an example and impetus to expand such efforts.

Abstract #: 132

Title: ***Empowering oyster growers while growing capacity: Addressing microbiological impediments on shellfish aquaculture.***

Authors: Melissa Partyka, Ronald Bond

Organization: Auburn University

Off-bottom shellfish aquaculture in Alabama (AL) is a new and growing industry that requires a significant investment by would-be growers. Growers that have successfully applied for permits and sited their operations often face environmentally driven regulatory closures, potentially leading to significant financial hardship. Though the microbiological quality of water within oyster growing areas is of critical importance for both seafood safety and harvest quality, current regulatory monitoring by Alabama state officials is severely limited in space and time, only adhering to the minimum sampling required under the National Shellfish Sanitation Program. The lack of regular data reduces the ability of growers to understand variability in water quality conditions that impact both profitability and seafood safety. While existing state-funded labs can analyze water and shellfish meats from growing areas, they cannot perform the analyses that allow growers to â€œtest to openâ€ following sewage overflows or excessive rainfall events (common occurrences in coastal Alabama). Nor can these labs test wet storage tanks for certification, a tool that can help limit the impacts of extended regulatory closures. Finally, there are currently no training programs that inform prospective, new, or established growers about regulatory hurdles related to microbiological water quality and give them the knowledge to navigate those hurdles with confidence and understanding. A recently funded partnership between Auburn Marine Extension and Research Center the University of California, Davis will be specifically addressing these needs by 1) developing and implementing a detailed, grower-supported, water quality monitoring plan to supplement current state-run efforts, 2) working with state and federal authorities to create an independent certified laboratory capable of conducting all tests necessary for shellfish growing operations, and 3) creating and delivering training programs and outreach documents to help growers understand and comply with the microbiological requirements for shellfish growing and harvesting operations. These steps will collectively give growers the decision-making tools, knowledge, and access to resources they need to make informed business decisions, greatly improving their chances of financial success.

Abstract #: 133

Title: ***Modeling hydrologic alteration in the Pearl and Pascagoula River Basins using rule-based model tree machine learning algorithm***

Authors: Victor Roland II, Elena Crowley-Ornelas

Organization: U.S. Geological Survey

The U.S. Geological Survey, in cooperation with the Gulf Ecosystem Restoration Council and the U.S. EPA are investigating changes in the delivery of freshwater from the Gulf States to the Gulf of Mexico. In the United States and globally, humans have altered many streams and hydrologic alteration poses a major threat to riverine ecosystems. A great deal of research has been done to develop methodologies of quantifying hydrologic alteration and to better understand the causes and effects on riverine ecosystems. This study pilots the application of machine learning to predicting measures of hydrologic alteration in the Pearl and Pascagoula River Basins in Mississippi. Modeled daily streamflow for 12-digits hydrologic unit code (HUC12) watersheds was used to compute two predictors of hydrologic alteration, the net change and P values from applying a confidence interval hypothesis test to the streamflow data for each HUC12 across a pre- and post-alteration period. The two metrics were then used to predict patterns and drivers of hydrologic alteration in the basins. Cubist is a machine learning algorithm that uses series of rules and regression models to make predictions. Cubist models were developed for each basin to predict the P value of the confidence interval hypothesis test as a function of the net change and a range of physical and meteorological watershed characteristics. Results from net change and the hypothesis test indicated the basins were essentially identical with respect to the amount of significantly altered HUC12s. Patterns of altered HUC12s tended to coincide with the locations of densely populated areas, dams, and in areas with substantial land cover change during the period of analysis. The Cubist models developed for the basins accurately predicted the P values for HUC12s in each basin with the exceptions of extremely large or small P values. Based on the importance of predictors used in each model, the models indicated that the relationships between basin geomorphology, land cover, and hydrologic alteration differed in both basins. The results of this study demonstrate the application of machine learning and model trees in assessing hydrologic alteration. More broadly, the cubist algorithm can be applied to a wide variety of complex water resource questions to leverage data-driven approaches to inform local, state, and federal resources managers.

Abstract #: 134

Title: ***Forecasting harmful algal blooms in inland water bodies using Sentinel-2 data and long-short term memory (LSTM)***

Authors: Kamand Bagherian, Yin Bao, Kelly Kaye, Edna Fernandez-Figueroa, Stephanie Rogers

Organization: Auburn University

Harmful algal blooms (HABs) in inland water bodies are a global concern due to their negative impact on human and animal health. In order to anticipate and thereby minimize the effects of HABs, a forecasting system is needed. Satellite imagery with high temporal resolution has been widely used for monitoring HABs. It is necessary to examine historic satellite imagery and complex time-series data for forecasting HABs. Therefore, in this work, a Long-short term memory (LSTM) model is employed, which is capable of extracting the temporal features of the satellite data. This study explores the application of the LSTM model using Sentinel-2 data to estimate chlorophyll-a (chl-a) and microcystin concentrations, one month in advance. The method is evaluated on case studies in Florida including Lake Okeechobee, Lake Seminole, Lake Tallavana, Lake Jackson, and Lake Hall. The results show that the LSTM model has the potential to forecast chlorophyll-a and microcystin concentrations in Florida lakes, based on the Sentinel-2 images.

Abstract #: 135

Title: ***Detecting global declines of stoneflies at a local scale: measuring changes in stonefly diversity in the Cahaba River of central Alabama***

Authors: Gabriella Gentry, Lori Tolley-Jordan, Lisa Huff

Organization: Jacksonville State University

Projections of a global 40 percent decline in overall insect diversity within the next few decades is particularly worrisome for stonefly (Plecoptera) diversity. This group contains many species that are endemic, sensitive to habitat loss, and pollution intolerant primarily in their aquatic life stages where they occur only in non-impaired waterways. Also, these insects often have life cycles of at least a year before emerging as adults so chronic exposure to pollutants, siltation, scouring, and other trends in impaired waterways cause localized extinction events. Currently, there are 650 described species in nine genera of stoneflies in the US, of which 107 species are found in Alabama. In fact, type localities of 21 species are from small streams throughout the state, of which three species were described from small tributaries of Choccolocco Creek. The headwaters of the creek are nearly pristine and have 10 genera in seven families while lower reaches have fewer families and genera. However, this creek is on the 303-d list as an impaired creek because it flows 70 miles south through agricultural and urban landscapes, enduring the legacy effects of PCBs and Mercury pollution from previous industrial discharge which is likely causing reduced insect diversity in the stream. Further, regions of this stream are becoming more impaired from continued urban development in Oxford, Alabama which is presumed to also be a cause of declines in stonefly diversity. A comparison of stonefly taxa along different regions from surveys conducted in five sites along the length of Choccolocco creek in 2000, 2011, and 2022 will show trends in diversity changes through time and highlight the importance for long-term monitoring of Alabama streams.

Abstract #: 136

Title: ***Generalized Additive Model Estimation of No-Flow Fractions and L-Moments to Support Flow-Duration Curve Quantile Estimation***

Authors: Elena Crowley Ornelas, William H. Asquith, Scott Worland

Organization: U.S. Geological Survey

The U.S. Geological Survey in cooperation with the Gulf Coast Ecosystem Restoration Council and the U.S. EPA are collaborating on a project to analyze the timing and delivery of freshwater to the Gulf of Mexico. An important aspect of analyzing timing and delivery is modeling flow-duration curves at ungaged locations. Censored and uncensored generalized additive models (GAMs) were developed from 941 U.S. Geological Survey streamflow-gaging stations (streamgages) to predict decadal statistics of daily streamflow for streams draining to the Gulf of Mexico. The modeled decadal statistics comprise no-flow fractions and L-moments of logarithms of nonzero streamflow for six decades (1950â€“2009). These statistics represent metrics of decadal flow-duration curves (dFDCs) derived from approximately 10 million daily mean streamflows. The GAMs were fit to the statistics from 941 streamgages and 2,750 streamgage-decades by using watershed properties such as basin area and slope, decadal precipitation and temperature, and decadal values of flood storage and urban development percentages. The GAMs then estimated decadal statistics for 9,220 prediction locations (stream reaches) coincident with outlets of level-12 hydrologic unit codes. Both entire dataset (whole model) and leave-one-watershed-out model results are reported. No-flow fractions are censored data, and Tobit extensions to GAMs were used to model ephemeral streamflow conditions. Conversely, uncensored GAMs were used for estimation of the L-moments. The GAMs are shown, by coverage probabilities, to construct reliable 95-percent prediction limits. This example shows how no-flow fractions and L-moments may be used to approximate dFDCs by using selected probability distributions (mathematical formulas) including the asymmetric exponential power, generalized normal, and kappa distributions. The ability to approximate dFDCs at ungaged or unmonitored locations helps water managers balance environmental and anthropogenic needs on water resources.

Abstract #: 138

Title: ***Interactions of Per and Polyfluoroalkyl Substances with Dissolved Organic Matter as a Potential Contributor to Soil and Water Contamination.***

Authors: John Lawhon, Yaniv Olshansky, Ann Ojeda

Organization: Auburn University

Per- and polyfluoroalkyl substances (PFAS) are a large group of chemicals that are highly persistent and ubiquitous in the environment. These compounds, known for their adverse effects on humans and the ecosystem, reach farmlands with irrigation water and land use of biosolids. The fate and bioavailability of PFAS in the soil environment are fundamentally influenced by their interactions with dissolved organic matter (DOM), the concentration of which in soil solutions is elevated due to land application of organic amendments. The development of efficient risk assessment and treatment strategies requires an understanding of the underlying mechanisms of PFAS interactions with DOM and its effect on contamination spread in the soil and water medium. In this study, we tested the interactions between perfluorooctane sulfonate (PFOS) and DOM of humic acid standard, and seven extracts of organic amendments, including class B biosolids, animal manure, and plant derived composts. The molecular structure of the DOM was analyzed using UV-vis absorbance, fluorescence excitation-emission matrices (EEM) coupled with Parallel Factor (PARAFAC) analysis, Fourier Transform Infrared (FTIR) spectroscopy, and size exclusion chromatography. The PFOS â€“ DOM binding interactions were assessed using equilibrium dialysis and fluorescence quenching. Furthermore, to evaluate the impact of DOM on PFAS transport in soils, we measured the sorption and desorption of PFOS on the B horizon of an ultisol and vertisol.

First, our data show distinct molecular properties of DOM from the different types of organic amendments. The biosolids have a smaller molecular weight, lower aromaticity, and higher proteinaceous content. In contrast, plant-derived compost and humic acid are composed of a larger aromatic molecular structure. Second, the binding of PFOS to DOM was highly correlated with the proteinaceous content (r = 0.71), aromaticity (r = 0.7) and negatively corelated with the content of oxygenated functional groups (r = -0.81). Depending on the DOM and soil type, adsorption of PFOS increased by up to 38% in the presence of 100 mg L-1 of strong binding DOM in the reaction solution and decreased by 32% for the low binding DOM compared with adsorption from DOM free solution. This study demonstrates the strong potential for using DOM molecular descriptors as predictors for PFAS fate in the soil and water environment.

Abstract #: 139

Title: ***Seeking Sustainable and Replicable Wastewater Solutions for Small, Rural Communities in the Alabama Black Belt--Decentralized Cluster Demonstrations***

Authors: kevin white, Lacey Christian, Mark Elliott

Organization: University of South Alabama

There are many small towns located in the impoverished Alabama Black Belt Region. This mostly rural region, with low population density and limited economic development, faces many wastewater challenges. Much of the region has access to municipal sewer systems and have rich clay soils that do not allow traditional onsite septic systems with drain fields to function properly. The combination of insufficient infrastructure and failing onsite wastewater systems puts the area at a high risk for public health and environmental health hazards. The Consortium for Alabama Rural Water and Wastewater Management (CARWW), which formed in 2018 to foster collaboration amongst academic institutions, regulators, private industry, elected officials, and citizens. This group has partnered with Columbia World Projects (CWP) and has recently received ARPA funds to establish a decentralized wastewater demonstration in the Black Belt region (Hale County). In establishing this decentralized wastewater demonstration, CARWW and CWP seek to show that cost-effective wastewater solutions are available and sustainable for rural communities. The goal of this demonstration is to show how utilizing decentralized collection, treatment, and disposal infrastructure can minimize capital costs as well as long term operation and maintenance costs. The demonstration site is being chosen partially because of its access to high speed internet connectivity, so that remote monitoring and operation are possible. The successful implementation of remotely monitoring wastewater collection and treatment infrastructure will provide the opportunity for expanded management of multiple systems by single responsible management entities, reducing the labor costs of operation and maintenance activities. Additionally, this decentralized wastewater demonstration hopes to lead into rapid implementation of additional wastewater treatment systems for population clusters within the Alabama Black Belt utilizing the same or similar decentralized collection, treatment, and disposal technologies. With the current American Rescue Plan Act (ARPA) and Bipartisan Infrastructure Law (BIL) capital funds available to communities, this is a once in a lifetime opportunity to get wastewater infrastructure established without (in many cases) the need for capital cost recovery. Opportunities such as these are invaluable to the improvement and economic development of impoverished communities in the Alabama Black Belt. Details of this project are made available to the public via the consortium website at http://ruralwastewater.southalabama.edu/.

Abstract #: 140

Title: ***Baseline Flow, Gage Analysis, and On-Line Tool Development Supporting Bay and Estuary Restoration in Gulf States***

Authors: Kirk Rodgers

Organization: USGS Lower Mississippi-Gulf Water Science Center

The U.S. Geological Survey, in cooperation with the Gulf Coast Ecosystem Restoration Council and the U.S. EPA are collaborating to assess the climatic, physiographic, and anthropogenic factors driving spatial variability and temporal trends in the freshwater delivery to the Gulf of Mexico. The timing and magnitude of freshwater delivery influences terrestrial and aquatic communities, changing community composition and altering habitats necessary to support indigenous life. The 9-year, 8.9 million dollar project examines multiple aspects of streamflow including streamflow trends, alteration of flow, lowflow statistics, and flow-ecology relationships in the southeast United States. Data produced as part of the Baseline Flow study is served on the RESTORE Data Visualization tool which utilizes modern web technologies and numerous free and open-source software (FOSS) libraries to provide user with an engaging experience through a high degree of interactivity and responsiveness. The web application provides a map-based interface for viewing spatial patterns of basin characteristics, streamflow statistics, and various metrics of flow alteration across the Gulf Coast region

Abstract #: 141

Title: ***In-Situ Chemical Oxidation Groundwater Remediation at the Robertsdale Elementary School ADEM Tank Trust Fund Site***

Authors: Kendall Rich

Organization: Wood Environment & Infrastructure Solutions, Inc.

Robertsdale Elementary School was newly constructed at its current location in Baldwin County during the early 2000s, and as part of the school facility, a new bus-refueling station was planned at the site. A previous bus fueling station there included one 1000-gallon underground storage tank (UST) for unleaded fuel and one 3,000-gallon aboveground storage tank (AST) for diesel fuel. Removal of the UST in 2009 revealed gasoline-contaminated soil and groundwater, and the site was subsequently enrolled in the Alabama Department of Environmental Management (ADEM) Underground and Aboveground Storage Tank Trust Fund program to fund reimbursement of costs for removal and remediation of contaminated soil and groundwater associated with the discovered release of fuel. With the aid of the ADEM Tank Trust Fund, preliminary and secondary investigations were conducted in 2013 and 2014, respectively, and an Alabama Risk Based Corrective Action evaluation was performed in 2016 to characterize potential exposure pathways and to determine appropriate remediation goals. A corrective action plan (CAP) was developed, and a series of four high-vacuum extraction (HVE) events were conducted using mobile, enhanced multi-phase extraction (MEME) techniques in 2018. To further aid in remediation of gasoline-related compounds in groundwater, a revised CAP was developed to include in-situ chemical oxidation (ISCO) with HVE. In 2020, an ISCO pilot test and treatability study was conducted to evaluate potential efficacy of ISCO. A full-scale ISCO injection design was developed, and as required by ADEM an underground injection control (UIC) permit was obtained from the ADEM Water Division along with pre-approval of MEME events obtained from the ADEM Air Division. The ISCO injections were conducted during the week of February 14, 2022, and subsequent quarterly groundwater monitoring events are being conducted to evaluate effectiveness of the ISCO injections paired with HVE. This presentation will provide a description of the ADEM Tank Trust Fund program, an explanation of the use of chemical oxidation as a groundwater remediation tool, as well as an example of coordination between ADEM and the Baldwin County Board of Education to clean up groundwater at a sensitive locale in Robertsdale, Alabama.

Abstract #: 142

Title: ***Runoff sediments and nutrient losses from soybean crop***

Authors: Arpita Sharma, Rishi Prasad, Anh T. Nguyen, Anjan Bhatta, Brenda Ortiz

Organization: Auburn University

The new technologies, mechanization, and increased chemical use favored maximizing agriculture production. Although these developments have reduced risks in farming and helped achieve food security, they have also posed numerous threats. Agricultural intensification and poor land management practices accelerate soil erosion and increase the number of source areas that contribute sediments and nutrients to the stream network. Excessive nutrient load contributions, especially nitrogen and phosphorus, have adversely impacted the freshwater resources. Thus, the determination of the causes of accelerated nutrient enrichment has become a contentious and litigious issue in the United States. To address this concern, an edge-of-field (EOF) experiment was initiated in 2021. A farmer's field was selected in Lawrence County. The field was divided into paired watersheds based on their hydrological characteristics; site 1 and site 2 with an area of 26 acres and 92 acres, respectively. Later, the conservation practices will be implemented in one of the watersheds and the other one would be farmed as usual. These two watersheds will be compared to evaluate the effectiveness of conservation practices in the reduction of erosion and nutrient loading from agriculture fields. At the edge of paired watersheds, plastic culverts were installed in the field, and area velocity sensors were used to monitor the runoff discharge along with a monitoring station to quantify runoff volume and to collect water samples from runoff produced by precipitation and/or irrigation. During 2021, soil, plant, and surface runoff observations were made for unfertilized soybean crop to understand the characteristics of watersheds. The runoff samples were collected during each rainfall event and the samples were analyzed at the nutrient management lab, CSES- Auburn University, AL. using standard methodology and including analysis for total suspended sediments (TSS), nitrate, ammonium, total phosphorus, and dissolved reactive phosphorus. Throughout the crop period, 35.23 inches of rainfall was observed. The initial flushes of runoff had high inorganic N and dissolved reactive P which eventually decreased later, whereas the total suspended sediments were low initially and increased in the later flushes. Site 1 had high runoff, sediment loss, and nutrient loading compared to site 2. These differences were due to the high slope of 6% and erosion-prone Abernathy silt loam soils at site 1. In comparison site 2 had a 3% slope and Decatur silty clay loam soils. This data will be used as baseline data to understand and characterize paired watersheds for further studies. EOF monitoring is a tool to document runoff water quality on real, working farms and it highlights the importance of obtaining â€œreal worldâ€losses to inform risk assessment tools and remedial policies and strategies.

Abstract #: 143

Title: ***Geochemical modeling of the speciation and mobilization of arsenic and molybdenum in coal combustion residual sites of Alabama, USA***

Authors: Shifat Monami, Ming-kuo Lee

Organization: Auburn University

A long list of toxic heavy metals including arsenic, molybdenum, and other carcinogens can be produced by burning coal and subsequently concentrated in the coal ash waste product. The contamination of groundwater and surface water from coal combustion residuals (CCR) is a major problem worldwide since it may pose a risk to drinking water resources. The CCRs may leach into the water supply by groundwater recharge, or transport into freshwater systems through runoff or flooding events. It is therefore critical to understand the fate, transport, and mobility of toxic heavy metals associated with CCRs under changing physicochemical and biogeochemical conditions. In this study, we are focused on understanding the transformation, mobility, and potential remediation of arsenic and molybdenum in groundwater systems impacted by CCRs. To better understand how arsenic and molybdenum may be removed from contaminated water, we assess the speciation and interactions of arsenic and molybdenum with iron-sulfate bio-minerals under reducing conditions. The geochemical modeling techniques using the thermodynamic data were applied to investigate the adsorption and co-precipitation of arsenic and molybdenum- onto Fe-S solids formed under sulfate reducing conditions. A new thermodynamic database has been created for arsenic and molybdenum aqueous species and solid phases in Geochemist's Workbench (GWB) to study the stability field of those species and which species will precipitate or dissolve under changing pH and redox conditions. Phase diagrams for arsenic and molybdenum were calculated in the presence of sulfate and/or iron using the ACT2 sub-program of GWB with the new thermodynamic database. The modeling results evaluate the redox potential (Eh) effects on mineral precipitation and pH controls on the sorption and co-precipitation of arsenic and molybdenum. Overall, the geochemical modeling study and ongoing laboratory experiments will provide new insights and proof-of-concept for the sequestration of arsenic and molybdenum in contaminated groundwater at the CCR disposal sites.

Abstract #: 144

Title: ***Microplastic accumulation, excretion, and effects on the behavior of freshwater organisms-Daphnia magna***

Authors: Jessica Okutsu, Tham Hoang

Organization: Auburn University

The recent rapid increase in plastic use and mismanagement of plastic waste have resulted in a plastic pollution problem around the world. Microplastics (1Âµm - 1mm in size) and nanoplastics (< 1Âµm in size) are the most concern because they can last for hundreds of years in the natural environment and being accumulated in living organisms and transferred through the food chain and food web. Although research has been conducted to determine the impact of micro- and nanoplastics on the environment, most research has focused on the toxicity of micro- and nanoplastics on living organisms. Limited research has been performed to evaluate behavioral changes of organisms, which can lead to changing the dynamic of population and community of aquatic ecosystems. This research characterizes the accumulation, excretion, and the effects of microplastics (PE 63â€“75 Î¼m) on the behavior of Daphnia magna. To determine the effects, D. magna were exposed to microplastics at different concentrations for over 48 hours and collected over time to determine accumulation and excretion of microplastics. Daphnia magna were also monitored for behavior using a NOLDUS behavior monitoring system (EthoVisionXT). The study showed that D. magna began ingesting microplastics between 30 minutes to 1 hour of microplastic exposure. Results of behavioral monitoring showed that D. magna exposed to microplastics spent most of their time at lower depths in the water column, where microplastic abundance is higher. Daphnia magna in the control spent time at low and high depths. These results indicate that D. magna have changed their feeding niche to the area that has higher microplastic abundance that allow them to ingest more microplastic particles. This would lead to changing population distribution and dynamics of the organisms in natural ecosystem. The ingestion accumulation of microplastics in D. magna also reveals a potential consequence of microplastics being transferred through the food chain and food web. Further research should be conducted to characterize trophic level transfers of microplastics into the environment.Keywords: Organismal behavior, Microplastic accumulation and excretion, Trophic transfer of microplastics

Abstract #: 145

Title: ***Phosphorus solubility in traditional versus gypsum treated poultry litter and its environmental implications***

Authors: Debolina Chakraborty, Rishi Prasad, Dexter Watts, Allen Torbert

Organization: Auburn University

With a surge in world population, there is an increasing demand of poultry products leading to generation of enormous volumes of poultry litter (PL). Although PL is an excellent source of fertilizer (N-P2O5-K2O content is typically 3-3-2), however, it is bulky which prevents its long-distance transportation. Limitation in long-distance transportation promotes excess PL application in localized areas of poultry operations leading to increased risks of phosphorus (P) transport during runoff events that can eventually cause water quality degradation. More than 50% of P in PL is water soluble and can be lost during runoff events. Use of amendments such as gypsum can be used to reduce P solubility in PL and hence can be used as an effective PL management strategy to reduce environmental P loss risk. The objective of this study was to understand P availability in traditional versus gypsum treated PL for environmental risk assessment. Treatments included PL mixed with gypsum at 1600 lb/1000 ft2, PL treated with industry standard PLT (sodium hydrogen sulphate) @ 100 lb/1000ft2, and control (litter decaked with no amendments). After air-drying, PL was characterized for pH, total carbon (TC), total nitrogen (TN), total P (TP), and total elements (calcium, magnesium, potassium, manganese, copper, iron, aluminum). Repeated water extractions at 1:100 PL:water ratio were conducted for seven cycles to understand the P desorption for gypsum treated and untreated PL. Phosphorus fractionation was also performed on all the samples following modified Hedley procedure. The mean TP content in the litter samples was 1.6% and TN content varied between 1.8 to 3.6%. Preliminary result indicates that gypsum treated PL had significantly less P availability (<30%) compared to traditional PL and hence can be beneficial in reducing P loss during runoff events.

Abstract #: 146

Title: ***Monitoring sediment and nutrient losses from paired watersheds in agriculture fields in runoff water in Alabama farms***

Authors: Anh Nguyen, Rishi Prasad, Arpita Sharma, Anjan Bhatta, Brenda Ortiz

Organization: Auburn University

Surface runoff from agricultural land causes sediment and nutrient losses, contributing to soil and water quality degradation. This study summarizes nutrient and sediment data for rainfall-runoff from foura paired watersheds located in two Alabama row crop farms. The Posey field in North Alabama consisted of two independently drained management sites, 26 ac (Posey1) and 92 ac (Posey2), respectively. Due to the larger discharge area, two plastic culverts were installed at Posey field, and area velocity sensors were used to monitor the runoff discharge. The Lewey field in south Alamaba covers two sites of 4.6 ac (Lewey1) and 5.2 ac (Lewey2) equipped with 3.0 ft H flumes. Our objective was to quantify drain flow volume and nitrogen and phosphorus losses during the growing and non-growing season. Sampling frequency during a runoff event was set up as volume-paced sampling. Discharge was calculated by measuring stages in H-flume (Lewey) and area velocity at the PPE culvert (Posey) by applying the appropriate stage-discharge relationship. For the Posey field, five runoff events occurred during the soybean growing season (6/24/2021 â€“ 10/5/2021), while twelve runoff events happened during off growing season on the empty field (12/29/2021 â€“ 5/6/ 2022). Posey1 experienced more runoff events compared to Posey2 due to higher slope and shorter flow path. For Lewey field, there were five runoff events during the peanut growing season (4/24/2021 â€“ 8/20/2021) and two events from December 2021 to April 2022 while the area was planted with cover crop. Lewey2, with a higher slope, experienced higher discharge, and sediment load. Runoff samples were collected and analyzed for ammonia N, nitrate N, total Phosphorus (TP), dissolved reactive phosphorus (DRP), and total suspended solids (TSS). Preliminary results showed that mean event nitrate-N, DRP, and TP concentrations losses in surface runoff decreased as the crop progressed to maturity.

Abstract #: 147

Title: ***The relationship between changing land use land cover and macroinvertebrate diversity over twenty years in Choccolocco Creek, Northeast Alabama.***

Authors: Kindall Brown, Lori Tolley-Jordan

Organization: Jacksonville State University Dept of Biology

With a drainage area of ~ 300,000 acres and a length of 70 miles, Choccolocco Creek is one of the largest tributaries in the Coosa River drainage system. Choccolocco Creek is found in northeast Alabama where the headwaters of the creek begin in the Talladega National Forest in Cleburne County, and flows through Calhoun, Clay, and Talladega counties to the confluence with the Coosa River. Along the length of the creek, a distinct urban-rural gradient occurs with highest degradation occurring in the areas surrounding Oxford. In 2000, a survey of benthic macroinvertebrate diversity was conducted that showed declines in biodiversity along the length of the stream. These declines became more pronounced through time based on data collected from a repeated survey in 2011 and continued declines are expected with a survey scheduled for 2022-2013. However, documentation of land use along the length of the basin were not given in the earlier surveys. Therefore, a detailed assessment of land use land cover differences between 2000 to 2011 to 2022 will be conducted in Summer 2022 using data made available by the National Land Use Land Cover land sat imagery needed for all years. Land use land cover at HUC 12 watershed delineations will capture site specific changes that will be correlated to macroinvertebrate diversity indices from these surveys. These long-term assessments of watersheds are critical for determining biodiversity changes due to stream degradation.

Abstract #: 148

Title: ***An Educator's Guide to Alabama Rivers***

Authors: Sydney Zinner, Mona Dominguez, Bill Deutsch, Rachel McGuire

Organization: Alabama Water Watch

An Educator's Guide to Alabama Rivers is the companion curriculum to Alabama Rivers: A Celebration & Challenge, written by Dr. Bill Deutsch, which highlights the human history and natural wonders that shape Alabama. The goal of the Guide, and associated Alabama Rivers Educator Workshops, is to extend thook's message to Alabama's youth, to shift their perspectives of rivers and what it means to be an Alabama citizen. The Guide introduces educators and students alike to the abundant life that lives beneath the rivers' surface, the threats to that life and biodiversity, and how they can engage in watershed stewardship to protect those waters. Nine modules within the Guide are based on the chapters within the book, and the seven River Celebrations presented in the book: Rivers are Full of Life, Rivers are Ancient and Physically Diverse, Rivers are Beautiful, Mysterious, and Spiritually Enriching, Rivers are a Part of Alabama History and Culture, Rivers are Key to Alabama's Economy, Rivers are Precious and Provide Vital Ecological Services, and Rivers are Vulnerable and Need Our Care. Alabama Rivers Educator Workshops are open to all formal and informal educators, including (but certainly not limited to!) 4-H Regional Extension Agents, classroom teachers, volunteer educators, environmental centers, and anyone who conducts environmental education programming with Alabama youth. The curriculum correlates to the Alabama Course of Study Standards for Social Studies, Science, Social Science, Arts and more for grades 4-7, but is adaptable for any grade K-12. This lightening talk will provide a brief overview of the curriculum and how it can be implemented by educators throughout Alabama.

Abstract #: 149

Title: ***Hydrologic Controls on Organic Matter Partitioning in Headwater Streams Across Alabama***

Authors: Michelle Wolford, Arial Shogren, Shannon Speir, Delaney Peterson, Carla Atkinson

Organization: The University of Alabama

Despite being one of the wettest states in the US, many headwater streams in Alabama (AL) experience drying and can be defined as "non-perennial." As non-perennial stream channels alternate between wet and dry, they represent unique ecotones at the terrestrial-aquatic interface. Ultimately, organic matter and other nutrients sourced from these laterally (land to water) and longitudinally (up- to downstream) connected networks may significantly influence the highly biodiverse downstream ecosystems in AL. However, it is unclear how hydrologic variability and stream drying impact the downstream transport of materials. To address this knowledge gap, we investigated how stream network expansion and contraction control organic matter (OM) fate and partitioning, as particulate and dissolved organic carbon (POC and DOC, respectively), in three headwater watersheds in AL. We characterized hydrologic conditions using â‰¥20 spatially-distributed binary inundation loggers (i.e., dry vs. wet) deployed throughout each watershed and measured continuous flow at the outlets. We collected grab samples to characterize C quality and quantity at each stream outlet every three weeks and throughout the watershed three times per year during synoptic sampling. Preliminary data suggest network extent, seasonal shifts in flow, and the timing of canopy leaf-on/leaf-off drive temporal trends in DOC concentrations and dissolved organic matter (DOM) character at all three sites. At each watershed, we observed temporal shifts in DOM quality (quantified as SUVA254 and spectral slope ratios) that likely reflect differences in allochthonous sourcing versus autochthonous processing. In addition to discrete water chemistry data, we leveraged high-frequency sensor data available at two sites to examine potential drivers of OM variability at multiple timescales (e.g., from seasonal- to event- scale). Initial data reveal stark differences in DOC vs. POC concentrations and DOM quality between the two sites, likely due to variation in biotic, hydrogeomorphic, and microbial drivers at each site. Overall, results to date emphasize the complexity of OM dynamics and the importance of particulate chemistry in non-perennial streams and point to their potential importance supporting downstream water quality and biodiversity resources.

Abstract #: 151

Title: ***Promoting Citizen Science to put paddles and preservation into the current of a Capitol's undervalued asset.***

Authors: Rebekah Correia

Organization: Alabama Water Watch

Sandwiched between America's third and fifth most endangered river systems of 2022, Alabama's namesake waterway lacks appropriate attention as the third largest contributing medium to "America's Amazon." Recreative facilities and opportunities on the Capitol's portion of the Alabama River have been markedly underwhelming despite nearly 18 years of revitalization efforts beginning a mere few hundred feet from the water's edge in Downtown Montgomery. The wide, deep bend with a dark and steady flow that hugs High Red Bluff is, for most of the year, ideal for paddle sports, yet such activity has largely been absent, save for one-off events. There is, as yet, no existing Riverkeeper or related group monitoring the Alabama watershed. In a state where, relative to its amount of water resources (132,000 miles-worth) funding and water quality enforcement are both greatly lacking, it is the work of such organizations, citizen scientists, and freshwater enthusiasts that keeps the health and safe use of the state's waterways a concern by simultaneously encouraging vigilance of "red flag" issues as well as promoting the improved recreational use of our vast freshwater resources. The recent announcement of plans for a riverside trail system in Downtown Montgomery, drafted by nonprofit River Region Trails, shows promise in garnering attention for this underutilized stretch. Likewise, programs equipping citizens with water-testing training such as Alabama Water Watch, help residents capitalize on the Pandemic listlessness that thrust many of us out into our wild and less-peopled places with quantifiable action. These factors feel timely for Montgomery's portion of the Alabama River, with a fifty-million dollar construction project having just begun on its banks.

Abstract #: 152

Title: ***Stochastic Analysis of Profitability of Irrigated Corn Production in Alabama***

Authors: Denis Nadolnyak, Valentina Hartarska

Organization: Auburn University

Corn prices and production are increasing due to expanding ethanol markets and related supports for corn production. Persistence of this trend will likely lead to adoption of more intensive production practices and expansion of corn acreage to marginal areas. Alabama, unlike many traditionally agricultural states, has relatively abundant water supply that permits sustainable irrigated crop production but may also strain the natural resources. It is therefore important to know how producer decisions on adoption of irrigated practices are likely to be affected by yield responses to irrigation, market conditions (prices and costs), and producer characteristics (risk attitudes and production scale and mix). This paper investigates potential profitability of irrigated corn production in North Alabama using simulated and historical yields, variable and fixed input costs, and market data. In order to show the viability of irrigation for corn in Alabama, simulated yield data for irrigated and rainfed corn production data are first compared to historical yield data. This is done in order to ascertain the validity of the simulated yield data the use of which is necessitated by the absence of reliable irrigated historical yield data from the area with predominantly rainfed crop production and to justify analysis of the stochastic properties of the yield series. Then, simulated yield series combined with enterprise budget data on variable costs for both practices, irrigation investment costs, and other economic data are used to generate stochastic profits from corn production. Based on these profit series, profitability of irrigated and rainfed corn production is compared for different assumed producer risk attitudes, corn prices, and interest/internal discount rates. Analysis of irrigation viability is done using certainty equivalent revenues (CER) calculated by calibrating a constant absolute risk aversion (CARA) utility function parameters for variable risk premium values. Comparison of the simulated and historic yield series provides some evidence of their similarities. The results of profit analysis show that the profitability difference between irrigated and rainfed corn production measured in CER increases with risk aversion and with output prices. Raising corn prices magnifies rainfed yield volatility more than that of irrigated yields, making irrigated production more desirable. According to the numerical simulation results, the threshold corn price that makes investment in irrigation profitable is around $3.75/bu even for low risk aversion levels and reasonable discount rates. Adoption of irrigated production is quite profitable at moderate corn prices, even when the yield data are transformed to proxy for farm supports which reduce yield variability and make the cheaper rainfed production more attractive.

Abstract #: 153

Title: ***The Development of a MODFLOW Groundwater Model to investigate groundwater/surface water interaction in the Mobile Bay Watershed***

Authors: John Richins, Kevin Befus, Kirk Rodgers

Organization: USGS Lower Mississippi-Gulf Water Science Center

The U.S. Geological Survey (USGS), in cooperation with the Gulf Coast Ecosystem Restoration Council and the U.S. EPA, will conduct a study to investigate surface water/groundwater interactions within the Mobile Bay Watershed. Rivers and streams can gain water and lose water to adjacent aquifers. If groundwater discharge from an aquifer is a large portion of a stream's baseflow, these groundwater fluxes can strongly influence streamflow and water chemistry. Therefore, groundwater-stream interactions can have a significant role in the health of downstream and riparian ecosystems. Additionally, future climate conditions may change how groundwater interacts with surface water. We will use MODFLOW-based groundwater flow models to test how and where groundwater-surface water interactions occur and may change in the future. We will construct the MODFLOW model to simulate groundwater flow within the Mobile Bay Watershed, which spans Alabama, Florida, Georgia, and Mississippi.

We plan to build the model with scripted workflows using the Python programming language and the FloPy library. The model will be calibrated using past groundwater level and streamflow observations and/or statistics. Once calibrated, we will use the model to analyze groundwaters' contribution to baseflow within the watershed including how much and where groundwater discharge occurs within the system. Next, we will use the calibrated models to forecast how possible changes in the system can affect future conditions. Climate change is expected to cause changes in precipitation, evapotranspiration, and sea level within the study area. All these changing factors are expected to affect groundwater within the area. Using the MODFLOW model, we plan to investigate how groundwater discharge rates will respond to these changes by altering model inputs that correlate with different climate change scenarios.

Abstract #: 154

Title: ***Novel Time-integrated Techniques to Quantify Waterborne Fecal Microorganisms in the Alabama Black Belt***

Authors: Corinne Baroni, Jillian Maxcy-Brown, Emily Elliott, Kristen Jellison, Mark Elliott

Organization: The University of Alabama

In the Alabama Black Belt, widespread rural poverty, limited access to sewer, and shrink-swell clay soils that preclude the use of conventional septic systems lead to both failing septic systems and the discharge of raw sewage from homes through â€œstraight pipes.â€ Sewage that is discharged to the surface typically pools in a ditch or trench until rain flushes the sewage and sediment into local waterways. The degree to which fecal microbes are associated with the suspended sediment load (SSL) has important implications for the sustained transport of these contaminants within the waterway, with ~60% of fecal microbes in surface water during storms associated with particles. Therefore, an accurate and efficient way of capturing and monitoring suspended sediment and determining the microbial association is critical in understanding the potential impact that storms have on the fate and transport of fecal pathogens. Sampling surface water for fecal contamination typically involves collection of grab samples. While this method is technically simple, microbial surface water quality is highly variable and indicator bacteria are poorly correlated with many waterborne pathogens including oocysts of Cryptosporidium spp. Therefore, a grab sample tested for fecal indicator bacteria is inadequate to evaluate potential risk to human health from enteric pathogens in a body of water. There has been little to no effort to explore time-integrated sampling methods that have been used in sedimentology and incorporate those into pathogen capture. This project uses novel time-integrated methodologies for capturing suspended sediment and Cryptosporidium in study three sites along Big Prairie Creek in Newbern, AL. The novel time-integrated sampling procedure for Cryptosporidium takes advantage of the propensity of oocysts to stick to biofilms; growth of biofilm on glass slides yield a surface that can capture suspended oocysts, with addition of added calcium ions to enhance collection. Cryptosporidium oocyst analysis and quantification is conducted at Lehigh University. The time-integrated mass sediment sampler (TIMS) method that has been used in sedimentology has been applied for the first time to the challenge of quantifying pathogens and other fecal microbes attached to suspended sediment. TIMS samples are currently being analyzed for particle size distributions, with microbial analysis to follow. Current results show that Cryptosporidium and E. coli levels are higher after large rain events, pointing to increased runoff resulting in more surface water contamination. The TIMS and the novel Cryptosporidium samplers are both made of PVC and will provide inexpensive alternatives to conventional time-integrated or Cryptosporidium sampling methods in surface waters. This work reflects our efforts to enable affordable time-integrated approaches to the quantify Cryptosporidium in rural streams, differentiate sediment-associated fecal microbes, assess the potential of in-sit

Abstract #: 155

Title: ***Develop Tidal/Non-Tidal Forested Wetlands Using Imagery Classification***

Authors: Eian Margaret Davis, Lana Narine, Christopher Anderson

Organization: Auburn University

Estuaries along the Gulf of Mexico include several large, river-dominated deltaic systems that include tidal freshwater forested wetlands. These areas are susceptible to future changes in their tidal regime from altered flows (due to river management and climate change) as well as sea level rise. The goal of this study was to determine boundaries in tidal and non-tidal freshwater forested wetlands along the lower Apalachicola River in western Florida. Our objectives included approximating a tidal/non-tidal boundary and establishing a methodology to monitor possible changes. Cabbage palm (Sabal palmetto) is a common forest canopy species along the river that was previously identified as an indicator species that correlates with tidal forested wetlands. Using existing aerial imagery from National Agriculture Imagery Program (NAIP) and various remote sensing approaches to detect cabbage palm, we estimated the reach of tidal freshwater forested wetlands along the river. A Maximum Likelihood classifier was applied to NAIP imagery to detect cabbage palm and approximate tidal boundaries. Normalized Difference Vegetation Index (NDVI) and textural bands were added to the NAIP image bands to assess improvements to our classification accuracy. This work will improve our understanding of tidal freshwater forested wetlands and provide an approach for evaluating and monitoring these wetlands throughout the Gulf of Mexico and beyond.

Abstract #: 156

Title: ***The Impact of Irrigation on Crop Productivity in U.S. Agriculture***

Authors: Ekene Aguegboh, Valentina Hartarska, Denis Nadolnyak

Organization: Auburn University

By 2050, the demand for global grain is expected to double. This causes significant pressure on the demand for ground and surface water, crucial resources for crop development and yields. Farm irrigation facilitates use water for agricultural purposes and allows for crop production in arid regions and supplements soil moisture in humid areas, especially during seasons of insufficient precipitation. This study examines the impact of land irrigation on crop productivity. Prior studies dating back to the 1950s, show that expansion of irrigation facilities is associated with increase in agricultural production, especially in the region west of 100o meridian in the U.S. plains. We revisit the issue and examine how irrigated land affects crop productivity in different regions of the U.S using county-level variations and plot characteristics as controls. Our preliminary analysis suggest that crop yields have more variability relative to the variability in of the share of irrigated land. However, across states, crop yields seems to have less variability compared to irrigated land. A panel data analysis will help to integrate this variability in the analysis. Thus, we use the fixed effects approach and panel data of county-level data to estimate how agricultural crop productivity is linked to the percentage of irrigated land. Our results reveal that in the nationwide sample, irrigation has a strong and significant impact on crop productivity. Specifically, a percent increase in irrigated land causes crop production to increase by 0.16%. However, for different regions of the U.S., we find different results for the impact of irrigated lands on crop productivity. For example, in southeastern states we do not find a strong evidence for impact of irrigated lands on crop productivity. Our findings generally provide evidence that suggest continued investment in farm irrigation to improve access to ground and surface water and perhaps improved irrigation technologies that would boost agricultural productivity.

Abstract #: 157

Title: ***A human-natural framework for assessing, forecasting and managing for coastal resiliency at Perdido Bay***

Authors: Christopher Anderson, Kelly Dunning, Puneet Dwivedi, Richard Hall, Latif Kalin

Organization: Auburn University

The lands around Perdido Bay, like many areas along the northern Gulf of Mexico (GOM), have a distinct land use and land cover (LULC) pattern. Near the shoreline, there is expanding urban development related to population growth and increased tourism. However, inland from these areas, the land can abruptly become rural where forests and agricultural land becomes dominant. These rural lands are important to coastal waters because they represent most of the watershed draining to them. Current socio-economic and climatic factors are causing many rural landowners to reconsider their land use. Future land conversion, particularly the loss of forest cover (natural and managed), may substantially alter the timing and quality of water draining to local estuaries thereby impacting coastal environments and surrounding communities. To address these issues, our interdisciplinary team has devised a coastal human-natural (CHN) framework to examine the potential impact of LULC conversion and climate change on the drainage patterns, estuarine ecosystems, and the coastal communities of Perdido Bay. For this talk, we highlight the elements of our CHN framework. A series of social surveys, data gathering, and environmental modeling is designed to connect social and natural factors from watersheds to coastal zones. We review the design and utility of our CHN framework for the purposes of projecting future LULC change (up to 2050) along with potential impacts to coastal water clarity, estuarine habitats, and the local communities along Perdido Bay and the Alabama coast. We describe how our framework can be used to address issues of coastal resilience, watershed management, and policy for LULC and climate change. Finally, we describe potential applications of the CHN framework to assist watershed planners and other stakeholders within our study area.

Abstract #: 158

Title: ***Examining the extent and functional value of headwater wetlands in relation to land use in coastal Alabama***

Authors: Kurtis Fisher, Christopher Anderson

Organization: Auburn University

Headwater slope wetlands are forested wetlands located at the headwaters of coastal streams. They are a ubiquitous wetland type in the Alabama and southeastern U.S. Coastal Plain. These gentle slopes tend to move water gradually through these wetlands as shallow groundwater discharge. They are a critical element to the coastal Alabama landscape because they occur at the interface of uplands and coastal drainages. These wetlands are a subclass of slope wetlands that are understudied however they have a significant impact on groundwater storage, contributions to baseflow, nutrient attenuation, and habitat connectivity. There is concern about how urbanization and land use change in Alabama may ultimately affect their capacity to provide these important services. A study was initiated in 2022 to evaluate the extent of these wetlands and their functional value throughout Mobile and Baldwin County. Using over 50 wetlands across a range of surrounding land uses, an evaluation of soils, vegetation and other ecological and landscape measures was conducted using the Hydrogeomorphic Method (HGM) approach for the functional assessment of headwater wetlands in coastal Alabama (Noble et al. 2007). These data will be combined with HGM functional scores already completed for 50 other wetlands along the gulf coast (based on previous work). Using HGM functional scores, multiple regression or other suitable methods will be used to model wetland function as it relates to land use in the two-county region. Early results from HGM analyses and their relation to land use are provided here. Ultimately, the information gained along with a spatial analysis of headwater wetland function will assist watershed managers interested in maintaining and potentially improving coastal drainages to the Alabama gulf coast.

Abstract #: 159

Title: ***Breaking Down LID+GSI Barriers: A Code Audit Tool for Local Governments***

Authors: Eban Bean, Lesley Bertolotti, Lynn Jarrett

Organization: University of Florida

Outdated, conflicting, and poorly constructed local ordinances are a common barrier to the implementation of Low-Impact Development (LID) designs and Green Stormwater Infrastructure (GSI; LID+GSI). These codes often directly or indirectly prevent or restrict the use of these practices. The state of Florida is considering including a requirement in the revision of the MS4 permit to require permittees to review their local codes to identify these barriers. Ordinance Audit tools are intended to facilitate the process of reviewing local codes following a structured, methodical approach. Building largely on work of Wisconsin Sea Grant, the Center for Watershed Protection, we integrated and adapted code review elements into a state-specific tool for Florida municipalities and counties. The tool includes of a community scoping exercise intended to assess the extent of GSI implementation, community support and resistance, and to identify a core group of local government liaisons to provide experience and perspective on the process from varying departments. The second part is the Audit Workbook, which is includes nearly 200 questions divided into 16 sections aligned with typical code sections. Each question includes audit tips and is scored on a scale from zero to four, with positive a positive response receiving a higher score. Sections with lower percent of possible points may indicate sections of code that could be revised. The workbook is comprehensive but scalable, such that communities (external parties) may conduct as complete, or as limited, of a review as deemed necessary. The tool is set to be piloted in early 2022.

Abstract #: 160

Title: ***Species-specific thermal stress responses in freshwater mussels of the Pea River, AL***

Authors: Hannah Adkins, Jim Stoeckel, Jonathan Miller, Kayla Boyd, Brian Helms

Organization: Troy University

How freshwater mussels respond to warming waters is poorly understood. Knowledge of species-specific thermal tolerance is essential for unionid conservation efforts in the face of global climate change, particularly in species-rich, extinction-prone areas such as the SE U.S. Drainages of the Pea River in SE Alabama support a diverse and imperiled unionid assemblage, with 19 species including 5 federally Threatened and Endangered species. To examine whether interspecific variation in thermal tolerance occurs among sympatric unionid species in the Pea River, we quantified indicators of thermal stress, including onset temperature of metabolic depression (MDt) and behaviors (e.g., foot extension and gaping valves), and the lethal upper limit of critical thermal maximum (CTM). Wild-caught individuals of three common species, Elliptio pullata, Leaunio lienosus and Lampsilis straminea, were compared ex-situ. After a period of acclimation, intermittent flow respirometry was used to measure resting metabolic rate of 8 individuals/species over a 10+ hour period of increasing temperature (2°C/hr). Simultaneously, empirical observations of an additional 8 individuals/species were used to determine the temperature of occurrence of behavioral indicators and CTM. Mean MDt of E. pullata was 39.57°C and significantly different ($F_{2,21}= 30.73$, $p < 0.001$) from mean MDt of in L. lienosus (37.30°C) and L. straminea (38.15°C). No significant difference occurred among species in the temperature at occurrence of behavioral indicators (Foot extension: $F_{2,20}= 0.21$, $p= 0.81$; Gaping valves: $F_{2,16}= 0.19$, $p= 0.83$) or CTM ($F_{2,18} = 0.75$, $p= 0.49$). Mean CTM occurred at 43.2°C in E. pullata, 43.7°C in L. lienosus, and 44.3°C in L. straminea. Physiological indication of thermal stress (e.g, MDt) occurred before behavioral indication of thermal stress in all three species. These findings indicate that similarities in thermal tolerance occur among common, sympatric unionid species and suggest shared environmental conditions may play a larger role in driving evolution of thermal tolerance than species-specific physiology; however, evidence of species-specific physiology driving evolution of thermal tolerance was also present in our findings. Our results highlight the complicated nature of thermal tolerance as an evolutionary product of environmental filtering and ancestral adaptations. This study provides the first measures of thermal tolerance for unionid species in the Pea River watershed. From these data, formation of conservation strategies to maintain water temperatures below harmful levels can begin and may include restrictions on groundwater withdrawals as groundwater input sets baseflow and maintains ecological function during dry months. Studies including additional species within the drainage and beyond are needed to determine if thermal tolerance is a characteristic distinguishing common unionid species from rare species unionid species.

Abstract #: 161

Title: ***Alabama Drought Reporting and Condition Monitoring Program - A New Partnership***

Authors: Rachel McGuire, Eve Brantley, Kent Stanford, Lee Ellenburg

Organization: Auburn University Water Resources Center

In 2021, the Auburn University Water Resources Center (AUWRC) determined the mechanism for effective drought reporting by Alabama Cooperative Extension System (ACES) Regional Extension Agents and County Extension Coordinators is poorly understood. This may result in unreported drought conditions, thereby impacting drought response and economic implications. In response, the AUWRC has partnered with the Office of the State Climatologist housed at the University of Alabama in Huntsville (UAH), the Alabama Agricultural Experiment Station (AAES), and ACES to expand educational resources and to develop a streamlined approach to enhance drought reporting and monitoring in Alabama. This program will improve understanding of drought reporting, drought declaration, agency connections (federal, state, and local), insurance claims, drought condition documentation (i.e., U.S. Drought Monitor classifications of D0 -D4) for agriculture, forestry, and homeowner landscapes, proactive responses for stakeholders to minimize risk, and mechanisms to document climatic conditions. The AUWRC will serve as a liaison for the development of an Alabama Drought Reporting and Condition Monitoring program for ACES that will provide the State Climatologist Office with quality-assured data in a streamlined, managed approach that assists with decision making. Ultimately, this partnership will better prepare ACES for drought by providing more accurate data when called upon, clarify the most effective path to share critical information to the appropriate agencies, and optimize drought communication, education, and connections for agricultural, forestry, and agriculture, forestry, and homeowners.

Abstract #: 162

Title: ***Low-flow frequency estimation from synthetic daily mean streamflow with bias correction estimated at 5,316 level-12 hydrologic unit code (HUC12) pour points in the south-central and southeastern United States***

Authors: Amanda Whaling, Kelly Sanks, William Asquith

Organization: U.S. Geological Survey, LMG WSC

Low-streamflow (low-flow) frequency (LFF) statistics guide streamflow regulatory efforts; however, observational streamflow records required for LFF analyses exist for only a relatively small number of stream reaches in the United States (U.S.). Therefore, the U.S. Geological Survey (USGS), in cooperation with the Gulf Coast Ecosystem Restoration Council and the U.S. Environmental Protection Agency, is studying LFF estimation using synthetic daily mean streamflows. LFF analyses include 7-day and 30-day annual minima computed from synthetic daily mean streamflow previously estimated at level-12 hydrologic unit code (HUC12) pour points (outlets) in the south-central and southeastern United States for 1950–2010 (calendar year). Out of 9,203 HUC12 outlets in the study area with previously estimated synthetic streamflow, LFF analyses were restricted to 5,316 HUC12 outlets classified in study workflows as perennial based on a dataset of modeled no-flow fractions for each HUC12 outlet. The reliability of synthetic LFF statistics was assessed by comparing the synthetic LFF statistics to LFF statistics computed from daily mean streamflow for USGS streamflow-gaging stations (streamgages). The comparison dataset consists of 261 streamgages that were hydrologically matched to (coincident with) a HUC12 outlet and similarly classified as perennial based on a dataset of observed no-flow fractions of each streamgage. Conventional methods of frequency analyses were made using the annual minima: (1) the annual minima are treated as distributed by the PE3, and (2) a moment-like method for parameter estimation. The difference between the synthetic and gaged LFF statistics showed a bias; the synthetic LFF statistics were generally being over estimated. A spatial bias was modeled from the differences between synthetic and gaged LFF statistics. The magnitude of the overprediction generally increases where no-flow conditions are predominant. Overall, reliable LFF statistics for the HUC12 ungaged locations can be computed from synthetic streamflow where the magnitude of the spatial bias is low.

Abstract #: 163

Title: ***A review of North American freshwater mussel (Bivalvia: Unionoida) lethal thermal tolerance***

Authors: Kaelyn Fogelman, Jennifer Archambault, Maureen Walsh, Jim Stoeckel

Organization: Auburn University

Southeastern North America has the greatest diversity of unionid freshwater mussels in the world. Alabama alone has 181 species of mussels, 1/3 of which are endangered or threatened under the Endangered Species Act. Accurate risk assessments and development of effective management strategies for remaining populations requires knowledge of thermal limits in the face of increasing surface water temperatures. We conducted a systematic literature review to summarize existing lethal thermal tolerance data for North American unionids by life stage and taxonomy. We found published lethal tolerance estimates for only 9% (28 / 302) North American species in the families Unionidae and Margaratiferidae. The mean acute median lethal temperatures were 32.8°C for glochidia (19 species), 35.0°C for juveniles (13 species), and 36.3°C for adults (4 species). Generally, glochidia were less tolerant than juveniles or adults of the same species – but there were several exceptions. Generally, Amblemini had the highest acute and chronic thermal tolerance of all tribes followed by Anodontini, Pleurobemini, Lampsilini, and Quadrilini. However, too few species have been studied at this time to draw firm conclusions regarding patterns in upper thermal limits related to phylogeny and/or life history stage. Peak water temperatures in many Alabama drainages already approach or exceed the median lethal temperatures for all three life-stages of small proportion of species for which we have data. There is a great need to determine lethal tolerance data for additional species and to develop a comprehensive database of stream temperatures in order to identify watersheds facing the greatest thermal threats.

Abstract #: 164

Title: ***D'Olive Watershed Restoration in Baldwin County, Alabama***

Authors: Jason Kudulis

Organization: Mobile Bay National Estuary Program

Published in 2010, the D'Olive Creek Watershed Management Plan (WMP) described factors underlying excessive erosion and sedimentation, identified degraded stream reaches, and recommended actionable measures to reduce active instream impacts and prevent future degradation. At the time the WMP was developed, approximately 45% of the Watershed was covered in forest and agriculture, and planners anticipated most of the remaining undeveloped land would be converted to urban development. Draining a total area of over 7,700 acres in the fastest growing county in Alabama, the Watershed drains three principal tributaries, each addressed in the WMP and listed on the State's 303(d) list of Impaired Waters for sedimentation. With significant topographical relief, layers of erodible sand and clay, an average of five and a half feet of hard precipitation annually, and hardened urban landscape, the D'Olive Watershed, located on the eastern shore of Mobile Bay in Baldwin County, has been called "the perfect storm" of stormwater impacts, including flooding and flashiness, streambank erosion, wetlands degradation, and sedimentation. Beginning in 2012, the Mobile Bay National Estuary Program secured funding from the Alabama Department of Environmental Management (Section 319 Program), the National Fish and Wildlife Foundation Gulf Environmental Benefit Fund, and other sources to undertake implementation of recommended projects. To date, restoration of 19 degraded stream segments totaling over two linear miles, increased retention capacity (294K cu ft), and enhancement of floodplains (90 acres) have been completed. The cities of Spanish Fort and Daphne have adopted strengthened ordinances to encourage low impact development and preserve riparian buffers, and an impaired stream segment was removed from the State's 303(d) List. Yet more remains to be done. Engineering and design are currently underway for restoring one more segment, as is an update to the 2010 WMP.

Abstract #: 165

Title: ***Following Watershed Management Plan Recommendations to Eradicate the Island Apple Snail from the Langan Park Lakes in Mobile, Alabama***

Authors: Christian Miller

Organization: Mobile Bay National Estuary Program

Responding to a Three Mile Creek (TMC) Watershed Management Plan recommendation to â€œReduce the occurrence of nuisance and/or exotic species,â€ Mobile Bay National Estuary Program used RESTORE Act funding to facilitate the development of the TMC Invasive Species Control Plan delivered in 2019. This technical document described the distribution of nuisance invasive plant and animal species across the Watershed and prescribed measures and timelines for their effective control and eradication. The Watersh's iconic animal invader is the island apple snail (Pomacea maculata), introduced to the Langan Park lakes in the early 2000s via aquarium releases. Since introduction, they have infested the lakes and moved downstream into Three Mile and One Mile creeks, threatening the submerged aquatic vegetation (SAV) beds of the Mobile-Tensaw Delta. Control measures implemented by AL Wildlife and Freshwater Fisheries were unsuccessful, but with the City of Mobile having secured funds to dredge and restore those lakes, eradicating the snails assumed increased priority. During the COVID pandemic of 2020, MBNEP staff began twice-weekly comprehensive efforts from shorelines and kayaks to destroy egg masses on vegetation and infrastructure around the lakes and opportunistically collect and destroy adult snails. In mid-summer, contractors were hired to assume those responsibilities until the end of reproductive season. With the eggs taking at least two weeks to hatch, this strategy was aimed at preventing introduction of new snails while, to the extent possible, eliminating egg-laying adults. In April 2021, contractors were hired to begin applying herbicide to nuisance SAV (precluding water circulation) and emergent vegetation (providing egg-laying substrata), manually removing egg masses and collecting/destroying adult snails, and applying a copper-based molluscicide to eradicate snails in advance of City dredging efforts. Baiting and sampling will provide assays of project success.

Abstract #: 166

Title: ***Forest Carbon Offset Markets and Water Quality***

Authors: Richard Hall

Organization: Auburn University

The market for forest carbon offsets continues to expand significantly throughout the U.S. as well as other parts of the world. Ancillary ecosystem benefits, also referred to as stacked benefits, are a key component of the forest carbon offset market. Improved water quality resulting from forest carbon offset projects is one of the primary stacked benefits often associated with forest carbon offset projects. Forest management plans for forests within forest carbon offset project areas must be developed and implemented according to stringent criteria associated with various forest carbon offset methodologies. In most cases, this results in enhanced forest cover conducive to better water quality in watersheds adjoining forest carbon offset project areas. This presentation will provide an overview of the forest carbon offset market including recent price trends for different types of offsets as well as key considerations for primary market participants and other stakeholders. The presentation will also provide an overview of areas within Perdido watersheds that may be suitable for forest carbon offset projects and how these types of projects might benefit water quality within the Perdido watersheds. Finally, this presentation will cover various policy considerations associated with the broader forest carbon offset markets and water quality, particularly as relates to the Perdido watersheds.

Abstract #: 167

Title: ***National Association of RC&D Councils Organization Update***

Authors: Colton Buckley

Organization: National Association of RC&D Councils

The National Association of Resource Conservation & Development Councils (NARC&DC) builds relationships, cultivates partnerships, and designates resources to enhance the quality of RC&D Councils to provide leadership, education, conservation, and the development of natural and human resources to improve the quality of life and wellbeing of the communities they serve. The RC&D Program was established in the Agriculture Act of 1962, with responsibility for the administration of the program placed within the Department of Agriculture's Natural Resources Conservation Service (NRCS). Successive Farm Bills have provided for the further development of the program, including deepening the partnership between RC&D Councils and the NRCS through partnership agreements and grant funding as RC&D Councils are 501(c)3 non-for-profit corporations. NARC&DC's priority programs and opportunities involve Youth, Underserved and Beginning Farmers, and Veteran Farmers engagement in addition to urban agriculture initiatives, rural economic development, and human resource development.

Abstract #: 168

Title: ***Partnerships and Funding Opportunities***

Authors: Ronald Davis

Organization: Wiregrass RC&D

Wiregrass Resource Conservation & Development (WRC&D) was created to help local communities meet local needs through building relationships, cultivating partnerships, and designating resources and that remains our mission today. At WRC&D we help build up small rural communities across southeast Alabama by providing leadership development training and administer a state grant program. We provide education and general grants to agencies, schools, small towns, and local 501c3 nonprofit organizations to carry out programs that benefit local communities. Opportunities for funding include conservation education programs, natural resource conservation, human resource development, recreational opportunities, and public safety. We also partner with state and federal agencies and towns to access community needs and provide resources to meet those needs.

Abstract #: 169

Title: ***USGS Water Mission Area FY21 NGWOS R&D Project: USGS Real-time Flood Impact Map***

Authors: Athena Clark

Organization: U.S. Geological Survey

USGS products such as the National Water Information System (NWIS) and WaterWatch are the flagship products for displaying USGS streamgage data. Unfortunately, because the data is displayed in a technical format, the data can be misunderstood. What does "Gage height, feet" mean? What are the real-world impacts when "Gage height" reaches a certain foot? In order to increase the usefulness of the USGS streamgage, the USGS Next Generation Water Observing System (NGWOS) funded a project in FY21 to demonstrate an "Alternative Way of Delivering USGS Streamgage Data". The project deliverable was the USGS Real-time Flood Impact Map. The Real-Time Flood Impact Map displays the locations (called "Flood Impact Locations") where the USGS has measured the height of critical safety or infrastructure features that may be vulnerable to flood impacts. Some examples of flood impact locations include stream and river embankments; roads and bridges; pedestrian paths; buildings; and more. Flood Impact Locations are surveyed and associated with a nearby USGS real-time streamgage. When the streamgage water level (or gage height) exceeds the Flood Impact Location's surveyed height, its icon will display on the map, showing that this location may be currently flooded. When you click on the icon, the pop-up will display the current gage height and the Flood Impact Location height, so you can compare how close that location is to the current water level. Some Flood Impact Locations may be measured below the level of actual flooding to provide an early warning that flooding may be imminent. The following are the flood impact icon descriptions currently represented: • Embankment Flooded – Flood waters are overflowing the stream/river channel and into the surrounding area. • Path Flooded – Pedestrian greenway/trail/path is underwater. • Road Flooded – Road is underwater.

• Bridge Flood at Risk – Water from the river or stream has reached the bottom of the bridge.

• Bridge Flooded – Bridge is underwater. • Structures Flooded – Water from the river or stream has reached the lowest finished floor of the structure (FEMA Finished Floor Elevation, or FFE). FEMA 100-year BFE – The FEMA 100-year Base Flood Elevation (BFE) has been reached. • Uncategorized – This Flood Impact Location is experiencing flooding. For more information about this location, open thethe icon's pop-up and look for the "Flood Impact Type" description. The white circles on the map represent all Flood Impact Locations that have been measured but are not currently flooding. You can use the date picker to retroactively view Active Flood Locations of any 7-day period within the last calendar year.

Although this mapper is not a flood warning system, it can be used to convey immediate flood risks by showing the locations where flooding may be currently or soon occurring.

Abstract #: 170

Title: ***Stream Crossings in Georgia, A Handbook for Connectivity and Resilience (GA-ACT).***

Authors: Fred Halterman, Sara Gottlieb

Organization: Moffatt and Nichol Engineers

The southeastern United States is home to an extraordinary diversity of aquatic-dependent wildlife. Yet where roads and streams intersect, poorly designed culverts, bridges and other structures often fragment aquatic habitats – contributing to the Southeast also having one of the highest fish imperilment rates in the world (Elkins et al, 2016; 2019).

Poorly designed or degraded stream crossings also alter hydrology, impact water quality, and often fail during extreme weather events. Large numbers of aging, undersized and poorly maintained stream crossings in a watershed can result in widespread failures, closing roads and stranding communities during extreme rainfall and flood events.

Georgia's more than 70,000 miles of rivers and streams flow from the Appalachian Mountains to the Atlantic and Gulf coasts and intersect with more than 85,000 roads. Through different physiographic regions, these streams create unique and diverse habitats that support many types of species. About three-quarters of fish species and more than 90 percent of all mussel and crayfish species native to the United States reside in a 500-mile radius of Chattanooga, Tenn. (Elkins et al, 2019) – a diversity of life that is nationally and globally significant.

Initially published in 2012 (Prowell, Duncan and Albanese, 2012), this revised, expanded, and updated handbook is intended for general audiences including consultants, county-city engineers, construction industry, students, regulators, and anyone else interested in the cost-effective design of stream crossings to promote public safety, watershed health, flood resilience and wildlife passage. We outline the importance of maintaining aquatic connectivity at stream crossings, highlight examples where aquatic and terrestrial wildlife can pass easily (and where they cannot), review regulations in general terms, and provide examples to illustrate regulatory intent. Several new sections highlight an expanded focus on indirect impacts, barrier assessment protocols, resources for getting started and recent case studies.

Abstract #: 171

Title: ***Investigating the Effectiveness of Best Management Practices in Reducing the Agricultural Water Footprint in Alabama***

Authors: Betelhem Demeke, Mesfin Mekonnen

Organization: The University of Alabama

The limited freshwater resources in the United States are under increasing stress from agricultural, industrial and other sectors. Being the major water consumer, there is a potential for water conservation in the agriculture through employing the best management practices. Population growth and effects from climate change such as drought are exacerbating the stress on the water resources amid increasing demand. Agriculture is the major sector in the economy of Alabama and the state produces crops such as corn, cotton, and soybean etc. Historically, Alabama known to have large surface and groundwater resources. However recently, the state is facing water scarcity challenges as a result of population expansion and drought. While several studies have been conducted on calculating the water footprint of the crops grown in Alabama, this study analyzes the water consumption along with the information on best management practices to increase the efficiency of water usage and hence reduce the water footprint of agriculture. The Environmental Policy Integrated Crop Model (EPIC) is used to compute crop water consumption and crop yield under different management practice scenarios such as crop rotation and changing crop planting date. The study shows that application of different management measures results in reduction of water footprint of soybean, corn, peanut and cotton crops in Alabama. It is encouraged to apply the management measures in order to adopt to drought and water scarcity challenges due to population expansion and several other factors.

Abstract #: 172

Title: ***The spatiotemporal patterns of community vulnerability in Mobile Bay from 2000-2020***

Authors: Hemel Dey, Wanyun Shao

Organization: University of Alabama

The coastal region is facing heightened risks posed by climate change. Mobile Bay, part of the Alabama coastal area, is prone to storm surge given its physical configuration and is likely to experience high surges under climate change. It is thus imperative to prepare the coastal community in Mobile Bay area for future climate change risks. The first necessary step would be to understand the spatiotemporal patterns of community vulnerability in recent history so that the information can guide future resilience plans. Using data from the American Community Surveys, we construct social vulnerability indexes at the block group level for Mobile county and Baldwin county for 2000, 2010, and 2020. To further investigate the spatiotemporal patterns of changing social vulnerabilities over the past 20 years, we conduct hotspot analysis and cluster analysis. Results suggest that the area with heightened social vulnerability has clearly expanded in Mobile county. Some consistent hotspots in Mobile city are detected. In addition to social vulnerability analyses, we depict the spatiotemporal patterns of changing land use land cover (LULC) from 2001 - 2019 by using the National Land Cover Database. Examining the changing spatial patterns of both social vulnerability and LULC highlights areas that need allocation of resources to build resilience to future climate change.