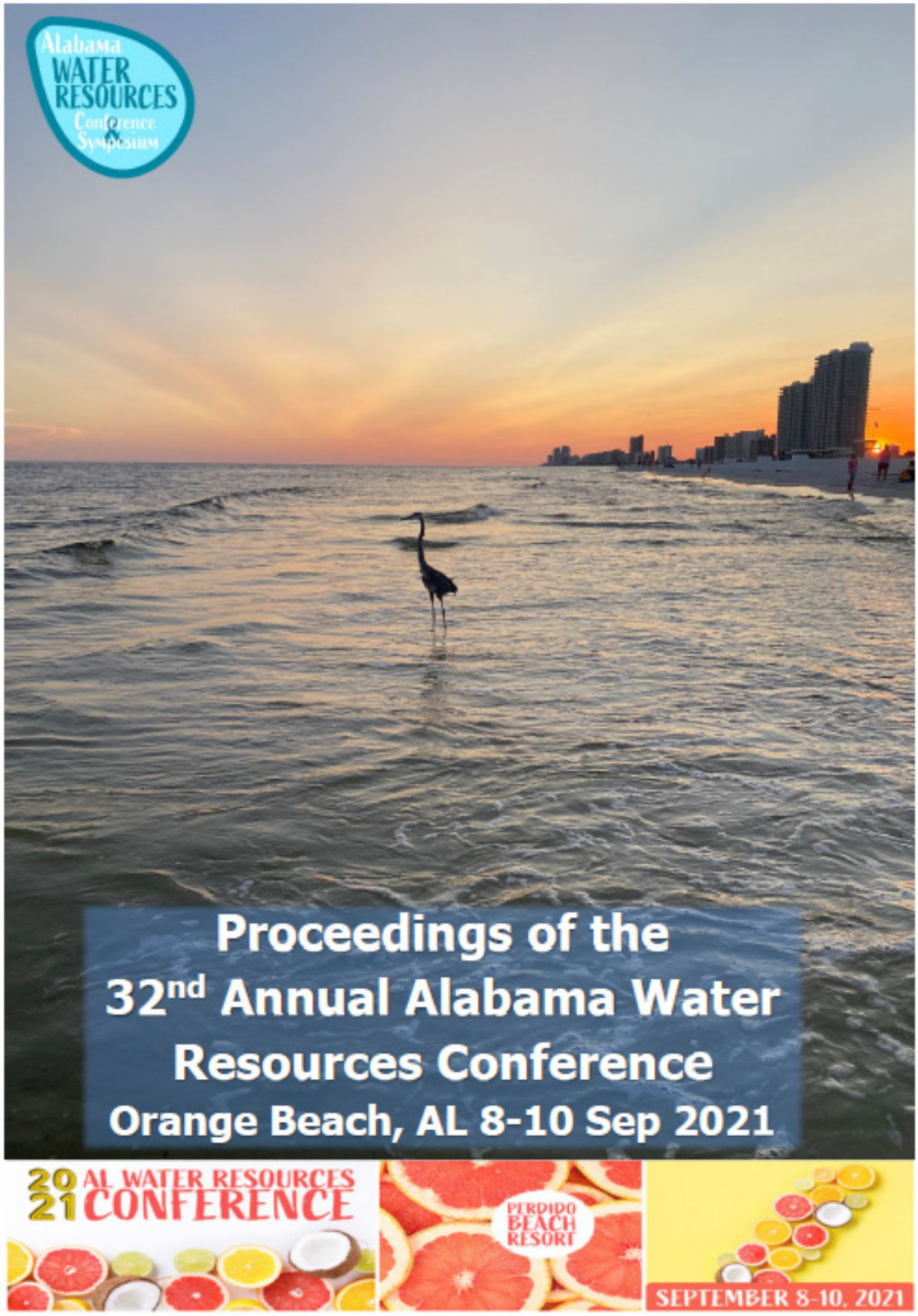
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Srivastava, P., J. Lamba, R. McGehee, H. Kumar & D. Tian, 2021. *Stochastic generation of 15-minute precipitation for water resource modeling under climate change over Southeastern United States.* Poster session presented at the 32nd Annual Alabama Water Resources Conference; 8–10 Sep 2021; Orange Beach, AL. Proceedings of the AWR Conference: **Abstract No. PO29,** p. 132.

Visit here for examples of citations to papers and poster Sessions presented at meetings

The abstracts in these proceedings were selected by members of the Alabama Water Resources Conference planning committee and officers of the Alabama Water Resources Association based on quality of content and relevance to the conference, but have not been submitted to a peer review process.

THE CONTENTS OF EACH ABSTRACT ARE THE SOLE RESPONSIBILITY OF THEIR AUTHORS

Alabama Section of the American Water Resources Association

SYMPOSIUM

Wednesday | Sept. 8 | 1-4:40 PM

"Coastal Recovery, Restoration, and Resiliency"

10:00 AM	**Registration Desk Opens (Lobby)**
1:00 PM	**Welcome & Introductions** | Lynn Sisk | AWRA Alabama Section President
1:20 PM	Resilience: The Path from Thriving to Surviving | Casi Calloway | Chief Resilience Officer | City of Mobile
2:00 PM	Planning for the Future: Water Resources, Resiliency and Restoration | Bethany Kraft | Senior Program Manager/Restoration Ecologist | Volkert, Inc.
2:40 PM	**Networking Break**
3:10 PM	Restoration Across the Northern Gulf of Mexico with a Focus on Coastal Alabama | Amy Hunter | Deepwater Horizon Restoration Coordinator | Alabama Department of Conservation and Natural Resources
3:50 PM	Transforming Watershed Management: Building Resilience along the Alabama Coast | Roberta Swann | Director | Mobile Bay National Estuary Program
4:30 PM	Announcements & Adjourn
5:30 PM	**Social And Dinner (Flora-Bama - casual beach attire)**

AWRC Conference Program
Session Topics and Presenters

SESSION 1
THURSDAY | SEPT. 9 | 9:15 AM - 10:35 AM

AGRICULTURE & IRRIGATION I — SALON ABC
MODERATOR: TODD FOBIAN, ALABAMA DEPT. OF CONSERVATION & NATURAL RESOURCES

1. **Development of a Water Consumption Model to Estimate Broiler Farm Water Needs.** Carson Edge, Auburn University*
2. **Novel Water Sensors for Precision Agriculture.** Zhongyang Cheng, Auburn University
3. **Response of Crop Yield and Crop Acreage to Droughts in Mobile River Basin Across Different Climatic Divisions.** Proloy Deb, The University of Alabama
4. **Time Stability in Soil Moisture in Irrigated Agricultural Field.** Hemendra Kumar, Auburn University*

MODELING & WATER MANAGEMENT I — SALON D
MODERATOR: LATIF KALIN, AUBURN UNIVERSITY

1. **Predicting Field-Scale Daily Evapotranspiration Using Multi-Source Spaceborne Remote Sensing Imagery and Deep Learning.** Taufiq Rashid, Auburn University*
2. **How Important is Considering Point Sources in Large-Scale Watershed Modeling?** Henrique Haas, Auburn University*
3. **Watershed Scale Assessment, Analysis, and Prioritization: A GIS Approach to Whole System Modeling.** Jason Throneberry, The Nature Conservancy of Alabama
4. **Augmented Reality (AR) and 3D Geospatial Technologies for Coastal Flooding Visualization.** John Cartwright, Mississippi State University

AQUATIC ECOLOGY — SALON E
MODERATOR: PATRICK O'NEIL, GEOLOGICAL SURVEY OF ALABAMA (RETIRED)

1. **Gulf Sturgeon Fall Spawning: Implications for Water Management in the Choctawhatchee River, Alabama.** Steven Rider, Alabama Division of Wildlife and Freshwater Fisheries
2. **The Invasive Omnivore, *Dreissena polymorpha* (zebra mussel), Structures Multi-Scale Diversity and Ecosystem Attributes in Invasion Front Reservoir Metaecosystems.** Riley Lovejoy, The University of Alabama*
3. **Multi-scale Fish Diversity and Flow Variability among Streams and Beaver Ponds.** Stephanie Sickler, The University of Alabama*
4. **Evaluating the Feeding Ecology of Freshwater Mussels (Unionidae) from Gantt Lake, Alabama Using Stable Isotope and Fatty Acid Analysis.** Kaelyn Fogelman, Auburn University*

WATER MONITORING — SALON FGH
MODERATOR: KENNETH ODOM, ALABAMA POWER

1. **Monitoring Karst Aquifers for the Protection of Alabama Cave Shrimp and Tuscumbia Darter Habitats in North Alabama, USA.** Gheorghe M L Ponta, Geological Survey of Alabama
2. **Sediment Risk Index: Crossing Structure and Landscape-Level Influence on Aquatic Organism Passage in Alabama.** Daniel West, Geological Survey of Alabama
3. **Quantification of 3-D Soil Macropore Characteristics in Different Land Uses Using X-ray Computed Tomography.** Suman Budhathoki, Auburn University*

*STUDENT PRESENTER

SESSION 2

THURSDAY | SEPT. 9 | 10:45 AM - 12:05 PM

AGRICULTURE & IRRIGATION II

SALON ABC

MODERATOR: ASHLEY HENDERSON, ALABAMA SOIL AND WATER CONSERVATION COMMITTEE

1. **Calibration of Solvita® CO_2 Burst System for Reducing Nitrogen Pollution in Agronomic Systems.** Annabelle McEachin, Auburn University*
2. **Multi-Level Influences of Center-Pivot Irrigation Adoption in Alabama.** Nicholas Magliocca, The University of Alabama
3. **Assessing the Geographic Representativeness of Irrigation Adoption Studies.** Ruchie Pathak, The University of Alabama*
4. **Variable Rate Irrigation: An Environmentally Sound Irrigation Water Management Strategy.** Brenda Ortiz, Auburn University

MODELING & WATER MANAGEMENT II

SALON D

MODERATOR: CHRIS ANDERSON, AUBURN UNIVERSITY

1. **Urban Areas vs. Impervious Surfaces: Implications for water quality/quantity predictions.** Dongjun Lee, Auburn University*
2. **What are the Most Important Factors in Generation of Flood Inundation Maps?** Atieh Alipour, The University of Alabama*
3. **Expanding Utilization and Comprehension of Coordinated Needs Management Strategy: Understanding Where Floodplain Mapping Scope Comes From.** Jeff Zanotti, Wood Environment & Infrastructure Solutions, Inc.
4. **Geographically Isolated Wetland Mitigation of Agricultural Non-Point Source Pollution in the Dougherty Plain, Southwest Georgia.** Coleman Barrie, Auburn University*

STORMWATER I

SALON E

MODERATOR: SABRA SUTTON, ALABAMA ASSOCIATION OF CONSERVATION DISTRICTS

1. **Application of Hydrodynamic Modeling and Flood Planning in Resilience Assessment of Urban Coastal Regions.** Ross Nazari, The University of Alabama at Birmingham
2. **The Seven Habits of Highly Effective Drainage Studies.** Bradley Heilwagen, Wood Environment & Infrastructure Solutions, Inc.
3. **The Use of High Definition Stream Survey to Document Channel Conditions for the City of Cleveland's MS4 Stormwater Permit.** Brett Connell, Trutta Environmental Solutions
4. **Closing the Gaps in Local Floodplain Policies.** Byron Hinchey, S&ME Inc.

WATER QUALITY I

SALON FGH

MODERATOR: LEIGH TERRY, THE UNIVERSITY OF ALABAMA

1. **Influence of Manure Application and Soil Physicochemical Properties on Phosphorus Leaching in Pastures.** Kritika Malhotra, Auburn University*
2. **Quantifying Nutrient Reductions at Wetlands in the Upper Fish River Watershed.** Sabahattin Isik, Auburn University
3. **Modeling Nutrient Dynamics in Wetlands Undergoing Wetting/Drying Cycles.** Latif Kalin, Auburn University
4. **Addressing Waterbodies Impaired for Siltation - Identifying Relationships between Instream Turbidity and Total Suspended Solids.** James Mooney & Matt Revel, Alabama Department of Environmental Management

LUNCH IN GRAND REEF - 12:15-1:30 PM

SESSION 3

THURSDAY | SEPT. 9 | 1:40 PM - 3:00 PM

EMERGING CONTAMINANTS

SALON ABC

MODERATOR: PATRICK O'NEIL, GEOLOGICAL SURVEY OF ALABAMA (RETIRED)

1. **Interactions of "Forever Chemicals" – Per and Polyfluoroalkyl Substances with Dissolved Organic Matter as a Potential Contributor to Soil and Water Contamination.** John Lawhon, Auburn University*
2. **A State-Wide Survey of the Spatial Distribution of Perfluoroalkyl Substances (PFAS) in Alabama.** Roger Lopes Viticoski, Auburn University*
3. **Measuring Energetic Effects of PFAS on the Eastern Oyster (*Crassostrea virginica*) Using Respirometry.** Kayla Boyd, Auburn University*
4. **Employing a Dynamic One Health Approach in Extension and Outreach to Reduce Impacts of Pharmaceuticals and Personal Care Products (PPCPs) on Water Quality.** Tyler Mason, Alabama Cooperative Extension System

DROUGHT, FLOOD, & CLIMATE I

SALON D

MODERATOR: ROY MCAULEY, MANUFACTURE ALABAMA

1. **Reducing Coastal Flood Risk for Water and Wastewater Utilities through Proactive and Forward-Looking Systems Management and Resilience Planning.** Matt Deavenport, Jacobs Engineering Group
2. **Flood Mitigation in Region IV: How does Alabama Compare?** Byron Hinchey, S&ME Inc.
3. **Can infrared canopy temperature data be used as a potential irrigation scheduling tool for corn in a humid subtropical climates?** Bruno Lena, Auburn University
4. **Paleo-Records of Sea Level, Floods, and Storms in the Mobile Bay and Weeks Bay Estuaries: Implications for Future Change in Alabama.** Rebecca Totten Minzoni, The University of Alabama

STORMWATER II

SALON E

MODERATOR: LISA HARRIS, CHOCTAWHATCHEE, PEA & YELLOW RIVERS WMA

1. **A "B.A.D." Presentation – Another Way to Look at Erosion Control on a Construction Site.** Perry Oakes, Alabama Soil and Water Conservation Committee
2. **Use of Vegetative Cover for Prevention of Erosion and Shallow Slope Failure along Roadways.** Homayra Asima, Auburn University*
3. **The Effects of Coastal Development and Salinity Dynamics on Tidal Creek Ecosystem Functions along the Northern Gulf of Mexico.** Christopher Anderson, Auburn University
4. **A Decision-Support Tool for Cost-Optimal Design of Stormwater Green Infrastructure Practices.** Frances O'Donnell, Auburn University

WATER QUALITY II

SALON FGH

MODERATOR: THORSTEN KNAPPENBERGER, AUBURN UNIVERSITY

1. **Using Molecular Simulations to Develop Temperature Swing Solvent Extraction Processes for High Salinity Brines.** Heath Turner, The University of Alabama
2. **Evaluation of Bacterial and Mitochondrial DNA Markers for Microbial Source Tracking.** Wenjing Ren, Auburn University*
3. **Impact of Dissolved Organic Matter Properties on Iron (III) Complexation.** Natalia Malina, Auburn University
4. **Proposed Solutions for Wastewater Management in Rural Communities of the Alabama Black Belt.** Mark Elliott, The University of Alabama

BREAK - 3-3:30 PM

SESSION 4

THURSDAY | SEPT. 9 - 3:30 PM | 4:50 PM

HARMFUL ALGAL BLOOMS & RESERVOIRS

SALON ABC

MODERATOR: LYNN SISK, JACOBS

1. **Ancient Algal Blooms: Did Ancient Societies Like the Maya Experience Water Quality Degradation Similar to Today?** Matthew Waters, Auburn University
2. **Identifying Drivers of Cyanotoxin Production in Subtropical Lakes over the Last 150 Years.** Troy Clift, Auburn University*
3. **Variations of Nutrient Deposition and Transport between Agricultural and Urban Watersheds through Time.** Benjamin Webster, Auburn University*
4. **Genetic Tools for Quantifying and Identifying Taste and Odor-Producing Microorganisms in Drinking Water Reservoirs.** Brendan Higgins, Auburn University

DROUGHT, FLOOD, & CLIMATE II

SALON D

MODERATOR: ROY MCAULEY, MANUFACTURE ALABAMA

1. **Spatial and Temporal Variability of Flash Drought in the Continental United States.** Kyle Lesinger, Auburn University*
2. **Effect of Climate Change on Rainfall Erosivity in Southeastern, United States.** T. Bijoychandra Singh, Auburn University*
3. **Assessment of Drought Impacts on the Uppermost Aquifer across Alabama: utilizing groundwater elevation data from ADEM LUST sites.** Terri Osborne, Geological Survey of Alabama
4. **Survivability of Mussels over the 13-Week Drawdown of Gantt Reservoir, Andalusia, AL and Factors Influencing Survival.** Jonathan Miller, Troy University

STORMWATER III

SALON E

MODERATOR: EVE BRANTLEY, AUBURN UNIVERSITY WATER RESOURCES CENTER

1. **Stormwater Best Management Practices to improve the Parkerson Mill Creek watershed in Lee County Alabama.** Thorsten Knappenberger, Auburn University
2. **Evaluation of Porous Pavements Hydrological Behavior on Alabama Soils.** Robson Leo Pachaly, Auburn University*
3. **City of St. Petersburg Watershed Model Refinement.** Heather Hyde, Jacobs Engineering Group
4. **Use of Flocculants in Construction Stormwater Treatment.** Billur Kazaz, Auburn University*

WATER QUALITY III

SALON FGH

MODERATOR: CHRIS JOHNSON, ALABAMA DEPT. OF ENVIRONMENTAL MANAGEMENT

1. **Source and Composition of Sediment Organic Matter and Relations to Mercury Distribution in an Impacted Estuarine System, Mobile Bay, Alabama.** Sakinat Ahmad, The University of Alabama*
2. **Nitrate Levels in Baldwin County Aquifers Suggest Background Levels of Nitrate Present within the System.** Mary Brandon Huettemann, The University of Alabama*
3. **Lead Testing in Drinking Water in Childcare Facilities.** Jason Barrett, Mississippi Water Resources Research Institute
4. **Aiming to Find a Unifying Framework to Study the Impacts of Aquatic Intermittency on Downstream Water Quality.** Carla Atkinson, The University of Alabama

SESSION 5

FRIDAY | SEPT. 10 | 9:15 AM - 10:35 AM

COASTAL ISSUES I

SALON ABC

MODERATOR: TODD FOBIAN, ALABAMA DEPT. OF CONSERVATION & NATURAL RESOURCES

1. **A Comprehensive Watershed Management Plan on a Mission to Protect "America's Amazon".** Jeanette Kelson, Wood Environment & Infrastructure Solutions, Inc.
2. **A Field Validated Model of Temporal Variability in Oyster Habitat Suitability.** Anna Linhoss, Auburn University
3. **Balancing Habitats and Humans: A Conservation Management Plan for the Lower Perdido Islands.** Katie Baltzer, The Nature Conservancy
4. **Contextualizing Extremes: New Sediment Archives and How They Will Help Us Understand the Frequency of Intense Tropical Cyclone Activity along the MS-AL Coast.** Emily Elliott, The University of Alabama

RESTORATION I

SALON D

MODERATOR: ASHLEY HENDERSON, ALABAMA SOIL AND WATER CONSERVATION COMMITTEE

1. **A Look to the Past and an Eye on the Future – An Overview of the D'Olive Watershed Management Plan (Past and Present).** Robert Dunn, Geosyntec Consultants
2. **Alternative Approaches to Water Quality Restoration.** Lynn Sisk, Jacobs Engineering Group
3. **Is Tidal Marsh Construction an Effective Restoration Strategy to Recover Nitrogen Removal Capacity?** Behzad Mortazavi, The University of Alabama
4. **Is Tidal Marsh Construction an Effective Restoration Strategy to Recover Carbon Sequestration Capacity?** Julia Cherry, The University of Alabama

WATER & ENERGY MANAGEMENT

SALON E

MODERATOR : ASHLEY MCVICAR, ALABAMA POWER

1. **Water Use in Alabama - An Update.** Michael Harper, ADECA Office of Water Resources
2. **New Water Use Data Application for Alabama.** Shae Holley, ADECA Office of Water Resources
3. **The IBT Map Project: Geovisualization of Interbasin Transfers of Water in Google Earth.** Philip Chaney, Auburn University
4. **Hydropower's Value in a Wind and Solar World.** Kenneth Odom, Alabama Power

CONNECTING AGENCIES

SALON FGH

MODERATOR: MONA DOMINGUEZ, AUBURN UNIVERSITY WATER RESOURCES CENTER

1. **Alabama Private Well Program.** Jessica Curl, Auburn University Water Resources Center
2. **Volunteer Water Monitoring in National Forests of Alabama.** Mona Dominguez, Auburn University Water Resources Center
3. **Fostering Watershed Stewardship in Alabama.** Eve Brantley, Auburn University Water Resources Center
4. **Building a Cross State Estuary Program during a Pandemic.** Logan McDonald, Pensacola and Perdido Bays Estuary Program

BREAK - 10:35-10:55 AM

SESSION 6

FRIDAY | SEPT. 10 | 10:55 AM - 12:15 PM

COASTAL ISSUES II

SALON ABC

MODERATOR: STEPHEN JONES, GEOLOGICAL SURVEY OF ALABAMA

1. **Land Use and Water Quality Trends in Coastal Alabama.** Ann Arnold, Geological Survey of Alabama
2. **The Effects of Maintenance Dredging of the Mobile Harbor Bar Channel on Dauphin Island are Similar to Mining of Alabama's Coastal Sands.** Glendon Coffee, Mobile Bay Sierra Club
3. **Putting Socio-Economic Vulnerabilities and Risks into Perspective: Dealing with Hurricane-Induced Extremes.** Hamid Moradkhani, The University of Alabama

RESTORATION II

SALON D

MODERATOR: PATRICK O'NEIL, GEOLOGICAL SURVEY OF ALABAMA (RETIRED)

1. **Successfully Rebuilding Bayou La Batre's Waterfront.** Mary Kate Brown, The Nature Conservancy
2. **A Comprehensive Watershed Management Plan Aimed at the Rehabilitation of a Culturally Significant Urban Creek and Bayou.** Jeanette Kelson, Wood Environment & Infrastructure Solutions, Inc.
3. **Watershed Management Planning along the Alabama Gulf Coast.** Mollie Taylor, Geosyntec Consultants
4. **Restoring Three Mile Creek One Neighborhood at a Time.** Christian Miller, Mobile Bay National Estuary Program

GROUNDWATER

SALON E

MODERATOR: GREG GUTHRIE, GEOLOGICAL SURVEY OF ALABAMA

1. **Investigating Chloride Concentrations in a Coastal Aquifer of the Gulf of Mexico: Methods and Results in the Chicot Aquifer of Southwest Louisiana.** Vincent White, United States Geological Survey
2. **Pesticide Occurrence in Shallow Groundwater Underlying Agricultural Areas in Alabama.** Amy Gill, United States Geological Survey
3. **Hydrogeological Investigation into the Physical Mechanisms of a Spring-Fed River System, Magnolia River, Alabama.** Mary Hastings Puckett, Geological Survey of Alabama*
4. **Spectral Analysis of Hydrographs to Evaluate Long-Term Aquifer Storage Changes.** Greg Guthrie, Geological Survey of Alabama

WATER LAW & POLICY

SALON FGH

MODERATOR: LISA HARRIS, CHOCTAWHATCHEE, PEA & YELLOW RIVERS WMA

1. **Alabama Water Management Policy from Past to Present.** Cindy Lowry, Alabama Rivers Alliance & Charles Miller, The University of Alabama
2. **Can Water Governance Reform Avert a Global Water Crisis?** Mary Wallace Pitts, The University of Alabama
3. **Tree-Ring Reconstructions of the ACF River System to Inform Alabama Water Policy.** Matthew Therrell, The University of Alabama
4. **A Grassroots Approach to the Development of Comprehensive State Water Management Plans: An Example from Alabama.** Rebecca Bearden, Geological Survey of Alabama

Abstracts (Oral Presentations)
(alphabetical order by First Author's last name)

Abstract No. 079. *Source and composition of sediment organic matter and relations to mercury distribution in an impacted estuarine system, mobile bay, Alabama.*

Ahmad, S.[1], S. Jones[2], M. McKinney[2], R. Wagner[2] & Y. Lu[1]

[1]The University of Alabama; [2]Geological Survey of Alabama

Estuaries are hot spots of organic matter (OM) production and transformation. Understanding the nature of estuarine sedimentary OM has important implications for water quality, aquatic habitat conditions, and carbon budget at the land-ocean margin. This study investigates the amount, source, and composition of surficial sediment OM in a river-dominated estuary – the Mobile Bay, AL, using stable isotopic composition and molecular biomarkers. Overall, carbon to nitrogen ratios (7.14 ± 2.78 n=58) and δ13C of total organic carbon (-27.98 ± 1.56, n=58) show that C3 plants and marine algae are the two primary sources for sedimentary OM. δ13C values increase along a salinity gradient, suggesting a gradual reduction of river-delivered terrigenous OM from the river mouth to the inner bay. Preliminary data of Hg sediment concentrations (0.0173 ± 0.1809mg/kg, n=14) show they have a moderate, positive correlation with TOC (r = 0.48, p = 0.079) and TN (r = 0.48, p = 0.086). The elemental and stable isotopic values of possible end members (terrestrial and aquatic plants, phytoplankton, zooplankton, and benthic algae) are currently being analyzed to construct a model to quantify the contributing sources of sedimentary OM. Molecular biomarkers are also being analyzed to provide more detailed insight into the origin, type and fate of OM and their influences on Hg distribution in the Mobile Bay.

Abstract No. 040. *What are the most important factors in generation of flood inundation maps?*

Alipour, A., K. Jafarzadegan & H. Moradkhani

The University of Alabama

Floods are known as one of the most catastrophic natural disasters that frequently cause loss of life, properties damages, with environmental consequences in the United States. Application of hydraulic or hydrodynamic model within an operational flood forecasting system can provide the probable time-varying spatial extent of flood inundation and depth, which are critical information for flood risk management. Recently the US Army Corps of Engineers Hydrologic Engineering Center (HEC) released a new version of HEC-RAS 2D that operates in LINUX system. This product enables the users to perform extensive computational simulations. Similar to other hydrodynamic models, HEC-RAS 2D is subject to different sources of uncertainties leading to inaccurate and erroneous model outputs. In this study, we applied variogram and variance-based Global Sensitivity Analysis (GSA) methods to assess the sensitivity of the HEC-RAS 2D hydrodynamic model to the channel and floodplain roughness coefficients, upstream boundary condition, computational mesh size, and terrain resolution. We evaluated the HEC-RAS 2D model performance over the San Jacinto river basin during the extensive flooding of Hurricane Harvey in 2017 using 4600 model configuration. The response surfaces of the GSA approach used in this study are four performance measures of RMSE, KGE, F, and Error that represent the model performance for water stage (RMSE, KGE) and flood extent simulations (F, Error), respectively. Our results demonstrate the role and importance of different drivers in the generation of flood inundation maps at medium scale based on the HEC-RAS 2D hydrodynamic model. This information paves the way for better interpretation of hydrodynamic processes

Abstract No. 086. *Land Use and Water Quality Trends in Coastal Alabama*

Arnold, A. & G. Hastert

Geological Survey of Alabama

Considering the current boom of housing and population growth within the coastal area of Alabama the matters of sustainable growth, environmental impact, and operational carrying capacity for the region's current infrastructure have become paramount in importance, if not urgent. A mosaic of the patterns of historical land use across Baldwin and Mobile counties from 1992 to 2016 has been established using ArcGIS and the USGS Land Use - Land Cover (LULC) land use classification scheme. Trends of rapid development can be readily identified in the mosaic. The cumulative land use change map (LUCM) for the 24-year period highlights those areas of greatest impact from development. In Baldwin County, there are three areas which are now highly developed: 1) the Eastern Shore as it grows eastward; 2) the corridor along Highway 59 (south of I-10); and 3) the coastal cities of Gulf Shores and Orange Beach. The most developed land from the eastern shore of Baldwin County (Highway 98) eastward toward Fish River (roughly 7 miles wide), is bound by Interstate 10 to the north and extends almost 20 miles southward. Most of this suburban development includes new housing subdivisions and local shopping centers. The LUCM reveals a pattern of land-use conversion from agriculture into subdivisions, which continues to expand. The increased impervious surface area has the effect of inhibiting shallow aquifer recharge. Available water quality data from USGS, EPA, ADEM, and GSA provide an overview of general surface water and shallow groundwater quality trends. These data have been analyzed to investigate the impact on water quality from land use changes, particularly areas of intense building and construction. Environmentally sensitive areas, such as Strategic Habitat Units (SHU's), will be evaluated for potential deleterious impact to water quality as part of the project.

Abstract No. 076. *Use of vegetative cover for prevention of erosion and shallow slope failure along roadways*

Asima, H., V. Niedzinski, F. O'Donnell & J. Montgomery

Auburn University

Shallow slope failures due to erosion are common occurrences along roadway slopes in Alabama due to the prevalence of high intensity rainfall in the region. The use of vegetative covers is a reasonable solution to stabilize newly constructed steep slopes or repair areas where shallow landslides have occurred. Generally, a mixture of grass species, perennial legume bushes, and woody shrubs is planted to establish a vegetative cover. This research aims to determine and evaluate vegetation species that would provide low maintenance and economic slope stabilization and decrease shallow slope erosion at priority sites along roadways. For this study, five plots with different species were planted on a steep slope at the National Center for Asphalt Technology (NCAT) test track in Opelika, AL. Four plots contain Parson's juniper (*Juniperus chinensis* "Parsoni"), vetiver grass (*Vetiveria zizaniodies*), fescue grass (*Lolium arundinaceum*), and hairy vetch (*Vicia villosa* Roth). These were planted in May 2020. One other plot contains a mixture of fescue grass (*Lolium arundinaceum*) and blue rug juniper (*Juniperus horizontalis* "wiltonii") and were planted in April 2021. Erosion pins are an inexpensive and intuitive method to estimate shallow slope soil erosion and deposition. Erosion pins were installed in each plot in April 2021 to measure sediment loss due to overland flow. Run-off volume and flow rate will be measured using depth measurements and water level loggers. So far, the four species planted in 2020 are growing well. The Juniper shrubs performed well in a previous study, so the mixture of Juniper and fescue grass is expected to perform well. This summer, a thorough quantitative analysis of the soil-strength effects of the roots will be included and soil moisture probe will be installed. In addition, to understand the effect of vegetative covers for minimizing deeper slope failures, a rainfall simulator will be used to induce slope failures while soil moisture and runoff are monitored. The results from this research will be used to identify suitable plant species that will meet the design objectives and low maintenance requirement along roadways, and, at the same time, it would be appropriate for the climate and soil type of Alabama.

Abstract No. 146. *Aiming to find a unifying framework to study the impacts of aquatic intermittency on downstream water quality*

Atkinson, C., N. Jones & J. Benstead

The University of Alabama

Our understanding of physical, chemical, and biological functions of rivers and streams is largely based on perennial flowing waters – yet over half of rivers and streams dry on an annual basis. These less-studied intermittent streams are potentially important control points that influence downstream water quality given their abundance and their propensity to act as hot spots of biogeochemical reactivity. Furthermore, how hydrology, biogeochemical processes and microbial communities (microbiomes hereafter) interact to affect water quality is likely distinct in intermittent streams compared to perennial streams. The Aquatic Intermittency effects on Microbiomes in Streams (AIMS) project will work to enhance our knowledge of these understudied systems while developing new tools and methodologies to study these systems. Through this 4-year project, AIMS will integrate datasets on hydrology, microbiomes, and biogeochemistry in three regions (Southeast, Great Plains, and Western Mountains) to test the overarching hypothesis that physical drivers (e.g., climate, hydrology) interact with biological drivers (e.g., microbes, biogeochemistry) to control water quality in intermittent streams. To address this hypothesis, AIMS is testing how hydrologic, biogeochemical, and microbiome drivers at different temporal and spatial scales. Concurrently, AIMS will be providing education and workforce training in collaborative and interdisciplinary science to a diverse group of students and scientists across all regions. Here we describe the environmental sensor network and the sampling design of the AIMS project and provide preliminary data with a focus on work being conducted across the Southeast. The goal of this presentation is to introduce the Alabama Water Science Community to the larger AIMS project, facilitate future collaborations, and stimulate discussions on intermittent streams management and policy.

Abstract No. 096. *Balancing habitats and humans: a conservation management plan for the Lower Perdido Islands*

Baltzer, K.[1], J. Haner[1], K. Dawson[2] & M. Goecker[2]

[1] The Nature Conservancy; [2] Moffatt & Nichol

The Lower Perdido Islands are a group of small, undeveloped islands (Bird, Robinson, and Walker) located near Perdido Pass in Orange Beach, Alabama. The islands are extremely popular among both visitors and residents for recreational activities. During holidays, the islands can host well over 500 boats at a single point in time. Unfortunately, valuable habitats on and around the islands have been heavily impacted by both natural and anthropogenic factors. Major concerns include erosion from boat wakes and storms, loss and disturbance of bird habitat, damage to seagrasses, and increasing trash and marine debris. To address these issues, the City of Orange Beach, Moffatt & Nichol, Olsen Associates Inc., and The Nature Conservancy in collaboration with NOAA have developed a comprehensive management plan, which proposes conservation strategies and restoration concepts for the Lower Perdido Islands. This restoration project is funded through the Alabama TIG Natural Resource Damage Assessment process to help address injuries to natural resources as a result of the Deepwater Horizon Oil Spill. Conservation strategies in the plan including increasing public awareness, reviewing current rules and regulations for better enforcement, and developing planting strategies for upland habitats will be discussed alongside restoration concepts developed through hydrodynamic and morphologic modelling, historical analyses, and stakeholder feedback. This multi-faceted approach provides holistic, sustainable options for restoring and managing the area to protect valuable habitats and ensure adequate space for public recreation.

Abstract No. 028. *Using Molecular Simulations to Develop Temperature Swing Solvent Extraction Processes for High Salinity Brines*

Barbosa, G., P. Sappidi, J. Bara, S. Weinman & H. Turner
The University of Alabama

Energy-efficient water desalination processes are desperately needed, in order to increase water sustainability and human health. Solvent extraction represents a promising energy-efficient technique when compared other alternatives often employed, due to its low maintenance and simple operation. The overall performance of a temperature-swing solvent extraction (TSSE) process is largely dictated by the solvent design. Surprisingly, very few fundamental studies have been performed to ascertain the impact of the solvent's molecular characteristics on a TSSE process, which involve a variety of kinetic, thermodynamic, and interfacial influences.

Using molecular simulation tools, we assess the viability of several different imidazole-based solvents and amine-based solvents for solvent extraction desalination of high salinity brines. Atomistic molecular simulations of pure solvent and water-solvent bulk mixtures are used to ascertain the influence of the solvents' molecular structures on solvent-solvent and solvent-water interactions. The thermodynamic properties obtained for pure bulk solvents reveal that imidazole-based solvents tend to self-associate due to the formation of short-range polar interactions as well as via hydrogen-bond interactions. The solvent molecular design substantially influences the thermodynamic properties of the solvents by enabling the existence of favorable sites for the presence of associative interactions. This fact is evident when we analyze the water-solvent interactions (via radial distribution functions) in a bulk mixture. We find that the size of the main alkyl chain linked to the imidazole ring, as well as the presence of associative sites, directly influences the water-solvent interactions.

As for the water-solvent interfacial behavior, the formation of a diffuse interface is observed for all of the imidazole-based and amine-based solvents analyzed here. Based on the local density profiles as a function of temperature, it is also possible to infer that water solubilization in imidazole-based solvents is an endothermic process; in contrast, water solvation in amine-based solvents is an exothermic process. Notably, 1-butylimidazole does not solubilize a significant amount of water over the entire analyzed temperature range, which may be associated with the absence of an electron donor site for the formation of hydrogen-bonds, as well as the effects of hydrophobic interactions.

Abstract No. 137. *Lead Testing in Drinking Water in Childcare Facilities*

Barrett, J.

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 (youth under the age of six). This research focuses on child care centers with a goal of determining best practices to reduce and/or eliminate the expose of lead in drinking water.

Mississippi citizens who acquire their drinking water from public water systems have the luxury of knowing the quality of their drinking water on a regular basis if they know who to contact and/or where to look. Approximately 90% of Mississippi citizens are served by one of the 1,200(+/-) public water systems, which provide safe reliable water under the regulatory guidance of the Mississippi State Department of Health-Bureau of Public Water Supply. The regulatory oversight of public water systems should promote and produce a safer drinking water supply for Mississippi residents. Individual residents' plumbing and fixtures may contribute to lead leaching in drinking water regardless of the quality of the water produced and provided by the public water supply. As a result of knowledge gained from applied research, the adaption of best practices by practitioners will increase the safety and reduce the expose of lead in drinking water for youths.

Abstract No. 081. *Geographically Isolated Wetland Mitigation of Agricultural Non-Point Source Pollution in the Dougherty Plain, Southwest Georgia*

Barrie, C.[1], F. O'Donnell[1], S. Brantley[2], C. Eggert[1] & M. Waters[1]

[1] Auburn University; [2] Jones Center at Ichauway

Geographically Isolated Wetlands (GIWs) provide numerous ecosystem services such as nutrient processing, stormwater retention, and critical habitat for plants and animals. GIWs are prevalent in the Dougherty Plain of Southwest Georgia as clay-lined depressions formed on the nearly flat landscape atop soluble limestone. Irrigated agriculture is also common in this karstic region as the high transmissivity of karst promotes rapid recharge to the surficial Upper Floridan Aquifer. Therefore, many GIWs of the Dougherty Plain are in agricultural settings, but their role in mitigating non-point source pollution is poorly understood. This study seeks to improve our understanding of agricultural pollution mitigation by GIWs using hydrologic and biogeochemical techniques on wetlands located inside and adjacent to working farms and to reference forested wetlands. We are collecting data describing precipitation, water level, and sedimentation to generate event-scale sediment yield models for each wetland using MUSLE. We are also investigating differences in wetland bathymetry and storage at each site using terrestrial LiDAR. The farm-scale watershed models will be functionally similar to SWAT, Soil Water Assessment Tool, and APEX, the Agricultural Policy Extender by establishing hydrologic response units (HRU's) and dynamic landcover factors considering plant growth and industrial agricultural farming operations. Hydrology calculations using Curve Number and Rational Method and will be calibrated to wetland water levels collected by HOBO dataloggers instead of storm hydrographs. Sediment yield calculations using MUSLE will also be calibrated with field data using an innovative sediment trap. Preliminary results indicate variations of sediment and nutrient loading and processing rates at all sites. This could be explained by unaltered forested wetland profiles, higher organic content in forested wetland catchments, higher watershed slopes in agricultural settings, and dynamic landcover in agricultural settings. Additionally, cost-effective wetland management practices will be suggested to enhance wetland function despite the absence of legal protections. Future work will engage agricultural stakeholders to identify a GIW prioritization framework.

Abstract No. 012. *A Grassroots Approach to the Development of Comprehensive State Water Management Plans: An Example from Alabama*

Bearden, R., G. Guthrie & B. Bearden

Geological Survey of Alabama

Comprehensive state water management plans (SWMPs) are developed through the cooperative engagement of state and federal agencies, industry representatives, landowners, and NGOs. These plans recognize that sustainable state economic interests are balanced by ecosystem and habitat health. Alabama does not have a comprehensive SWMP at this time, although cooperative environmental efforts are currently at the forefront promoting the development of one led by the Alabama Rivers and Streams Network (ARSN).

For the past 15 years, ARSN has used a watershed-based framework to focus conservation activities on more than 225 federally and/or state listed fishes, mussels, snails, and crayfishes in Alabama using applied science to successfully assess, restore, recover, and monitor the state's vital aquatic resources. Based on the number and presence of federally listed and state conservation priority species, 60 high priority watersheds in or adjacent to the state have been designated as Strategic Habitat Units (SHUs). Ongoing work in these areas includes determining population status for species of concern, outlining the number and magnitude of threats, and determining the presence of designated critical habitat(s) and key habitat components required for individual species.

Since 2006, assessment activities conducted by ARSN members have included more than 200 fish surveys, over 2,000 stream crossing surveys, three fish passage barrier removals, and a 1,069-ton sediment reduction project. SHUs have significant policy implications relative to the Endangered Species Act (ESA) and the Clean Water Act, reflected by the removal of five crayfish species from federal listing consideration, down listing of one snail species from endangered to threatened status, and inclusion of water quality components in various studies. In addition, the ARSN team has embraced outreach opportunities statewide to educate citizens, landowners, and students about the importance of clean water and the need for water policy development. Collaborative efforts, such as those employed by the ARSN team, are imperative for the development of a comprehensive SWMP because they engage partners at the local level. This grassroots approach provides a promising avenue for progress in the coming years for SWMP development in Alabama.

Abstract No. 036. *Fostering Watershed Stewardship in Alabama*

Bell, L. & E. Brantley

Auburn University Water Resource Center

Alabama Watershed Stewards (AWS) is a statewide science-based educational program for the general public that promotes healthy watersheds, increases understanding of water pollution, and provides the knowledge and tools needed to prevent and resolve local water quality problems. Developed by the Alabama Cooperative Extension System's Water Program and Alabama Water Watch in 2019 with funding from the Alabama Department of Environmental Management, the program strives to re-think the role of both education and citizen participation in addressing non-point source pollution concerns across the state. Housed under Auburn University's Water Resource Center, the program continues to develop and evolve to address educational needs.

By involving local watershed partners in virtual and in person trainings, integrating professional development opportunities, hands on projects, and developing educational resources, Alabama Watershed Stewards may offer a platform for multiple partners to collaborate over educational efforts and foster community relationships to address water quality concerns. Addressing non-point source pollution requires dispersed stewardship from citizens and agencies alike; as it develops, the AWS program seeks stakeholder feedback to better foster interest, care, and local connections to better protect and preserve Alabama's waterways.

Abstract No. 077. *The effects of coastal development and salinity dynamics on tidal creek ecosystem functions along the northern Gulf of Mexico.*

Bickley, S. & C. Anderson

Auburn University

Tidal creeks are important linkages between watersheds and adjacent coastal waters and serve as sentinel habitats that may reflect environmental changes before other coastal ecosystems. Development along the northern Gulf of Mexico (GOM) coast is increasing, which has led to changes in watershed drainage and increased freshwater runoff to tidal creeks. This has the potential to effect resident fish species which are a trophic link between the salt marsh and the tidal creek habitats used by economically important transient fish species at different life stages. We deployed salinity loggers in 12 tidal creeks (2nd to 3rd order) along the northern GOM (Alabama and west Florida, USA) for 16 months to assess salinity dynamics across a range of land uses. We found that mean salinities ranged from 5.5-14.1 ppt and that the Richard-Baker index (a measure of salinity flashiness) increased with the portion of development within the watershed (P < 0.01, r2 = 0.80). Between 2019- 20, three separate seasonal sampling events were conducted for resident salt marsh fish using 12 minnow-traps deployed along each creek. Mean total abundance of *Fundulus grandis* (the most common resident marsh species) was negatively associated with salinity flashiness. Further, dissolved oxygen was measured continuously at six of the creeks across an urban gradient. Using these data, seasonal ecosystem metabolism was estimated as gross primary production (GPP) and ecosystem respiration (ER). Results showed that GPP ranged from 167.71 – 304.18 mmol O2 m-2 d-1 and ER ranged from 339.9 – 640.2 mmol O2 m-2 d-1, with all sites being strongly autotrophic throughout the year. We found that as the flashiness of creek salinity increased, both GPP (P < 0.01, r2 = 0.44) and ER (P < 0.01, r2 = 0.31) decreased. These results suggest that increased variability in freshwater runoff is potentially altering aquatic ecosystems and leading to decreased rates of GPP and ER, two ecosystem function rates that constrain energy flow within aquatic ecosystems. Our results suggest that drainage from low to moderate development intensity, common to many parts of the northern Gulf of Mexico, may be inadvertently causing important shifts in the ecological function of tidal creek ecosystems.

Abstract No. 111. *Measuring energetic effects of PFAS on the eastern oyster (Crassostrea virginica) using respirometry*

Boyd, K., J. Stoeckel, J. Hayworth, E. Irwin & T. Bruce

Auburn University

Per- and polyfluoroalkyl compounds (PFAS) are a class of man-made chemicals that are widespread and persistent in the environment. The potential toxicity of these chemicals and their ability to bioaccumulate makes them of increasing concern for a wide range of species. Marine and freshwater aquatic organisms are now chronically exposed to PFASs, but effects of these emerging contaminants are not yet well understood. Some bivalves, including oysters, may absorb PFAS from the environment, but appear to be very efficient at eliminating PFAS from their tissues (depuration) – thus reducing the risk of bioaccumulation. However, some evidence suggests that the energetic cost of PFAS depuration is high and may inhibit growth and reproduction. Because the eastern oyster (Crassostrea virginica) is a keystone species, as well as a commercial aquaculture species, it is important to examine the potential for PFAS to negatively affect oyster energetics. In this study, we examined the energetic costs of PFAS depuration by oysters. We exposed oysters to a combination of PFOS and PFOA for direct comparison to a previous study focusing on a different bivalve taxon. We also exposed oysters to a combination of PFOS+PFOA+PFBS+PFPeA+PFHxA – PFAS compounds commonly detected in the Gulf of Mexico. Cumulative concentration of each combination was 10,000 ng/L – a concentration that has induced significant energetic costs in previous studies. After 10 days of continuous exposure, we used intermittent respirometry over a 12-hour period to calculate 1) the mean respiration rate for periods when oysters were open and 2) the area under the respiration curve (AUC) to incorporate effects of periodic valve closures. Preliminary results show no significant effect of PFAS exposure on mean respiration rate or AUC. Our results suggest that neither direct exposure to ecologically relevant PFAS compounds, nor depuration of these compounds is energetically expensive to eastern oysters.

Abstract No. 068. *Successfully Rebuilding Bayou La Batre's Waterfront*

Brown, M.[1], J. Haner[1] & M. Goecker[2]

[1] The Nature Conservancy; [2] Moffatt & Nichol

Together with the City of Bayou La Batre, the Alabama Department of Conservation and Natural Resources, Mobile County, and the National Fish and Wildlife Foundation, The Nature Conservancy implemented a large scale restoration project committed to protecting and preserving the coastal community of Bayou La Batre from future storms and coastal hazards as well as revitalizing the locally important waterfront area by restoring, enhancing, and protecting the shoreline habitats and providing improved community access for recreation and fishing opportunities. Designed with Moffatt & Nichol, the Lightning Point Restoration project included about 1 mile of overlapping breakwaters, 40 acres of marsh, tidal creeks and scrub shrub habitats, and more than 240,000 cubic yards of repurposed dredged material to create the new habitats and storm buffer along the community's waterfront. These new marsh areas were then planted with more than 90,000 native vegetation: black needlerush (*Juncus roemerianus*) and smooth cordgrass (*Spartina alterniflora),* while scrub-shrubs were planted with saltmeadow cordgrass (*Spartina patens*), marsh elder (*Iva frutescens*), and saltbush (*Baccharis halimifolia*). This restoration project began in Fall 2019 and was completed in less than 10 months in Summer 2020.

The implementation of Lightning Point Restoration project was successful due to the project team addressing various potential barriers before construction began. These barriers involved community acceptance, technical feasibility, funding limitations, political support, legal concerns, cost and benefit of actions, and consistence with community and regional environmental goals. In addition, this project was engaged by the local high school, Alma Bryant High School, a Signature Academy of Coastal Studies, and the students were involved by collecting seeds and growing them in their school's greenhouses with hopes to replant once project was completed. By understanding the impact of the Lightning Point Restoration project on the local coastal community of Bayou La Batre, The Nature Conservancy and Moffatt & Nichol were able to translate these concerns to the contractor and the community to ensure that the project was constructed with integrity and set the stage for future complex restoration projects. To date, The Nature Conservancy has been tracking the project since construction completed with its resilience to the past four storms in the 2020 hurricane season. Lightning Point has survived successfully with minimal damages and the native plants have responded healthy to each storm surge event. This presentation will show key features of the Lightning Point Restoration Project including the progression of the project planning, importance to the local coastal community, design considerations, and monitoring plans.

Abstract No. 106 *Quantification of 3-D soil macropore characteristics in different land uses using X-ray computed tomography*

Budhathoki, S. [1], J. Lamba[1], C. Williams[2], F. Arriaga[2] & K. Karthikeyan[2]

[1] Auburn University: [2] University of Wisconsin - Madison

Macropores e.g., root channels, earthworm burrows, inter-aggregate voids can cause rapid transport of water and contaminants through the unsaturated zone into deep soil through preferential flow. This makes quantification of different macropore characteristics essential for better understanding of the subsurface transport phenomenon. However, the macropore structure of the soil under different land uses is not well understood. Different types of macropores are formed depending on various factors such as biological activities, land use, tillage, and their interactions. Residues covering on soil surface and rooting processes vary with the type of land use that have huge impact on macropore formation. With differences in the macropore characteristics, each land use can contribute differently to the runoff and subsurface flows. Hence, it is critical to investigate the soil macropore structure to correlate it with the various transport phenomenon within the soil. X-ray computed tomography (CT) is a non-destructive technique that combines several X-ray images taken from different angles to provide a detailed description of the pore network in the soil. The objective of this study was to use X-ray CT and image analysis to characterize 3D soil pore structure of undisturbed soil samples collected from four different land uses - no till corn field (NT), conventional till corn field (CT), Alfalfa (Alf), and Native (Nat) located at the Arlington Research Station (43˚18’9.47”N, 89 ˚20’43.32”W) in Wisconsin. A total of 15 intact soil cores (150 mm diameter and 500 mm length) were sampled at 4 different sites. The cores were scanned using a medical CT scanner to produce images with a voxel size of 0.35*0.35*0.625 cubic mm. A public domain software program ImageJ was used to analyze and quantify macropore characteristics. Results on variability in soil macropore characteristics, including macroporosity, macropore diameter, connectivity, length density, network density, tortuosity, etc., will be presented.

Abstract No. 095. *Watershed Management Planning along the Gulf Coast*

Burcham, W. & M. Taylor

Geosyntec Consultants

It is difficult to imagine finding anyone in or around Alabama that does not see the Gulf Frontal Watershed complex as a source of refuge and recharge. A truly unique place where people from all backgrounds meet to work, live, and play among the diverse natural resources and over 200 miles of shoreline. Geosyntec has been fortunate enough to be selected by the Mobile Bay National Estuary Program (MBNEP) to prepare a comprehensive Watershed Management Plan (WMP) for the two watersheds that make up the Gulf Frontal Watershed complex; Perdido Pass (HUC 03140100204) and Little Lagoon (HUC 031401070206). Our vision was to produce a WMP for the community by creating a landscape of environmental and economic viability that promotes the protection and restoration of water quality and coastal ecosystems through strong local leadership and sustainable partnerships. The WMP is near completion, and now the real work and collaboration begin. This presentation will tell the story of the watershed planning process, including how the project team engaged the community, created partnerships, and identified management measures to conserve and restore these coastal habitats. Note this project was supported wholly or in part by MBNEP as part of funding received from the Alabama Department of Conservation and Natural Resources, Federal Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies Act.

Abstract No. 150. *Augmented Reality (AR) and 3D Geospatial Technologies for Coastal Flooding Visualization*

Cartwright, J. & J. vander Zwaag

Mississippi State University

The Geosystems Research Institute at Mississippi State University is working to enhance geovisualizations for coastal flooding. The frequency of flooding events in coastal areas has been increasing for several decades. Current sea level rise projections for this century will make the extreme events of today the norm by 2100. As the frequency of these events increases so does the need for improved education and decision making. Through the Geospatial Education and Outreach (GEO) Project, efforts have developed an interactive, web-based tool called GeoCoast. This geospatial decision-making tool allows users to simulate and visualize sea level rise along the Mississippi coast. GeoCoast uses a ground elevation model and three-dimensional (3D) buildings generated from QL2 LiDAR data collected in 2015. Users can choose to visualize inundation using either simple linear superposition model data, NOAA's sea level rise data from the Digital Coast, or ADCIRC surge model data. Using routing analysis, users can visualize the impact of inundation on transportation and service areas for critical infrastructure. These efforts are being coupled with augmented reality for in situ 3D modeling of coastal flooding. Augmented reality technologies provide the capability to overlay simulated geo-referenced data to the real world with a mobile device's integrated camera. GeoCoast AR allows the user to increase and decrease simulated inundation levels on the actual landscape as they navigate the area through the camera on their mobile device. The flooding of the landscape is simulated with simple linear superposition model data that is computed from the same QL2 LiDAR used in the GeoCoast application. Future and current project efforts are focused on expanding the geography to include other areas of the northern Gulf Coast. This includes improving the models for specific areas of the landscape with high-resolution LiDAR collected with unmanned aerial systems (UAS) and enhanced 3D structures. Both GeoCoast and GeoCoast AR will be used to provide improved education, decision-making, and management of coastal resources and how they may be impacted by flooding and sea level rise.

Abstract No. 098. *The IBT Map Project: Geovisualization of Interbasin Transfers of Water in Google Earth*

Chaney, P.

Auburn University

The Roman Aqueduct was one of society's earliest solutions to alleviating water scarcity. The modern-day version is known as an Interbasin Transfer (IBT), which refers to moving water from one drainage basin to another. Benefits include water for agriculture, domestic, and industrial uses; however, source basins may suffer environmental and societal impacts. The impacts are cause for concern, but the benefits suggest IBTs will remain an attractive option into the future. Clearly people need to learn more about IBTs as we strive to manage this limited resource in a more sustainable manner, especially considering the looming challenges of population growth and climate change. Unfortunately, there does not appear to be a global database of IBTs to support education and research on this topic. This project focuses on major IBTs 10s to 100s of miles in length, of which there are over 100 worldwide according to some sources. Modern IBTs often consist of a complex network of canals, tunnels, pipelines, and other features, thus, geovisualization is critical for understanding their complexity and function. Google Earth was chosen for this task because of its visualization capabilities and ease of use. 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. IBT maps available at present include the L.A. Aqueduct, Central Arizona Project, Cutzamala System (Mexico), Irtysh-Karaganda System (Kazakhstan), Goldfields Pipeline (Australia), Indira Gandhi Canal (India), and New Valley Project (Egypt), with many more in progress.

Abstract No. 128. *Is tidal marsh construction an effective restoration strategy to recover carbon sequestration capacity?*

Cherry, J. [1], E. Smyth[2], T. Ledford[1], A. Wood[1] & B. Mortazavi[1]

[1]The University of Alabama; [2] Mississippi Department of Marine Resources

Vegetated coastal habitats like tidal saline marshes play critical roles in the global carbon cycle by sequestering significant amounts of "blue" carbon (C). However, these ecosystems and the services they provide are highly vulnerable to degradation and loss, with 1-2% of coastal marsh area lost per year. Wetland restoration and construction projects have the potential to recover marsh biological structure and functions, representing an important strategy to mitigate climate change. To examine C functions between natural and constructed tidal marshes, we conducted a year-long field study comparing C stocks and ecosystem CO2 exchange in one 2,200-year-old natural marsh (NAT) and two 33-year old constructed marshes (CON-1, CON-2) on the Fowl River in Mobile County, AL. Structurally, we found that above- and below-ground biomass generally were greater in NAT than CON-1 and CON-2, although this was driven by greater heterogeneity within CON marshes. Percent soil organic matter and soil carbon also were significantly greater in NAT than in CON-1 and CON-2 after 33 years. However, in areas where vegetation had recovered in CON-1 and CON-2, we found that gross ecosystem productivity, ecosystem respiration, and net ecosystem exchange were similar to NAT. Collectively these results suggest that marsh construction may be a suitable strategy to achieve recovery in the rates of some ecosystem processes, but that the time to achieve full marsh recovery of C sequestration capacity can take longer than three decades.

Abstract No. 053. *Identifying Drivers of Cyanotoxin Production in Subtropical Lakes over the Last 150 Years*

Clift, T. & M. Waters

Auburn University

As lakes experience increased eutrophication due to cultural impacts on watersheds and lake ecosystems, cyanobacteria are given a competitive advantage over other phytoplankters. This increase in cyanobacterial abundance is concerning for lake users as many cyanobacteria can produce toxins hazardous to human health. Cyanotoxins are largely associated with acute health risks, such as pain, vomiting, fever and respiratory problems. With lake conditions favoring higher levels of cyanobacteria and, possibly, cyanotoxin production, it has become imperative to link environmental conditions to cyanotoxin production. Though widely contested, toxin production has been associated with several variables including zooplankton grazing, allelopathy, and nutrient availability. Through a thorough paleolimnologic investigation of six sub-tropical lakes in central Florida, USA, Cyanotoxin production was observed in sediments predating largescale, human impacts. A suite of paleolimnologic proxies—including microcystin and cylindrospermopsin concentrations—were utilized to reconstruct toxin production and lake condition over time. Through these reconstructions, key factors influencing toxin production have been identified. Providing a better understanding of how lake conditions alter cyanotoxin production is key for better lake management and risk mitigation.

Abstract No. 119. *The Effects of Maintenance Dredging of the Mobile Harbor Bar Channel on Dauphin Island Are Similar to Mining of Alabama's Coastal Sands*

Coffee, G.

Mobile Bay Sierra Club

Dauphin Island has been a feature of Alabama's coastline for 6,000 years. Continually nourished by sand transported in nearshore waters from the east, the island has recovered from countless hurricanes, demonstrating its natural resiliency over pre-historic time. As a buffer from the Gulf, the island plays a crucial role in maintaining the estuarine habitat of Mobile Bay and Mississippi Sound, within which occurs Alabama's largest expanses of coastal marsh, oyster reefs, and extensive nursery areas. Importantly, Mississippi's barrier islands also owe their existence to littoral drift sand carried westward from Dauphin Island. Dauphin Island was relatively stable until the latter half of the 20th century. A U.S. Geological Survey (USGS) study found that after 1958, the island entered a persistent net erosional phase. After considering sea level rise and storms, the USGS concluded a decrease in sand supply was the primary factor causing Dauphin Island's erosion. The decrease in sand supply is attributed to dredging of the Mobile Harbor Outer Bar Channel which removes large volumes of beach quality sand from the littoral drift system that are necessary to nourish not only Dauphin Island, but also Mississippi's barrier islands to the west.

The interruption of the capacity of natural littoral drift systems to transport sand across tidal inlets like Mobile Pass is a documented adverse consequence of maintaining navigation channels around the world. Dredging the Mobile Harbor Outer Bar Channel intercepts most of the littoral drift sands that move westward along Alabama's coastline. On an average annual basis, 664,000 cy of sand are dredged and disposed of in offshore Gulf waters in depths ranging between 20 to 30 feet. The US Army Corps of Engineers estimates that only 52% of the dredged sands return to the natural littoral drift system by wave action and currents. A significant consequence of the average annual loss of 48% of the dredged sands from the natural littoral drift system is the continuing erosion and weakening of Dauphin Island and its ability to adapt to sea level rise and recover from severe coastal storm events. Such effects are similar in scope to what would be occurring if the dredged sands had been removed from the natural littoral drift system by "mining". Deepening of the Mobile Harbor channel from 47 feet to 52 feet is scheduled to begin in 2021. When completed, the Corps estimates average annual maintenance dredging of the deepened Outer Bar Channel will increase by an additional 15%.

Abstract No. 054. *The Use of High Definition Stream Survey to document channel conditions for the City of Cleveland's MS4 Stormwater Permit.*

Connell, B.

Trutta Environmental Solutions

Municipal responsibility under the phase II MS4 general stormwater permit compliance is intended to minimize stormwater runoff and protect its citizens from various water pollution issues. The City of Cleveland, TN contracted Trutta Environmental Solutions to document the streambank and channel conditions within the city's boundaries using the High Definition Stream Survey (HDSS). HDSS method is adaptable to different sampling protocols including the Maryland Stream Corridor Assessment Survey Protocols which was used in the past by the city. Using the HDSS platform on both kayak and backpack, all necessary information was collected on 30 miles of stream in only 4 days with a crew of 2 technicians. In addition to completing MS4 Permit requirements associated with documenting the stream channel conditions, the city now has extensive geo-referenced, baseline condition video of its streams to track progress on the issues documented during this initial survey.

The HDSS approach was created to rapidly gather continuous geo-referenced data in a single pass for a broad range of stream and streambank conditions by integrating GPS, video, depth, water quality and other sensors. Once the data are collected, the videos are combined to create a virtual tour with four simultaneous views of the river survey (front, left bank, right bank and underwater). Other information such as side-scan sonar and a dynamic overhead map are also included when applicable. Because each second of video is linked to a specific GPS point, this allows for the identification, selection and prioritization of streambanks for restoration. The results can 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 "virtual tour" experience.

Abstract No. 005. *Alabama Private Well Program*

Curl, J. & L. Bell

Auburn University Water Resource Center

Groundwater is a source of drinking water for about 44 percent of the total population of Alabama. Approximately 20 percent of Alabama residents depend on private water supplies, such as wells, for drinking water. Limited resources were available to assist Alabama well owners, but several of the resources are now outdated. A program was needed to design updated tools and deliverables to help well owners maintain safe systems while training them to identify and resolve issues.

The Private Well Program was funded by the Alabama Cooperative Extension System in 2020 with the goal of developing a science-based educational program and additional resources for County Extension offices to provide information to Alabama residents who depend on household wells. Thus far, the program has successfully developed seven modular trainings for County Extension Professionals to utilize during public workshops. These training cover topics such as aquifers in Alabama, testing well water, well protection, common contaminants in well water, and treatment options for water wells. In addition, an interactive tool has been developed to identify laboratories across the state that offer testing services to private well owners.

County Extension Coordinators will be invited to attend webinar trainings hosted by the Private Well Program developers to familiarize themselves with the topics surrounding well water, and to gain the knowledge to better address questions and concerns from well users.

The creation of this program fulfills a much-needed role for the 20 percent of citizens that rely on well water. By equipping well owners and regional county agents with the information and skills to address and solve well water concerns, Alabama joins the ranks of other states leading the way in public health and safety.

Abstract No. 103. *Reducing Coastal Flood Risk for Water and Wastewater Utilities Through Proactive and Forward-Looking Systems Management and Resilience Planning*

Deavenport, M., J. Bird & H. Hyde

Jacobs Engineering Group

To improve service reliability and resilience to severe weather events, Jacobs has completed a system wide Resilience Plan for JEA's potable water, wastewater and chilled water systems. This abstract describes the tasks performed to identify current and future flood risk, identify critical path needs and prioritize capital investment to position JEA as an industry leading resilient utility of the future.

As a provider of electric power, potable water, wastewater, reclaimed water and chilled water services for the City of Jacksonville, Florida and surrounding communities, JEA serves a population of over 1.5 million across a 900 square mile service area.
To address the uncertainty of future climate risk, JEA prepared a System Resilience Plan to further reduce flood risk and advance its water, wastewater and chilled water systems toward the goal of being a benchmark resilient utility. This System Resilience Plan provides enhanced design standards and forward-looking adaptation strategies that allow JEA to maintain continued system reliability and minimize system interruptions during extreme weather events across its over 1,700 facilities. While JEA has already addressed many of the low hanging fruit, its decision to develop a comprehensive adaptation plan focused on adapting to changing conditions will greatly improve the overall system performance and long-term resilience.
The presentation will summarize the key tasks completed for the preparation of the System Resilience Plan, including the following:

1. Smart Data Collection of Key Facilities
2. Flood Modeling with Existing and Future Extreme Weather Scenarios
3. Vulnerability Assessment
4. Risk Analysis
5. Mitigation and Adaptation Strategy Development
6. Economic Impact and Benefit-Cost Analysis
7. Design and Construction Standards
8. Strategy Prioritization

Resilience Plan has been completed and submitted in draft form to JEA in May 2020.
Project findings and material has not previously been presented or published.

Abstract No. 052. *Response of Crop Yield and Crop Acreage to droughts in Mobile River Basin across Different Climatic Divisions*

Deb, P., H. Moradkhani & P. Abbaszadeh

The University of Alabama

Droughts can severely affect cropping practices and crop yields across the globe. This is more pronounced in the rainfed dominant regions. One such example is the Mobile River Basin in the southeast United States where almost 70% of the farmlands are rainfed. Therefore, in this study, a detailed analysis of the effects of droughts in the corn and soybean yields and the cropping areas (crop acreage) under drought years is assessed across different climatic divisions in the Mobile River Basin. The Standardized Precipitation Evaporation Index demonstrates in the recent past Mobile River Basin experienced mild to moderate droughts during the years 2008, 2011, 2012, and 2016. Moreover, it is observed that for 2008, 2011, and 2012 drought years, for most of the climate divisions the crop acreage for soybean was reduced ranging from 30% to <60% relative to normal precipitation years. On the other hand in the case of corn in certain climate zones affected by droughts an increase in crop acreage was observed ranging from 1% to 60%. The corn and soybean yields however reduced significantly in the drought affected climate divisions for all four drought years ranging from 3.73 t/ha to 6.95 t/ha and 1.28 t/ha to 1.92 t/ha for corn and soybean respectively (average corn and soybean yields are 7.70 t/ha and 2.20 t/ha respectively in normal precipitation years). These poor crop yields during drought years highlight the importance of adaptation measures such as transitioning from rainfed to irrigated agricultural practices in the region.

Abstract No. 022. *Volunteer Water Monitoring in National Forests of Alabama*

Domínguez, M. [1], E. Smith[2], R. McGuire[1], S. RuizCórdova[1] & S. Smith[1]

[1] Auburn University Water Resources Center; [2] USDA Forest Service

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. In 2019, AWW was approached by USDA Forest Service, more specifically, National Forests in Alabama (NFAL) staff, with interest in engaging citizen scientists through data collection on the NFALs. Together, USFS and AWW are implementing the project, "Developing a Citizen Volunteer Water Quality Monitoring Program in Alabama's National Forests", funded by the USDA CitSci Fund.

During the initial phase of this project, AWW led recruitment and training of approximately 50 citizen scientists who were certified to conduct water chemistry and bacteriological water tests according to AWW's EPA-approved Quality Assurance Plans in the Bankhead, Tuskegee, and Conecuh National Forests. NFAL staff selected sampling sites in priority watersheds, which were identified through the USDA Forest Service's Watershed Condition Framework.

Following certification, AWW and NFAL paired participating volunteers with sampling sites based on the volunteer's interest and project criteria. Volunteers had access to necessary water monitoring materials and equipment. Volunteers submit their water data on a monthly basis to the AWW Database through an online data portal. Subsequently, the data is made public through the AWW Water Data Tools on the AWW webpage and provided to NFAL for further analysis. Despite challenges presented by COVID-19, volunteers have consistently collected water data from the NFALs (over 215 data records as of May 2021).

Volunteer monitors are creating a baseline of water quality observations within the NFAL priority watersheds that will be used to evaluate how management practices are resulting in clean water for the Forests, its ecosystems, and the public as well as to develop a Watershed Restoration Action Plan (WRAP) to make better land management decisions within each forest. The project is streamlining the NFAL hydrology and aquatic ecology programs by providing a water quality monitoring workflow and data collection that supports both programs.

This project highlights the value of community-based water monitoring to watershed protection and restoration efforts. Furthermore, it demonstrates the benefit of successful partnerships between agencies and organizations, and provides a model for others to follow. In 2021, the project was selected for additional funding by the CitSci fund in 2021. As a result, the model for volunteer monitoring is being expanded to the Talladega National Forest, and existing project volunteers will continue to receive support as they collect water data on the NFALs.

Abstract No. 097. *A Look to the Past and an Eye on the Future – An Overview of the D'Olive Watershed Management Plan (Past and Present)*

Dunn, R. & W. Burcham

Geosyntec Consultants

The D'Olive Watershed hosts communities that are among the most sought-after places to live, work, and play. The quality of life that the watershed provides is a significant part of why Baldwin County, now Alabama's fifth largest by population, is the fastest growing county in the state. The richness of the watershed's nature, heritage, and small hometown spirit has supported record growth, but ironically, these aspects are now threatened by that growth more than ever.

Since the 1970s, excessive erosion and sedimentation have plagued D'Olive Watershed. This "system in peril" has some of the highest sediment rates ever measured by the Geological Survey of Alabama (GSA). Therefore, the Mobile Bay National Estuary Program (MBNEP) led an initiative to restore the D'Olive Watershed and realize the lower cost of proactive management over a do-nothing approach. This approach included a 2010 Comprehensive Watershed Management Plan (WMP), which defined the primary objectives, identified immediate needs, and prioritized opportunities.

The 2010 WMP covered 10 years from 2011 to 2020. During that period, various management measures identified in the WMP were implemented, including but not limited to stream restorations, stormwater retrofits of existing developments, an increase in "Smart Growth" concepts, ordinance development, strengthening regulatory relationships, and beginning the development of the Lake Forest Lake Master Plan. Geosyntec Consultants was fortunate enough to be selected by the Mobile Bay National Estuary Program (MBNEP) to prepare an update to the D'Olive WMP, set to be the first WMP update prepared for a previously completed WMP for MBNEP. This presentation will highlight the restoration successes of the 2010 WMP and will provide an update on the top restoration opportunities identified as part of the WMP update process.

Abstract No. 016. *Development of a water consumption model to estimate broiler farm water needs*

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[1] Auburn University; [2] USDA-ARS Poultry Research Unit

With global populations expected to rise, appropriation of clean water supplies for human consumption pose capacity challenges for agricultural sectors. Broiler (meat-type) chicken production consumes hundreds of thousands of gallons per flock which can present a significant cost to contract growers, particularly for farms raising large birds in hot weather. However, broiler water needs have been commonly overlooked in the industry. In recent years, there has been increased interest by broiler industry stakeholders to better understand water consumption needs for farms. The objective of this research was to develop a water consumption model to estimate the two main water needs on a broiler farm, broiler bird water consumption (BWC) and evaporative water consumption (EWC). Equations for BWC and EWC were developed to estimate total water consumption (TWC) given a farms geographic location and farm characteristics. The model was evaluated over a 25-year period for locations representing high concentrations of broiler production across the U.S. to estimate an average annual TWC. This model will provide both growers and industry stakeholders a better understanding of broiler water needs during the grow-out process.

Abstract No. 142. *Contextualizing Extremes: New sediment archives and how they will help us understand the frequency of intense tropical cyclone activity along the MS-AL Coast*

Elliott, E. [1], B. Minzoni[1], D. Wallace[2], A. Lehrmann[1] & C. Dike[2]

[1] The University of Alabama; [2] University of Southern Mississippi

In the last five years, the northern Gulf of Mexico has experienced some of the most damaging tropical cyclones (TC) on record, raising concern that the frequency of these extreme events is increasing. The recent storms are unprecedented in the instrumental period, yet the historical documentation of the frequency of intense tropical cyclones is sparse and limited to the last three centuries, making it difficult to assess the long-term frequency of these impacts and their connection to larger systematic changes in the climate and ocean. Lacking this information limits the ability of the scientific community to model and predict storm impacts with future climate change, leaving coastal communities along the northern Gulf of Mexico vulnerable.

To better predict the frequency of intense TC activity and understand their drivers, we must contextualize recent extreme events within a long-term (thousands of years), high-resolution (decadal-scale) record of extreme storms that track along the MS-AL coastline. In addition to the physical damage that TC activity can have along the coast, high-energy events can have long-lasting impacts on coastal ecosystems. In Mobile Bay, for example, TC activity has led to both short- and long-term shifts in the water properties, bay ecology, and barrier island morphology. Here we present new sediment records from Bon Secour and western Mobile Bay that preserve sediments that washed over barriers during TC events. We present the grain size results of piston cores and vibracores from behind Morgan Peninsula and Dauphin Island and quantify the frequency of TC events along the Alabama coastline during the Late Holocene.

Integrating this new information with the limited number of established TC sediment records and geomorphic records along the MS-AL coastline, as well as a recently published environmental record from Bon Secour Bay, we provide historic reference conditions and additional information for evaluating controls on estuary ecosystem stability through time. This work should aid in the development of long-term predictors of coastal resiliency for the entire northern Gulf of Mexico.

Abstract No. 118. *Proposed Solutions for Wastewater Management in Rural Communities of the Alabama Black Belt*

Elliott, M.[1] & K. White[2]

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The surface soil in much of rural central Alabama is an impermeable shrink-swell clay that prevents septic systems from infiltrating wastewater into the ground. The confluence of lack of sewer, unsuitable soils, and poverty can lead households to have no feasible option for treating wastewater. In many such communities, households discharge raw sewage onto the ground through what are commonly called “straight pipes.” Recent evidence from our group reveals that straight pipes relatively common in underserved rural communities in Alabama and other states (Maxcy-Brown et al., 2021). This presentation will address the suite of wastewater management solutions available for rural communities in the Black Belt of Alabama and beyond, including technical, financial, and regulatory considerations. The physical typologies to be addressed include: (1) expansion of conventional sewer, (2) installation/repair of conventional septic systems and advanced onsite wastewater treatment systems (OWTS), and (3) decentralized clustered wastewater systems. Increases in the costs and timelines of sewer and other infrastructure projects in the U.S. have been well-documented; installation of sewer main now costs roughly $1 million per mile. The costs of OWTS have also increased greatly in recent years, based on reports from many states. In contrast, continued improvements in the performance, capabilities, and costs of the key components of decentralized clustered wastewater treatment systems (modular treatment technology, sensors, communication technology, and control systems) have led to a substantial increase in clustered system implementation in recent years. As decentralized clustered systems become more widespread, potential economies of scale associated with centralized management provide a feasible path to robust and sustainable wastewater management in even low-income and low-density communities. However, regulators, federal funders, and some local stakeholders are understandably risk-averse with emerging approaches to wastewater management. This presentation will also cover our experience and lessons learned in working with diverse stakeholders including politicians, regulators, researchers, and community organizations to establish the Consortium for Rural Alabama Water and Wastewater.

References:

Maxcy-Brown, J., M.A. Elliott, L.A. Krometis, J. Brown, K.D. White and U. Lall (2021) Making Waves: Right in Our Backyard - Surface Discharge of Untreated Wastewater from Homes in the United States. Water Research. 190: 116647. https://doi.org/10.1016/j.watres.2020.116647

Abstract No. 147. *Evaluating the feeding ecology of freshwater mussels (Uniondale) from Gantt Lake, Alabama using stable isotope and fatty acid analysis.*

Fogelman, K. [1], J. Stoeckel[1], H. Abdelrahman[1], B. Higgins[1] & B. Helms[2]

[1] Auburn University; [2] Troy University

Freshwater mussels are a highly diverse yet imperiled group of animals that play critical roles in ecosystem processes. Quantifying their feeding ecology is necessary to fully understand species-specific contributions to aquatic systems and to address conservation-related issues, including propagation and relocation programs. Unionids are generally regarded as filterers of planktonic algae, however there is evidence they utilize benthic food resources in addition to suspended material, although the relative contributions of different dietary constituents may vary depending on habitat. Using a stable isotope approach, we compared feeding relationships of a federally threatened, a state priority, and a common mussel species (*Fusconia escambia*, *Utterbackiana hartfieldorum*, and *Elliptio pullata* respectively) in Gantt Lake on the Conecuh River to determine the relative dietary contribution of fine particulate organic matter (FPOM) associated with benthic sediments, suspended particulate organic matter (SPOM), and detrital coarse particulate organic matter (CPOM). We collected tissue samples of mussels and environmental samples of putative food resources from Gantt Lake in Fall 2018. Stable carbon isotope ratios (□13C) and stable nitrogen isotope ratios (□15N) were analyzed using Bayesian MixSIAR modeling and values suggested mussel species were feeding similarly, as all species derived the majority of assimilated carbon from FPOM (94%) but not SPOM and CPOM. Fatty acid profiles of foot tissue were quantified to further elucidate specific constituents of FPOM that contribute to the mussel diet (e.g. algae, bacteria, fungi). These data indicate that these mussels similarly exploit multiple carbon sources, but their primary carbon sources appear to be coming from benthic rather than planktonic sources. Based on food web analysis, these freshwater mussels species appear to feed in a remarkably similar fashion and protection of high quality benthic habitat as an important food resource is critical to common and imperiled species alike.

Abstract No. 024. *Pesticide Occurrence in Shallow Groundwater Underlying Agricultural Areas in Alabama*

Gill, A.

United States Geological Survey

The U.S. Geological Survey (USGS) and Alabama Department of Agriculture and Industries (ADAI) are cooperating on a long-term project to evaluate concentrations of pesticides in groundwater underlying areas of high-intensity agricultural land use in Alabama. The project began during the summer of 2009, and groundwater samples are collected from a network of approximately 15 existing groundwater wells on an annual to biennial basis. The network wells are evenly distributed among three main regions of agricultural land use in Alabama: the Tennessee River Valley, Wiregrass area, and Baldwin County.

Project samples are analyzed by the USGS National Water Quality Laboratory in Denver, CO, and the USGS Organic Geochemistry Research Laboratory in Lawrence, KS. Sample collection and analyses of pesticides for this project use field and laboratory methods common with USGS national water-quality surveillance programs, which allows regional and national comparisons to be made. There have been changes to field and laboratory methods during the project, which allow for comparisons between the alternate methods. Water samples from the USGS-ADAI network wells have been analyzed for presence of 290 distinct pesticide and pesticide degradate compounds.

Since the project began, 178 environmental samples were collected from study wells. Detection frequencies were calculated for each individual pesticide compound as the percentage of detections in the total number of analyses for the compound. There were fewer than 178 analyses for some individual pesticide compounds due to either special short-term analyses of additional pesticides (e.g. glyphosate and degradates) or additions or deletions of compounds from laboratory schedules during the study. For environmental samples, thirty-seven of the pesticide and degradate compounds were detected in more than 10 percent of the samples. There were 6 compounds detected in more than 50 percent of analyses: metolachlor and two metolachlor degradates, metolachlor oxanilic acid and metolachlor sulfonic acid, atrazine and two atrazine degradates, CIAT and OIAT. Many compound concentrations were very low and detected below method reporting levels indicating greater uncertainty in the magnitude of pesticide compound present. Only two compounds, metolachlor oxanilic acid and metolachlor sulfonic acid, were detected above their respective method reporting limits in more than 50 percent of analyzed samples. Seventeen compounds were detected above their respective method reporting limits in 10 percent or more of analyzed samples. The maximum concentration of an individual pesticide compound measured during this study was for the herbicide metolachlor. Degradates of metolachlor, metolachlor sulfonic acid and metolachlor oxanilic acid, were the compounds with the second and third highest measured concentrations, respectively.

Abstract No. 087. *Spectral Analysis of Hydrographs to Evaluate Long-Term Aquifer Storage Changes*

Guthrie, G. & G. Jin

Geological Survey of Alabama

Hydrographs are time-series representations of water-level measurements in a given location, and linear analysis of these data sets is a traditional method of evaluating short- and long-term changes in aquifer storage. The Geological Survey of Alabama (GSA) maintains a real-time network of wells equipped with transducers that record water level and temperature at defined intervals with daily transmittals to the GSA. Hydrographs derived from these data sets can be complex, seemingly noisy, and thus difficult to interpret due to diurnal, seasonal, and decadal measurement variations. GSA has conducted spectral analysis by discrete Fourier transform to evaluate frequency spectra of water-levels that decompose the data into seasonal, trend, and random (residuals) components. Cumulative departure of the data from a mean value reflects either increasing or decreasing hydraulic head over time. These changes suggest that long-term aquifer storage changes in wells only affected by natural stressors may be related to long-term climatic cycles. The methodology has been applied to data from eight wells in the GSA real-time network that are outside the influence of anthropogenic stresses. The wells are shallow, less than 150 feet deep, vary in aquifer type, are unconfined to semi-confined and therefore most susceptible to natural stressors such as drought, and have at least (?) most (?) up to 10 years of continuous data available for analysis. Six of the wells display positive hydraulic head trends across the period of record, which may reflect storage level restoration to pre-pumping conditions, and three of the wells display negative, declining trends. Level-time curves do not display linear trajectories, but periodic oscillations that are expressed differently for each well. These may reflect decadal climatic variations that influence net recharge for each well. The amplitude and frequency of the oscillations may also be influenced by aquifer characteristics, reflective of the different aquifer types.

Abstract No. 067. *How important is considering point sources in large-scale watershed modeling?*

Haas, H. & L. Kalin

Auburn University

The Mobile Bay watershed (MBW) covers approximately 65% of the state of Alabama and is the fourth largest in North America in terms of freshwater discharge. This watershed supports a diverse flora and fauna and is vital to Alabama's commercial and recreational sectors. Over the last two decades, water quality deterioration has been reported in the MBW area with hypoxic conditions increasing in frequency and duration, a trend that is expected to continue. In this study, we employ the Soil and Water Assessment Tool (SWAT) to characterize the MBW and assess the impacts of point source discharges on freshwater flow to the Bay from the Alabama River watershed, which includes 61 major point sources from major wastewater treatment plants. First, a baseline SWAT model was set up and run without the presence of point sources. The goodness-of-fit analyses indicate a good representation of the watershed system based on daily observations of streamflow measured at the watershed's outlet. Results indicate that the inclusion of point sources to the model resonates in only marginal increases in streamflow (2%), sediments (1%), and mineral phosphorus (0.23%) compared to the baseline scenario. However, a 51% increase in simulated nitrate was found at the watershed's outlet due to the loadings originating from the major point sources. The results of this study point to the importance of considering point source discharge data for modeling nitrate and may contribute to future water quality modeling studies in large-scale watershed systems.

Abstract No. 023. *Water Use in Alabama - An Update*

Harper, M., T. Littlepage & S. Holley

ADECA

In 2019, the Alabama Office of Water Resources (AOWR) published one of the most comprehensive summaries of water use and surface water availability ever produced for the State of Alabama. It was based on an analysis of 2015 data submitted under the Alabama Water Use Reporting Program and other data sources and entitled "Estimated 2015 Water Use and Surface Water Availability in Alabama". The information in this report is being used as an integral aspect of the water demand component of OWR's water resource assessment analysis.
Accordingly, the Alabama Office of Water Resources is developing an update to the 2015 Water Use in Alabama report for 2020. In this presentation, information based on an assessment of annual water use data submitted through the 2020 reporting cycle will be provided including a review of the methodologies and procedures for data collection and analysis in eight primary water use sectors including:

- Public Water Supply
- Residential Water Use
- Industrial Water Use
- Thermoelectric Water Use
- Mining
- Irrigation Water Use (including nursery and sod use)
- Livestock Water Use
- Aquaculture Water Use

The presentation will also provide information on other topics including consumption analysis for the public supply, agriculture, and the combined industrial, thermoelectric, and mining water use sectors. The AOWR will also highlight how the Water Use in Alabama series fits into the overall water use assessment process.

Abstract No. 031. *The Seven Habits of Highly Effective Drainage Studies*

Heilwagen, B.

Wood Environment & Infrastructure Solutions, Inc

My induction into the world of performing drainage studies was as a young agricultural engineering major at the University of Illinois. Back then, they truly were drainage studies since we were most concerned with draining off water from saturated corn fields. From there I went to work for a hydroelectric utility in mountainous and arid Idaho, where the concern was less about draining off water and more about optimizing power production. From there I got into developing flood studies for FEMA maps, which evolved into local stormwater and flood reduction studies. Now nearly 20 years later, I find myself doing peer and third-party reviews of several drainage studies. While not unique, this collective experience has allowed me to see drainage studies of all shapes and sizes created for a variety of purposes in a variety of geographic settings.

This experience has also allowed me to see numerous drainage studies that were not performed in the most effective way. I have participated in studies where the model software used was not appropriate for the terrain and geography. I've been 75% through the development of a flood study, only to receive new topographic data to use for input. I've seen municipalities caught off-guard when a developer submits plans to build a subdivision in an area where no previous drainage study was been done, and then I've seen that same community fund a new drainage study to completion, only to find that it wasn't done at a resolution that could be used to test the effects of the new subdivision on runoff. I've read drainage study reports written by the best technical minds that left me less knowledgeable about the basin and modeling methods than I was when I started. I've seen communities fund, and fund, and fund again studies of the same drainage system, but for varying purposes. These issues cost communities in time and money.

In 1989, Stephen Covey published a book titled The 7 Habits of Highly Effective People. The groundbreaking book presents a series of habits that, if followed by the reader, result in the alignment of one's values with universal principles that Covey calls "the character ethic." It has been recognized as one of the most influential business management books in history. While the character ethic may not apply to performing drainage studies, the seven habits certainly do. Be proactive; begin with the end in mind; put first things first; think win/win; seek first to understand, then be understood; synergize; and sharpen the sword are tenants that we should subscribe to.

This presentation will draw parallels between Covey's seven habits and best practices to consider when performing drainage studies or all shapes and sizes. Examples will be given from my 20 years as a water resources engineer that highlight the need to subscribe to these habits. Although not revolutionary by any means, my hope is that the ideas presented help to increase the effectiveness of drainage studies across Alabama.

Abstract No. 090. *Genetic tools for quantifying and identifying taste and odor-producing microorganisms in drinking water reservoirs*

Higgins, B., P. Goodling & M. Thomas

Auburn University

Taste and odor (T&O) episodes in drinking water reservoirs are a major issue facing water utilities. These episodes are generally caused by cyanobacteria and actinobacteria that produce odorous compounds including geosmin and MIB. There is a strong interest among utilities to predict when these episodes will occur and also identify which specific organisms are causing the T&O episode. Many utilities currently use metrics like algae counts or chlorophyll-a measurements to predict T&O events but correlations are often poor. The reason is because the vast majority of algae and even cyanobacteria do not produce T&O compounds. We hypothesize that it is better to measure organisms that have the genes to synthesize MIB and geosmin. We use quantitative PCR targeting geosmin synthase and MIB synthase. Other researchers have developed primers targeting these genes and our original plan was to use existing primers for this analysis. Unfortunately, we discovered that many of these primers offered poor specificity toward the target gene or exhibited negative side effects like primer dimerization. We developed two new primer tools: one targeting geosmin synthase in cyanobacteria and one targeting this gene in actinobacteria. Our cyanobacterial geosmin synthase primers in particular were highly specific and targeted amplicon sequencing of the gene products showed that this set could exclusively amplify this gene in cyanobacteria. The primer set was also general enough to capture a diversity of cyanobacteria (e.g. Oscillatoria, Anabaena, Aphanizomenon) that are known to produce geosmin. These primers had good correlation with geosmin levels but only when geosmin levels were high (>20 ng/L). We were also able to use these primers to identify the specific cyanobacteria that caused a geosmin episode in Auburn's Ogletree reservoir in May of 2020. Similar work is underway to determine the effectiveness of primers targeting MIB synthase.

Abstract No. 131. *Closing the Gaps in Local Floodplain Policies*

Hinchey, B.

S&ME Inc.

To be a member of the National Flood Insurance Program (NFIP), a community must establish minimum standards for new development through adoption of a floodplain ordinance. However, many communities don't often expand on the minimum standards in FEMA's model ordinance which leaves many design and permitting decisions to be addressed on a case-by-case basis.

This presentation examines floodplain management policies that could, or should, be considered by local governments to reduce the risk of flooding and to reduce the risk of legal action by property owners affected by flooding. Full of real-life examples from local communities, mostly from Alabama, this presentation is intended to provoke thought among community officials to enhance local land development regulations in order to promote more resilient communities.

Abstract No. 134. *Flood Mitigation in Region IV: How does Alabama Compare?*

Hinchey, B.

S&ME Inc.

Congress amended the 1974 Disaster Relief Act in 1988 (Stafford Act) and created the Hazard Mitigation Grant Program (HMGP). The HMGP accounts for nearly 85% of the disaster mitigation funding through FEMA's Hazard Mitigation Assistance (HMA), which also includes Flood Mitigation Assistance (FMA) grants and Pre-Disaster Mitigation (PDM) grants. In 2020, the PDM grant program ceased and the new Building Resilient Infrastructure and Communities (BRIC) grant began.

In this presentation, we review the 30-year history of FEMA Hazard Mitigation Assistance in FEMA Region IV and take a fun and informative look at the many and varied ways that southeastern states, particularly Alabama, utilize these grant programs to mitigate flooding. In several key metrics, flood mitigation priorities, projects, and funding in Alabama are compared to our neighbors in Region IV.

Abstract No. 027. *New Water Use Data Application for Alabama*

Holley, S., T. Littlepage & M. Harper

ADECA - OWR

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 "eWater" 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. The enhancements will 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, 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.

Abstract No. 092. *Nitrate Levels in Baldwin County Aquifers Suggest Background Levels of Nitrate Present within the System*

Huettemann, M.[1] & G. Guthrie[2]

[1] The University of Alabama; [2] Geological Survey of Alabama

Southern Baldwin County is dependent upon the quality and quantity of groundwater resources in the area to help support its rapidly growing population and economy. Groundwater is the only viable source of fresh water in the region, and it is vital to help maintain the sustainability of the drinking water supplies. In 2010-2011, a network of eighteen wells was established in Dauphin Island, Fort Morgan, Orange Beach, and Gulf Shores to monitor groundwater in the area. The wells were sampled in May/October of 2010 and June/December of 2011. During this sample period, the southeast was experiencing drought conditions, with the exception of May 2010 and Tropical Storm Bonnie in July 2011. Using drought and non-drought conditions, the aquifer's response to precipitation was compared between three wells using discrete sampling events relative to a continuous precipitation record. Wells COM and PH-3 are private wells and GS-1 is a GSA observation well located at the Gulf State Park pier. The depth of the wells is 60, 40, and 4.5 feet, respectively. Of the eighteen wells observed, wells COM, GS-1, and PH-3 had the highest recorded nitrate concentrations, with some samples containing concentrations above the 0.09 mg/L limit. Salinity was calculated using water temperature and specific conductivity measurements. Analytical results Indicate that salinity and nitrate were constant during each sampling event. These results suggest that there are background levels of nitrate in the groundwater that contribute to the overall nutrient budget of the hydrologic system and need to be accounted for in future restoration efforts.

Abstract No. 085. *City of St. Petersburg Watershed Model Refinement*

Hyde, H. [1], S. Pati[1] & C. Frey[2]

[1] Jacobs Engineering Group; [2] City of St. Petersburg

The watershed model developed for the City of St Petersburg covers 26 basins in Pinellas County and shares many boundaries with County-maintained watersheds, making it one of the largest watershed studies being completed in Florida for the scale of detail it boasts. Jacobs has modeled the highly urbanized watershed for floodplain development and will be utilized to identify sustainable BMP projects to mitigate watershed flooding and improve water quality. This WMP includes:

- Large, highly urbanized watershed model development
- Data collection, collation, evaluation, and assembly from various sources
- Data gap analysis, field reconnaissance, and data acquisition
- Sea level rise (SLR) and climate change assessment
- Model parameterization, development, calibration and verification as well as floodplain analysis
- Level of service (LOS) analysis based on the City's LOS criteria and identification of LOS deficiency areas
- Model simulations for future conditions with SLR and rainfall projections
- Stakeholder involvement through meetings and virtual website
- BMP alternative analysis for both flood reduction and water quality
- Evaluation of sustainable management of complex flood and water quality issues, including use of injection wells and potential development of new potable water sources from excess runoff to capture and store fresh water inland versus discharging it to nutrient limited estuaries.

Additionally, the project also evaluated a preliminary lake management plan for Crescent Lake to improvement water quality in the lake. This presentation will highlight the progress of the project, specially, the methods and the level of detail applied to such a highly urbanized watershed that will significantly help in analyzing the LOS and evaluating flood alleviation projects at both local scale and regional scale.

Abstract No. 048. *Quantifying Nutrient Reductions at Wetlands in the Upper Fish River Watershed*

Isik, S.[1], L. Kalin[1], H. Haas[1] & M. Hantush[2]

[1] Auburn University; [2] EPA

This study aimed to quantify reductions in nitrate, organic nitrogen, and phosphate loadings provided by 44 wetland complexes within the Upper Fish River watershed in coastal Alabama. For this purpose, the physical-based wetland nutrient cycling model WetQual was utilized. WetQual can simulate hydrology as well as nitrogen (N), phosphorus (P), total suspended sediment (TSS), and carbon (C) cycles and their dynamics in natural and constructed wetlands. Input loadings to the selected wetlands were estimated using a watershed-scale hydrologic model (SWAT). The SWAT model parameters were stochastically calibrated using 500 Monte Carlo Simulations for streamflow and water quality data available at a USGS gauge site for the period 2008-2015. The results yielded Nash-Sutcliffe Efficiency values of 0.93, 0.86, and 0.54 at monthly time resolution for streamflow, phosphate, and nitrate, respectively. The upper (90%) and lower limits (10%) of the prediction interval along with the medians of the SWAT generated nutrient loadings and discharge to each wetland were fed as input to the WetQual model. After performing 10,000 Monte-Carlo simulations with WetQual at each wetland, 10th, 50th, and 90th percentiles of WetQual outputs were calculated to get nutrient loads leaving the wetlands. Simple relationships were constructed between input and output loads to each wetland to develop equations which can be used to estimate nutrient reductions by wetlands in this region. Reduction efficiencies were calculated by (input loading –output loading)/(input loading). Median reduction efficiencies of the 44 wetlands were found as 60, 44, and 56% for nitrate, organic nitrogen, phosphate, respectively, while their reduction loads at reach level were 287.68, 42.9, and 8.1 kg/ha/y. This study showed that wetlands in the Fish River watershed are effective in removing organic nitrogen, nitrate, and phosphate.

Abstract No. 065. *Modeling Nutrient Dynamics in Wetlands Undergoing Wetting/Drying Cycles*

Kalin, L. [1], J. He[1], M. Hantush[2] & S. Isik[1]

[1] Auburn University; [2] EPA

Wetland hydrology has a strong influence on wetland structure, ecosystem functions, and biogeochemical cycles. A shallow water table can have a significant effect on the wetland soil moisture, which is one of the important considerations in wetland biogeochemistry. In this study, we incorporated a recently developed two-layer soil moisture, dynamics model into the wetland biogeochemistry model WetQual. For this, we first divide a wetland into ponded and variably saturated compartments and apply the two-layer soil moisture model to estimate the soil moisture in the variably saturated compartment which is subjected to various atmospheric conditions at the surface and a dynamic groundwater level at the bottom. We also improved the plant growth module of WetQual by introducing a more realistic primary productivity module by considering environmental factors including temperature stress, water stress, and plant dormancy. We evaluated the updated model by applying it to a restored wetland located on Kent Island, Maryland, by two numerical experiments using shallow and deep groundwater levels in the variably saturated compartment. Results showed that the model had excellent performance in estimating weekly NO3 and total organic C (TOC) exports and moderate performance in capturing weekly organic N (ON), NH4, and total N (TN) exports, but not as good in estimating weekly TSS and P exports. The moisture contents in the variably saturated compartment had significant differences between the two bottom boundary conditions (deep vs. shallow groundwater). Mass balance analysis showed that using different groundwater level conditions in the variably saturated compartment had a significant influence on the N and C budgets, but no influence on the P budget. The estimated biomass clearly reflected the role of temperature stress, water stress, and dormancy. The estimated plant biomass and nutrient uptake had good agreement with field measurements.

Abstract No. 151. *Use of Flocculants in Construction Stormwater Treatment*

Kazaz, B., M. Perez, W. Donald

Auburn University

Construction stormwater pollution constitutes an increased risk for downstream water bodies due to uncontrolled sediment-laden discharge exiting construction sites. Temporary sediment control practices are designed for capturing sediment particles and reducing the turbidity of the off-site discharge; however, these designs often show limited performance in capturing fine-sized sediment particles. The use of flocculants provides an effective solution for construction stormwater treatment. These chemical compounds build a bridging mechanism between particles to form larger flakes and create settlement out of suspension. Although flocculants are highly effective in reducing turbidity, improper dosing may pollute downstream water bodies and create risks for aquatic life. The effectiveness of flocculants for stormwater management has been well-investigated; however, a large gap in knowledge exits on guidance for application rates and dosage for construction site applications. This study investigates the use of flocculants for construction stormwater treatment in the U.S. by presenting a state-of the-practice survey and aims to fill the knowledge gap by investigating the performance of various commercially available products and practices. This research provides design-based guidance for roadway construction sites in Alabama by integrating lab-scale testing methods. Lab-scale testing will consist of bench-scale experiments that characterize the behavior of different flocculant types across different soil types. The study will enhance the proper use of flocculants in construction stormwater management by providing design guidance on application rates and dosage.

Abstract No. 072. *A Comprehensive Watershed Management Plan on a Mission to Protect "America's Amazon"*

Kelson, J. [1] & B. Vittor[2]

[1] Wood Environment & Infrastructure Solutions, Inc.; [2] Barry Vittor & Associates

The Mobile Bay National Estuary Program (MBNEP) works diligently to uphold the common values deemed as most important to Alabama's coastal quality of life, which include increasing public access to the water, protecting the beaches and shorelines, maintaining habitats for fish and wildlife, protecting the heritage/culture unique to the Alabama coast, helping natural systems remain resilient to unforeseen events, and improving the water quality of the rivers, creeks, and bays.

The MBNEP has been completing Watershed Management Plans (WMPs) throughout Mobile and Baldwin counties. Their efforts drive restoration efforts throughout coastal Alabama.

In January of 2020, the MBNEP continued their efforts with the commencement of the Mobile-Tensaw Apalachee (MTA) Watershed Management Plan. The "Delta" is considered one of the most biologically diverse ecosystems on the North American continent and has been referred to as "North America's Amazon".

The MTA watershed complex is very large, occupying over 350 square miles of area, and includes a variety of diverse uses and interests. One of the focal points of this WMP is the development of a plan to conserve and manage the lands in the watershed that offer high potential for improving the overall health and resiliency of its health.

The WMP involved very robust community and stakeholder outreach and involvement to assist with its development, including a virtual boat tour. As this WMP commenced just before the beginning of the COVID 19 pandemic in the United States, creative thinking was employed to engage the community in this very important project.

Abstract No. 071. *A Comprehensive Watershed Management Plan Aimed at the Rehabilitation of a Culturally Significant Urban Creek and Bayou*

Kelson, J.[1] & M. Posner[2]

[1] Wood Environment & Infrastructure Solutions, Inc.; [2] Escambia County

Carpenter Creek and Bayou Texar are in the heart of the Pensacola area. The creek and bayou have played a very important role in the lives of Pensacola ancestors, but few know of their importance today. Impacted by channel modifications, eroded banks, non-attenuated stormwater, gray infrastructure, and diminishment of the protective riparian zone, the creek and bayou are suffering from poor water quality, nuisance invasive species, high sediment loading, and overall poor ecosystem health.

Escambia County and the City of Pensacola are developing a comprehensive Watershed Management Plan (WMP) for the Carpenter Creek and Bayou Texar watersheds. Funding for the WMP development has been secured through the Escambia County Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast State Act (RESTORE Act), Direct Component allocation (Pot 1). This WMP will provide a roadmap for identifying, addressing, and recommending actions to improve: water quality and control water quantity (flooding), fish and wildlife habitat, public access and recreation opportunities, and community resiliency to sea level rise.

Escambia County contracted with Wood Environment and Infrastructure Solutions, Inc. (Wood) to assist with the development of this WMP. The Wood team also includes Scape, Wetland Sciences, and Impact Campaigns.

The WMP is very comprehensive in that it includes detailed assessments for hydrologic/hydraulic conditions, water quality and pollutant loading, and stream classification and restoration. Best management practices recommendations will also be comprehensive and will also look to provide value to the community in providing additional public access to this very significant urban system. This project's aim is to improve Carpenter Creek and Bayou Texar, while also increasing its visibility to, and appreciation of, its natural beauty and regional importance.

Abstract No. 057. *Stormwater Best Management Practices to improve the Parkerson Mill Creek watershed in Lee County Alabama*

Knappenberger, T., E. Brantley & C. LeBleu

Auburn University

The Parkerson Mill Creek Watershed is located in Lee County, in east-central Alabama. It is part of the Upper Chewacla Watershed (HUC 12: 031501100202) of the Lower Tallapoosa River Basin. Land use includes a mix of urban (City of Auburn; Auburn University), suburban, industrial, agricultural, and rural areas. The 9.3 square mile watershed has approximately 68,500 ft. of perennial streams and 282,152 ft. of tributary streams.

The headwaters of Parkerson Mill Creek originate on the campus of Auburn University. The campus is comprised of approximately 1800 acres of contiguous property of which between 60-80% is impervious or compacted surface. The area surrounding Auburn University consists of residential property to the east and southeast, agricultural property to the southwest and west, and urban city property to the north and east.

Parkerson Mill Creek does not meet minimum water quality standards for its designated Fish and Wildlife water use classification. In 2008, the Alabama Department of Environmental Management (ADEM) listed Parkerson Mill Creek on the CWA Section 303(d) List, as impaired for 6.67 miles from Chewacla Creek to its source. Parkerson Mill Creek's listing was based on a series of Auburn/Opelika Intensive Fecal Coliform Studies conducted in 2007. The cause of impairment was identified as pathogens from urban stormwater runoff and storm sewer sources. A pathogen Total Daily Maximum Load (TMDL) was developed by the Alabama Department of Environmental Management (ADEM) and approved by the Environmental Protection Agency (EPA) in 2011.

In 2018, we implemented a watershed plan and built several best management practices (BMPs) to improve stormwater runoff quality and to reduce pathogen loads from livestock. Construction of BMPs will be presented together with runoff volume reduction and water quality data from the past three years.

Abstract No. 058. *Time stability in soil moisture in irrigated agricultural field*

Kumar, H. [1], P. Srivastava[2], B. Ortiz[1], J. Lamba[1] & G. Morata[1]

[1] Auburn University; [2]University of Maryland

This study aimed to examine the time stability in soil moisture in corn and cotton fields at different soil depths in the Tennessee Valley Region (TVR) of Alabama, USA. A time stable location can explain the variability in soil moisture of the entire field using one sensor instead of using multiple sensors, which can help reduce costs and labor associated with the installation of multiple sensors within a field. In this study, soil moisture data was normalized to find the time stability in the data during the growing season. A relative difference approach was considered to study the time stability in soil moisture and various statistical tests (rs-Spearman's correlation, NSE-Nash-Sutcliffe efficiency, R2-coefficient of determination, etc.) were adopted to reduce uncertainty or increase confidence in the performance of representative sensors. The time stability analysis showed one representative sensor for the entire soil profile in each corn and cotton field. Among various field attributes, topography in corn, and soil properties in cotton were determined as significant factors responsible for soil moisture variability. Crop evapotranspiration (ETc) showed significant negative weak and moderate correlations with soil moisture in the corn and cotton fields, respectively. However, the mean air temperature showed a significant positive correlation with soil moisture in the corn and a significant negative correlation in the cotton field. This study gives insights into soil moisture variability, provides useful information about time stability, and identifies responsible factors for adopting precision uniform irrigation scheduling.

Abstract No. 020. *Interactions of "Forever Chemicals" – Per and Polyfluoroalkyl Substances with Dissolved Organic Matter as a Potential Contributor to Soil and Water Contamination.*

Lawhon, J. & Y. Olshansky

Auburn University

Per- and polyfluoroalkyl substances (PFAS) are a group of over 4000 human-made fluorinated aliphatic compounds. Strong C-F bonds make PFAS highly persistent under environmental conditions; therefore, PFAS accumulates in the environment. These compounds, known by adverse effects on humans and the ecosystem, reach farmlands with irrigation water and due to land use of biosolids, thus becoming an agriculture-related issue. 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. Evidence has been shown that binding of PFAS to DOM is essentially DOM nature-dependent, but no approaches persist which would predict interactions of PFAS with various types of DOM. This study aims to develop structural and compositional DOM descriptors which could be used as quantitative predictors for the interactions between PFAS and DOM. A range of DOMs relevant for soil solutions and, specifically, being under organic wastes application, will be analyzed for fluorescence spectra, collected as three-dimensional excitation emission matrices (EEM) where Parallel Factor (PARAFAC) analysis will be used to decompose EEMs into their underlying chemical fluorescent DOM components. Fourier Transform Infrared spectroscopy (FTIR) will provide information of the DOM functional groups and their chemical environment. Binding of PFAS with these DOMs will be tested under environmentally relevant conditions through dialysis equilibrium studies. Integration of DOM descriptors and PFAS binding coefficient will develop into a model allowing prediction of PFAS fate in natural and agricultural systems.

Abstract No. 037. *Urban Areas vs. Impervious Surfaces: Implications for water quality/quantity predictions*

Lee, D. & L. Kalin

Auburn University

Land use/cover (LULC) is one of the key components in hydrologic modeling. In particular, urban areas can significantly impact water quantity and quality due to impervious surfaces. Many hydrologic models rely on the National Land Cover Dataset (NLCD) as LULC input, where urban areas are represented as “developed” with four sub-categories: open space, low intensity, medium intensity, and high intensity. Each sub-category is associated with a range of imperviousness (e.g., 50-79% for medium intensity), thus introduce uncertainty. USGS has another national product that gives the fraction of impervious areas at 30-meter resolution. In this study, we combined the two products (called NLCD-Imp) to better capture impervious areas. The Soil and Water Assessment Tool (SWAT), one of the widely used hydrologic models, was used to test the impact of improved representation of urban areas, in an urban watershed in a coastal watershed, near Pensacola, USA. This paper will present the differences in predicted streamflow and various water quality constituents in response to using NLCD and NLCD-Imp as LULC sources.

Abstract No. 144. *Can infrared canopy temperature data be used as a potential irrigation-scheduling tool for corn in humid subtropical climates?*

Lena, B. [1], B. Ortiz[1], A. Jiménez-López[1], A. Sanz-Sáez[1] & S. O'Shaughnessy[2]

[1] Auburn University; [2] USDA: Soil and Water Management Research

The use of infrared temperature sensors to track plant water status through crop canopy temperature has been widely used in dry regions of the USA. For humid regions, like the southeast USA, this technology has not been fully investigated and its feasibility is still unknown. The objective of this study was to evaluate the use of canopy temperature data as a potential irrigation scheduling tool for the climate conditions of the state of Alabama. The study was conducted at the E.V. Smith Research Station located at Shorter, AL during the corn growing season of 2018, 2019, and 2020. Three water level was evaluated in each growing season: T100 – full irrigated, T66 – 66% of the irrigation depth calculated at T100, and T33 – 33% of the irrigation depth calculated at T100. In 2018, 2019, and 2020, a total of four, six, and five replications (plots) for each irrigation treatment were used, respectively. The soil water level was determined at 6, 12, and 24" depth using Acclima True TDR sensors. An infrared temperature sensor was installed in each plot to determine corn canopy temperature. The canopy temperature data was used to calculate the crop water stress index (CWSI), which is an index that indicates the plant water stress level. This index ranges from 0, fully irrigated plants, to 1, fully stressed plants. The CWSI was found to be very sensitive to changes in water level. The values reduced (got closer to zero) when irrigation was applied, and it increased between irrigation and rainfall events when the water level was reduced due to crop water uptake. The three-years mean value of CWSI for the T100, T66, and T33 was 0.12, 0.18, 0.27, respectively. For the same treatments, the three-years mean value of yield was 210, 101, and 177 bu ac-1, respectively. A negative correlation between CWSI and yield was found, which was expected since plants kept under lower water availability during the growing season will output lower yield values in comparison with plants that were kept at higher water levels. These values indicate that the use of infrared canopy temperature sensors is a promising irrigation scheduling tool for a humid subtropical region of the USA. There is an opportunity for studies that determine canopy temperature maps by installing infrared temperature sensors on center pivots and, therefore, irrigation prescriptions maps can be derived by the canopy temperature map.

Abstract No. 018. *Spatial temporal variability of flash drought in the continental United States and its impacts from global sea surface temperatures*

Lesinger, K. & D. Tian

Auburn University

Flash droughts are extreme climate phenomena that occur at the subseasonal-to-seasonal (S2S) timescale and develop with rapid onset and intensity. While flash droughts have significant socio-environmental impacts, its spatial and temporal variability and potential predictability from sea surface temperatures (SST) are still not well understood. The overall goal of this research is to assess the spatial and temporal variability of flash droughts in the continental United States (CONUS) and its predictability from global SST. Flash drought events are characterized with soil moisture- and evaporative demand-based definitions at the weekly timescale between September 1981 and December 2018. A hierarchical agglomerative clustering algorithm identifies geographic clusters where flash drought events occur synchronously over time. We identify the optimal number of clusters and further analyze the distribution and severity of flash drought occurrences within each cluster to understand the spatiotemporal variability of flash drought events for each flash drought definition. To understand flash drought cyclicities and trends for prediction, a spectral analysis using a flash drought percentage area time series is conducted for each cluster. We then explore associations between SST anomalies in the Pacific and Atlantic oceans and flash drought events, and further evaluate flash drought predictions using the identified SST patterns. The results reveal the spatial and temporal variability of flash droughts in CONUS and influential SST patterns. Such understanding will improve the current S2S prediction and early-warning management of flash droughts.

Abstract No. 108. *A field validated model of temporal variability in oyster habitat suitability*

Linhoss, A.[1] & P. Mickle[2]

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This work presents the development and validation of a spatially and temporally variable oyster habitat suitability model for the western Mississippi Sound, northern Gulf of Mexico. In the work, we develop an oyster habitat suitability model based on existing conditions in one year, forecast habitat suitability throughout the same location in following years, and validate the model using field counts of recently deceased oysters in those years. The model uses four environmental factors to determine habitat suitability, namely: maximum annual temperature, maximum annual salinity, minimum annual salinity, and minimum annual dissolved oxygen. Results of the validation show that counts of recently dead oysters were higher when the habitat suitability was below 0.2. The results also show that habitat suitability varies by up to 0.45 in any single location (One standard deviation. On a scale from 0 to 1). This is important for evaluating which areas will be most resilient for oyster habitat under a variety of conditions. This study presents the first validated model of temporally and spatially varying oyster habitat suitability.

Abstract No. 041. *Novel water sensors for precision agriculture*

Liu, J., W. Yi & Z. Cheng

Auburn University

For precision agriculture, it is important to monitor the soil-water content and water flow in farmland. Traditional techniques used to measure the soil-water content are stationary, meaning soil samples have to be taken a lab, which is inadequate to monitor the soil-water and almost impossible to characterize the water flow. For example, there are many factors that influence the results, such as the handling of soil sample, the locations to collect samples, the number of samples to be collected, and the time needed to get the final result. And there are commercial sensors, such as time domain reflection technology TDR, which can perform the in-situ measurement of soil-water content. However, these sensors are expensive and the sensor is not easy to use, and like the traditional method, the selection of collation and the number of location to be monitored are critical. More seriously, the installation of the sensor probe into soil is very critical. For example, a small gap between the sample probe and soil can result in a giant measurement error. Moreover, if one wants to use the sensors to monitor a farmland and to determine the water flow, a large number of the sensor would be needed, which is impossible considering the cost and infrastructure needed. On the other side, there are humidity sensors that are inexpensive and provide continuous measurement, but these sensors would be damaged when the sensor is immersed in water.

We recently developed an inexpensive and wireless sensor for in-situ monitoring soil-water content continuously by modifying existing humidity sensing materials and using our patented wireless sensor platform. Each sensor is only a few centers and can be placed in soil for continuous monitoring. The sensor is measured using an interrogation unit wirelessly over the surface. With this inexpensive sensor, many can be employed in a farmland at different locations and with different depths so that a 3-D map of the soil-water content can be generated and the time dependence of the 3-D water map can be used to determine the water flow in a farmland. This presentation will report the principle and experimental data to show the advantages of the new sensor over all existing sensors for soil-water content monitoring.

Abstract No. 030. *The invasive omnivore, Dreissena polymorpha (zebra mussel), structures multi-scale diversity and ecosystem attributes in invasion front reservoir metaecosystems*

Lovejoy, R., A. Kandow & J. Howeth

The University of Alabama

Non-native invasive predators often exert large ecological impacts on species richness and the local environment of freshwater ecosystems. The ecological effects of non-native omnivores, however, are less understood due to the complex direct and indirect effects of consumption on multiple trophic levels. Omnivory is hypothesized to alter local species richness and biomass of prey and primary producers and increase dissimilarity between invaded and uninvaded communities and ecosystems. High levels of community and ecosystem connectivity, however, may override these responses through strong spatial flows of species and nutrients. In this study, we evaluated the effects of an invasive omnivore, the zebra mussel (*Dreissena polymorpha*), on multi-scale diversity and local ecosystem attributes in reservoirs located at the southern invasion front of the species in North America. The study system included two adjacent partially invaded reservoir metaecosystems in Texas with different levels of hydrologic connectivity. Zebra mussels, crustacean and rotifer zooplankton, phytoplankton, and the reservoir environment were sampled in invaded and uninvaded reservoirs. Species diversity and ecosystem properties were contrasted as a function of reservoir invasion status and metaecosystem connectivity.

Zebra mussel veligers were detected in all invaded reservoirs, indicating established reproducing populations of the species and potential for local ecological impacts. While local diversity of plankton did not differ between invaded and uninvaded reservoirs, crustacean zooplankton beta diversity was lower in invaded reservoirs indicating an increase in compositional similarity. Additionally, crustacean zooplankton and phytoplankton biomass was significantly lower in invaded reservoirs. Likely due to observed reductions in phytoplankton, water column transparency was significantly greater in invaded reservoirs. These results are consistent with predictions that omnivory and highly effective filtration by zebra mussels reduce grazer and primary producer biomass. Further, total phosphorus was lower in invaded reservoirs, likely owing to uptake by zebra mussels for conversion into biomass. Invaded reservoirs were larger in surface area and cooler than uninvaded reservoirs. The reservoir metaecosystem with lower levels of hydrologic connectivity exhibited stronger structuring of local plankton communities by the environment and thus the potential for larger impacts of zebra mussel omnivory. Together, the results of this study indicate that effects of omnivory from a single invasive species can influence metacommunity and metaecosystem properties under different levels of hydrologic connectivity. The findings also suggest that co-occurring native species that depend upon planktonic resources, including mussels and fishes, are at risk of declines in population sizes and local extinction from zebra mussel establishment.

Abstract No. 044. *Alabama Water Management Policy from Past to Present*

Lowry, C.[1] & C. Miller[2]

[1] Alabama Rivers Alliance; [2] The University of Alabama

Alabama water management policy has a long and interesting history dating all the way back to 1955, with the 1955 and 1990 temporary commissions formed, to the passing of the Alabama Water Resources Act in 1992, to the creation of the Alabama Water Agencies Working Group in 2011. Each time the issue of water use challenges and water resource management rises to the state level, typically following a major drought, some forward progress towards addressing water challenges is made such as the recent funding and development of the first ever statewide surface and groundwater assessments as well as the passage of the Drought Act of 2014.

However, interest fades when the rain returns and political leaders interests' change leading to gaps in understanding and knowledge among leaders and stakeholders as well as the risk of starting all over and/or re-inventing the wheel. It is important that we continue to build on the successes of our water policy history, as well as learn from the challenges. We can only do this by ensuring that the efforts of the past are understood by new stakeholders to this work as well as refreshing the minds of those who have been involved for many years. The water management needs of 2021 are likely not the same as the needs of 1955 -- or even those of 2011-- and the information and data we continue to gather only helps inform those needs and identify any policy gaps that may still exist. This presentation will lay out the history of Alabama water management policy in a timeline format and discuss the successes we have achieved as well as the lessons learned in order to better inform our steps forward to ensure accessible, affordable, and equitably shared water resources for our future.

Abstract No. 046. *Influence of manure application and soil physicochemical properties on phosphorus leaching in pastures*

Malhotra, K. [1], J. Lamba[1], T. Way[2], S. Budhathoki[1] & P. Srivastava[3]

[1] Auburn University; [2] USDA-ARS National Soil dynamics Lab; [3] University of Maryland

Significant amount of poultry manure produced in the southeastern United States is being applied to pasture lands. Nutrient loss from manured pastures through surface and subsurface pathways has long been considered as a major source of non-point source pollution of waterbodies. Subsurface phosphorus (P) losses is significant and can lead to both declines in crop yield as well as deterioration of water quality. Therefore, to achieve the fundamental goal of sustainable agriculture, it is critical to evaluate the fate and transport of phosphorus through the agricultural systems. In this study, we used rainfall simulations to examine the effect of soil physicochemical properties, especially the soil macropore characteristics, on the flux, fate, and transport of P. Undisturbed soil cores were collected from Hartsells fine sandy loam soil with Kentucky 31 tall fescue pasture in Crossville, Alabama. Treatments included surface applied poultry manure and control (no manure applied). The leachates were collected and analyzed for ortho-P and total P along with the measurement of soil nutrient levels. In addition to column experiments, X-ray computed tomography (CT) was used to quantify the macropore network connectivity, which is essential to preferential flow. Results on the effect of soil macropore characteristics on vertical distribution and transport of P in the vadose zone will be presented.

Abstract No. 084. *Impact of dissolved organic matter properties on iron (III) complexation*

Malina, N. & A. Ojeda

Auburn University

In recent decades, increasing concentrations of dissolved organic matter (DOM) have been observed in rivers and lakes worldwide [1]. Higher concentrations of DOM in drinking water reservoirs complicate a drinking water preparation process. Aluminum or iron-based coagulation is generally used for DOM removal from the natural water. Depending on the DOM source and chemical composition the DOM-metal complexation capacity can change significantly. Here, we explore how DOM of different origins, and thus different chemical properties, influence iron (III) complexation in water. We hypothesized that efficiency of iron(III) complexation on DOM correlates with the molecular size and fluorescence intensity. We tested DOM from three different origins: leachate of coals from Pulaski County (Arkansas, USA), Suwannee River natural organic matter (International Humic Substances Society), and autochthonous lake (Auburn, Alabama, USA). The optical properties and molecular size of DOM were characterized by high-performance liquid chromatography coupled to size exclusion column (HPLC-SEC) with fluorescence detector. DOM concentrations were adjusted to 25 mg C/L, iron (III) chloride was added in solution at 2-20 ppm. Formed colloids were filtered through 0.45 μm filter and the remaining iron concentration was determined by spectrophotometric methods.

Prior to complexation, Suwannee River showed the higher molecular weight of fluorophores (1,231 Da), followed by Pulaski (930 Da) and autochthonous lake (723 Da). With the increased iron concentration the molecular weight of all studied DOM decreased, showing that iron (III) binds predominantly to the higher molecular size fractions. Molecular weights of fluorophores after addition of 20 ppm iron(III) chloride were 673, 673 and 302 Da in Suwannee River, Pulaski and autochthonous lake, respectively.. Fluorescence of DOM can be associated with the functional groups that tend to form complexes. Lowest fluorescence was observed for autochthonous lake, followed by Suwannee River and Pulaski. The lowest molecular weight and fluorescence of autochthonous lake DOM resulted in the highest efficiency of iron complexation at 2 and 5 ppm of iron(III) chloride (100% removal) followed by Pulaski (54 % removal at 5 ppm). Addition of 2 and 5 ppm of iron (III) chloride to Suwannee River DOM did not result in iron (III) removal. Understanding the properties of the DOM fractions that primarily remove by iron-based coagulation is important for improving the drinking water treatment processes and meeting the drinking water requirements in the changing environment.

References

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Abstract No. 124. *Employing a Dynamic One Health Approach in Extension and Outreach to Reduce Impacts of Pharmaceuticals and Personal Care Products (PPCPs) on Water Quality*

Mason, T., M. Dixon, R. Robinson, A. Shabel & K. Steedley

Alabama Cooperative Extension System

The presence of pharmaceuticals and personal care products (PPCPs) in our freshwater poses a significant threat to human, animal, and environmental health. The Associated Press estimated that pharmaceuticals were found in the drinking water supply of nearly forty-one million Americans. Compounds and metabolites of estrogen, cholesterol, caffeine, antibiotics, fire retardants, nicotine, and deodorizers were detected in surface waters with a frequency of 80, 80, 80, 75, 60, 35, and 25%, respectively. The potential toxicity of these chemicals remains unknown. However, it is evident that many wastewater treatment facilities are not equipped to remove these compounds or their metabolites. These factors pose an immense threat to human, animal, and environmental health in Alabama and worldwide. Furthermore, the misuse of prescription and opioid drugs intensifies the problem in urban and rural areas. The Synergistic Efforts to Reduce Pharmaceutical Impacts on the Environment (SerPIE) program was created to advance knowledge, raise awareness, and emphasize the benefits of using safe, effective methods to dispose of expired or unused PPCPs. Using a 'One Health' approach, SerPIE integrates the efforts of multiple disciplines to educate youth and adults about PPCP impacts on water quality. Over the past eight years, SerPIE has provided 347 outreach activities and reached over 10,000 people directly. It has partnered with Alabama law enforcement to install 13 permanent drug drop-off boxes. Additionally, it aided in 74 drug take-back programs, resulting in the collection of over 29,000 pounds of PPCPs. SerPIE efforts have also led to over 1200 lock-your-meds pledges. It has developed an interactive curriculum and provided training forums for at-risk clientele and Extension educators. The program also offered experiential learning opportunities that empowered future STEM (science, technology, engineering, and mathematics) professionals through summer enrichment programs. Measurable outcomes from the program include increased knowledge gained on PPCP issues based on pre/post-test measures, increased adoption of pharmaceutical best management practices (BMPs), decreased medicine stockpiles in homes, decreased costs associated with drug-related health issues, and improved water quality and environmental sustainability. SerPIE also helped to increase awareness among underrepresented and minority audiences. Overall, SerPIE has demonstrated how a novel outreach approach can improve knowledge, promote action, and ultimately protect water quality.

Abstract No. 140 *Building a Cross State Estuary Program during a Pandemic*

McDonald, L. & W. Scheffel

Pensacola and Perdido Bays Estuary Program

Effective watershed management requires coordination between agencies and organizations across geographic and political boundaries to evaluate ecosystem status and trends, inform future restoration efforts, and educate communities. Comprehensive long-term collaboration is especially needed for watersheds such as the Pensacola and Perdido Bays that span state lines. The National Estuary Program (NEP) model has historically served as a leader in developing community-based scientifically sound Comprehensive Conservation & Management Plans (CCMP) for the protection and restoration of valued natural resources. However, traditional coordination methods amongst agencies are challenged when faced with travel restrictions, changes in budget priorities and/or staffing, and other circumstances associated with a pandemic. Throughout the pandemic, there was an increased demand for unbiased organizations that have the ability to connect agencies and organizations utilizing innovative virtual technologies to overcome these challenges. The Pensacola and Perdido Bays Estuary Program (PPBEP) is a non-regulatory program in Alabama and Florida that was established to help inform the needs of local communities, educate the public on key issues affecting their watersheds, and build consensus among groups to set achievable goals and objectives for long-term success. Launching a cross-state estuary program during a pandemic brought both challenges and opportunities. By successfully incorporating virtual engagement tools, the program was able to engage stakeholders to collect public input and existing environmental data to advance the development of a CCMP. Lessons learned by the PPBEP can be utilized by other organizations to help facilitate coordination in the face of unforeseen circumstances.

Abstract No. 102. *Calibration of Solvita® CO2 Burst system for reducing nitrogen pollution in agronomic systems.*

McEachin, A. [1], E. Guertal [1], A. Gamble [1] & U. Singh [2]

[1] Auburn University; [2] International Fertilizer Development Center

Over application of nitrogen (N) fertilizer causes reduced fertilizer use efficiency, and possible drinking water contamination and eutrophication of affected waterways. Nitrogen fertilizer is often over applied because standard soil tests do not include a well-calibrated soil-test for N. This is partly because it is challenging to account for the N soil microorganisms will mineralize during the growing season. Quantification of potentially mineralizable soil nitrogen by multiweek incubations is time consuming and often not possible for large scale commercial labs. CO2 base trap titrations and analysis with gas chromatography are also tedious and not suitable for high volume use. The Solvita CO2 Burst test provides an alternative that only requires a 24-hour incubation period, with evolved CO2 directly correlated to the quantity of N mineralized. The objective of this project was to conduct incubation experiments on soils gathered from Alabama fields under a variety of management strategies (including high crop residue) and to compare N mineralization from that predicted via the initial Solvita test. Samples were collected from four crop rotation systems for initial testing, with soils sampled from the 0-15cm layer for: 1) conventional tillage corn with complete N-P-K fertilization, 2) no tillage turfgrass with minimal fertilization, 3) conservation tillage cotton with and complete N-P-K fertilization, and 3) conservation tillage cotton with rye cover and complete N-P-K fertilization. Initial analysis have not indicated a strong correlation between the three traditional measurement methods and the Solvita test data.

Abstract No. 107. *Restoring Three Mile Creek One Neighborhood at a Time*

Miller, C.

Mobile Bay National Estuary Program

In 2013, the Mobile Bay National Estuary Program (MBNEP) embarked upon a holistic, watershed-based approach to guide coastal ecosystem restoration and protection measures recommended through watershed management planning. The MBNEP's five-year Ecosystem Restoration and Protection strategy initiated this novel approach which prescribes development of watershed management plans (WMPs) to ensure that restoration projects are based in science and fit into an overall management program. A watershed approach is a shift from traditional land use planning, where geopolitical boundaries limit what can be done to address problems. Conversely, a WMP is concerned with areas, independent of political boundaries, that drain to common receiving waters.

In January 2014, the MBNEP released the completed WMP for the Three Mile Creek Watershed (TMC). The majority of TMC's 30-square mile watershed lies within Mobile city limits and includes portions of five City Council Districts, all three Mobile County Commission Districts, and portions of three Prichard City Council Districts. TMC is highly urbanized with over 90% of the land developed with greater than 37% impervious cover. Untreated stormwater runoff and pollutant loads from developed areas discharge directly into TMC and its tributaries. This discharge of untreated stormwater is primary among sources of surface water quality degradation and management measures recommended in the WMP, are currently being implemented by a host of partners to mitigate associated impacts.

The implementation of the Three Mile Creek WMP can be divided into three different overarching programs: Environmental restoration; expanding access to the water and open spaces along the creek through the creation of 10 miles of trail; and a comprehensive program of community engagement to ensure each program learns from and listens to affected residents, businesses, churches, schools and other entities to the greatest extent feasible to ensure projects undertaken meet the needs of the communities who live closest to the creek and its tributaries.

TMC is physically, spiritually, and historically ingrained into the fabric of the community and presents an extraordinary opportunity to the cities of Mobile and Prichard to transform a community liability into a community amenity and waterway destination. Improving water quality and maintaining healthy populations of fish and shellfish are at the base of ensuring what is most important to people living along the Gulf coast: access to natural areas; abundant fish and shellfish; protection of heritage; environmental health and resilience; and water that is fishable, drinkable, and swimmable.

Abstract No. 141. *Survivability of Mussels over the 13-Week Drawdown of Gantt Reservoir, Andalusia, AL and Factors Influencing Survival*

Miller, J., N. Quach, M. Patel & A. Guillaumet

Troy University

Dams require periodic maintenance, which sometimes entail reservoir drawdowns that impact local fauna. Gantt Reservoir near Andalusia, AL, underwent a planned 13-week drawdown for dam maintenance from September to December 2019. A previous but similar study of a 14-week drawdown in 2017 of Point A Reservoir, located immediately downstream, found multiple species of native mussels surviving at least 10 weeks. As part of USFWS/FERC requirements a recovery effort was implemented in both reservoirs to collect and relocate all federally and state listed mussels, including the largest known populations of the federally threatened *Fusconaia escambia*, during the initial phase of each drawdown. As part of this broader effort in Gantt Reservoir in 2019, we specifically sought to: (1) determine the amount of time mussels could survive the drawdown, (2) determine factors that influenced survival, and (3) compare our findings to results from the previous survivability study conducted during the drawdown of Point A Reservoir in 2017. We focused on the most common species, *Elliptio pullata*, as a proxy for species of conservation concern. In the study area, there were three zones differing in depths, from which eight 50 x 50 cm quadrats each of exposed lakebed were excavated weekly and sieved (for a total of N = 228 samples) in the representative study area (150 meters of shoreline). For each quadrat, we estimated depth at full pool based on bank indicators, measured substrate temperature and moisture, and noted natural and artificial cover availability as well as substrate type (e.g., sand or clay). Live and fresh dead mussels obtained from quadrats were identified to species, their shell lengths were measured, and their location in the substrate (exposed or burrowed) was recorded. A total of 875 *Elliptio pullata* was found over the duration of the study. Survival declined from approximately 80% live mussels during the first week to 10% at the end of the 13-week drawdown. Factors that positively influenced survival included soil moisture, shell size (average and slightly less-than-average individuals were more likely to survive), mussel position in the substrate (burrowed mussels were more likely to survive as compared to exposed individuals), and the presence of natural and artificial cover. Available cover in some instances probably helped reduce exposure to harsh drawdown conditions, similar to individuals found burrowed. Together with our 2017 findings from Point A Reservoir, our study shows that a fraction of individuals of multiple native mussel species are capable of surviving at least 10 weeks of emersion. The present study also provides insight into the environmental conditions that enhance mussel survival (such as cover during emersion events), and can aid in decision making associated with drawdowns and/or drought conditions that may worsen in response to climate change.

Abstract No. 120. *ADEM Water Quality - Siltation Research*

Mooney, J.

Alabama Department of Environmental Management

Sediment is a natural component of waterbodies. However, excessive levels of sediment and siltation in a waterbody can cause significant changes to the stream morphology and also lead to detrimental effects on the native aquatic flora and fauna. Therefore, the Department has embarked on an innovative siltation research project that will ultimately lead to a better understanding of the natural and acceptable levels of sediment present in the State's waterbodies. In doing so, the Department will be able to develop a practical and scientifically defensible approach that can be utilized for both the assessment of waterbodies and also the development of TMDLs for siltation impaired waterbodies.

The objective of the presentation is to provide an overview of the Department's efforts and to illustrate the progress made so far. The Department has employed several innovative techniques for continuously monitoring waterbodies for siltation/turbidity and also taking advantage of the available advances in technology to make significant strides in how water quality data is collected and transmitted for analysis.

Abstract No. 127. *Putting Socio-economic Vulnerabilities and Risks into Perspective: Dealing with Hurricane-Induced Extremes*

Moradkhani, H.

The University of Alabama

Extreme events impose significant global-scale socio-economic vulnerability and risk that are likely to increase in the future under climate change and human development. In particular, flood is one of the most catastrophic natural disasters in the United States, particularly in the Southeast states where hurricanes and tropical storms are most prevalent, causing billions of dollars in damage annually and significant losses of life and property. The massive impacts provoked by these extremes are clear motivation for improved understanding of the key drivers that characterize such events. In addition, building resilience to hurricane-induced floods or flash floods requires understanding of the socio-economic characteristics of the societies and their vulnerability to extreme events.

This presentation discusses the notion of hydrometeorological predictability, approaches for more reliable communication of hurricane risk and how to benefit from the linkage of in-situ and satellite data revolution, assimilation, machine learning, and Earth system modeling to better predict the hurricane-induced flooding. Also, I show how the confluence of socioeconomic vulnerability and flash flood hazard can be used to identify the hotspots for better planning and disaster management.

Abstract No. 123. *Is tidal marsh construction an effective restoration strategy to recover nitrogen removal capacity?*

Mortazavi, B. [1], C. Tatariw [1], T. Ledford [1], S. Starr [2] & J. Cherry [1]

[1] The University of Alabama; [2] Florida State University

Long-term trends indicate loss of marshes at rates nearly 4 times higher in the 20th and 21th century than previously. Since 1984 saltmarshes in Alabama have been disappearing at a rate of 1106 m-2/yr; equivalent to 1% loss of marsh area per year. The disappearance of coastal marshes has been attributed to sea level rise, urbanization, and other anthropogenic impacts such as damming of the rivers and oil spills. Coastal marshes are especially important in mitigating anthropogenic nutrient inputs and marine eutrophication by removing or sequestering nitrogen before it reaches marine waters. Restoration efforts are being promoted worldwide to mitigate the loss of ecosystem functions resulting from loss of marsh. We conducted a year-long field study comparing nitrogen removal through denitrification and retention by dissimilatory nitrate reduction to ammonium (DNRA) in one 2,200-year-old natural marsh (NAT) and two 33-year old constructed marshes on the Fowl River in Mobile County, AL. We found that rates of denitrification and DNRA in surficial sediments were similar across marshes, with the exception of greater rates of denitrification at CON-2 than at the other two sites. However, when these process rates were measured at 5 cm increments to a depth of 25 cm to assess how plant rooting depth and organic matter accumulation impact N-cycling, in both constructed and natural marshes denitrification and DNRA declined with depth. In both systems, N-retention by DNRA accounted for upwards of 75% of nitrate reduction capacity. The lack of response in DNRA to labile carbon additions in the CON2 suggested that the microbial functional community, not substrate limitation, limited recovery in function. The recovery in N cycling processes in surficial soils suggests that biogeochemical functions can be restored within decades and N-cycling capacity will increase following the continued development of belowground plant biomass in constructed marshes.

Abstract No. 008. *Application of Hydrodynamic Modeling and Flood Planning in Resilience Assessment of Urban Coastal Regions*

Nazari, R.

The University of Alabama at Birmingham

Coastal and inland flooding has been a problematic occurrence, specifically over the past century. Global warming has caused an 8-inch sea level rise since 1990, which made the coastal flood zone wider, deeper, and more damaging. Additionally, riverine flooding is extremely damaging to the coastal communities' substructure and the economy as well which causes river banks to overflow, inundating low-lying areas. Low-lying coastal areas at severe risk for flood hazard, sea-level rise, land depletion, economic loss, property damage, destroy habitat destruction and also threaten human health and safety which are the main study area of this work. A decision-making framework is being built to help mitigate the impacts of the environmental and economical dangers of storm surges, sea-level rise, flash floods, and inland flooding. With vigorous research and the use of innovative hydrologic modeling, this tool can be utilized to help with resiliency planning for coastal communities. This will allow the individuals living in a coastal community to understand the details of climatic hazards in their area and risks associated with their communities. This tool also suggests the best solution for the problem each community faces. The results and benefits from the simulation and modeling techniques, allow coastal communities to choose the most appropriate method for building a long-lasting and sustainable resilience plan in the future.

Abstract No. 002. *A "B.A.D." Presentation – Another Way to Look at Erosion Control on a Construction Site*

Oakes, P.

Alabama Soil and Water Conservation Committee

Unfortunately, effective erosion control is often overlooked on a lot of construction sites; however, effective erosion control that eliminates interrill erosion is the most effective process that can be accomplished to minimize erosion and thereby minimize sediment to be captured. This presentation discusses the importance of controlling interrill erosion and a method to see how well visually and numerically a construction site is doing to control erosion.

Abstract No. 125. *Hydropower's Value in a Wind and Solar World*

Odom, K.

Alabama Power

As the U.S. moves toward a net-zero-emissions future by installing more wind, solar and other renewables, the value of hydropower is becoming more evident. Wind and solar are at the top of the list when it comes to new renewable installations in the U.S., but total reliance on these electrical resources can be problematic because of the unpredictability of their fuel sources. Renewables need a stabilizing force to balance load demand with the unpredictability of their fuel. Hydropower provides this stability and more.

Hydropower, both conventional and pump storage, is seeing a bit of a renaissance with the increasing number of renewables. As of last year, Alabama ranked fifth in the nation in terms of hydropower generation. There are over 20 hydropower facilities in Alabama owned by Alabama Power, the U.S. Army Corps of Engineers, Tennessee Valley Authority, and PowerSouth. This presentation will focus on how hydropower fills a new need in a world of wind and solar power generation. We will look at hydropower in Alabama and discuss how it increases the reliability of the electrical grid by providing such ancillary services as inertial and primary frequency response, reactive power support, and black start capability.

Abstract No. 089. *A decision-support tool for cost-optimal design of stormwater green infrastructure practices*

O'Donnell, F., R. Ellis, D. Biessan, J. Vasconcelos & B. Bowers

Auburn University

Urban development projects typically increase the stormwater runoff of a site by increasing the amount of impervious area, which can also negatively impact the quality of the water leaving a site. Often, storage-based management practices such as detention basins are used to store runoff while it is slowly released from a site. Green infrastructure practices (GIP) make stormwater management more cost-effective and sustainable by reducing construction and operation costs associated with required detention storage, reducing environmental impacts of new construction, and improving the aesthetics of a project. A common barrier to sustainable stormwater management is uncertainty in determining the cost and selecting from the wide range of GIPs available to designers. Our goal was to address this issue by developing a user-friendly spreadsheet tool that helps urban planners, designers, and engineers achieve sustainable stormwater management through cost optimization of GIPs used in combination with detention basins. The user can select from a range of GIPs currently available in the tool: grass channel, sheet flow, downspout disconnection, green roof, infiltration trench, bioretention, and permeable pavement. Cost estimates are provided for each based on the site design. A more detailed cost optimization algorithm is included for permeable pavements due to the large number of design options and parameters for this practice and its popularity in Alabama. Sizing and design of GIPs in the tool is based on guidance provided by Alabama municipalities, primarily Birmingham and Auburn, and the Alabama Low Impact Development Handbook. The Excel tool executes hydrologic calculations in the EPA Storm Water Management Model (SWMM) from user inputs and determines a required detention storage that accounts for the use of GIPs. The results of these calculations can be exported to the General Algebraic Modeling System (GAMS) to develop a cost-optimized detention basin design. Through iterative applications of the tool, the user can quickly and easily compare the cost of GIP design options and assess the tradeoff in cost and performance between GI and detention storage. A preliminary version of the tool has been developed. By presenting at the Alabama Water Resources Conference we hope to identify stormwater management practitioners who would be interested in testing the tool in an applied setting.

Abstract No. 143. *Variable Rate Irrigation: An environmentally sound irrigation water management strategy*

Ortiz, B. [1], L. Bondesan [1], F. Morlin [1], G. Morata [2] & L. Duzy [3]

[1] Auburn University; [2] Alabama Cooperative Extension System; [3] Compliance Services

The high degree of summer rainfall variability along with short periods of drought in the Southeast US is influencing the increase in irrigated row-crop acreage. Adoption of water conserving irrigation practices could potentially reduce water and energy use and increase profitability, as well as protect the environment.

Precision irrigation consisting of soil sensors (SS) for irrigation scheduling and variable rate irrigation (VRI) was compared with conventional uniform irrigation (URI). The study was conducted in South Alabama during the 2018 and 2019 corn-growing seasons. The SS-VRI and URI treatments spanned the length of the field and were compared across five different management zones (MZ) that exhibited soil and terrain differences. Soil-water tension sensors were installed on each zone-treatment area to hourly monitor soil water changes.

Data of each irrigation application by treatment and yield were used to evaluate yield and irrigation water use efficiency (IWUE) treatment differences by zone and year. On the two zones covering 55% of the study field, MZ 1 and MZ 2, the SS-VRI treatment, on a two-year average, resulted in 26% less irrigation water applied compared to the URI treatment; however, there were no statistical difference between yields or yield variability among treatments. Even though in MZ 4, there was not a substantial difference in irrigation water applied among treatments, soil sensors increased the precision of irrigation rate determination during the peak of high crop water demand. The differences in rainfall amount and distribution changed among the study years, the soil sensor-based irrigation scheduling showed its potential to prevent over- or under irrigation across the different field zones. With proper management, the combination of soil sensors and VRI provides farmers with the opportunity to reduce water use, while relative to the benefits.

Abstract No. 083. *Assessment of drought impacts on the uppermost aquifer across Alabama: utilizing groundwater elevation data from ADEM LUST sites.*

Osborne, T. & A. Arnold

Geological Survey of Alabama

In its ongoing efforts to better understand the impacts of drought to aquifers across the state, the Geological Survey of Alabama (GSA) assessed groundwater elevation data from Leaking Underground Storage Tank (LUST) sites administered by the Alabama Department of Environmental Management (ADEM). The GSA believes this data can be an invaluable addition to its current real-time and periodic groundwater monitoring network. GSA staff evaluated groundwater elevation data maintained by ADEM on selected LUST incident sites. As of March 2020 at least 12,220 LUST sites have been identified across the state of Alabama. Currently 925 of these sites are under investigation or remediation. These investigative actions involve the drilling of soil borings and construction of groundwater monitor wells for the purpose of collecting soil and groundwater samples to be tested for the presence of petroleum hydrocarbons. These monitoring wells are screened across the water table of the surficial aquifer, termed the 'uppermost saturated zone' by ADEM. Those sites in known susceptible drought monitoring regions of the state with a long history of groundwater monitoring activity were prioritized as they cover a longer time period of groundwater elevation data collection. Precipitation data from nearby rain gauges were compared to groundwater elevation fluctuations at the LUST sites. Both precipitation and groundwater data show profound impacts from the periods of documented drought in Alabama over the past 30 years. In addition, rain gauge data near the LUST sites also show increasing rainfall amounts over time notwithstanding the periods of drought. The GSA believes that adding specific wells, with cooperation from ADEM, to the GSA real-time monitoring network from these LUST sites across Alabama will provide important data in understanding the impact of drought to the uppermost aquifers across the state.

Abstract No. 074. *Evaluation of porous pavements hydrological behavior on Alabama soils*

Pachaly, R., F. O'Donnell, J. Vasconcelos, B. Bowers & D. Biessan

Auburn University

The implementation of Low Impact Development (LID) techniques has been a common way to mitigate the effects of urbanization in the hydrological cycle, increasing the sustainability of stormwater management by reducing the runoff quantity and improving the water quality. Porous pavements are a popular LID practice across the southeast, especially in Alabama. The recommendations and requirements on how to design such structures are overly conservative, increasing significantly its construction cost. Some cities recommend that the porous pavement should be treated as a surface with curve numbers (CN) in the order of 85. However, studies show that the CN of most porous pavements is substantially lower and that the CN number may change over time due to aging. Also, in many cases the hydraulic conductivity of the underlying soil is much lower than the conductivity of the porous pavement and modeling the porous pavement as a detention storage can be more representative. Hence, it is very important to evaluate the most appropriate CN number for porous pavements, considering its soil type, soil infiltration capacity, land use, antecedent condition, and aging. The following study developed a model for the hydrological behavior of porous pavement systems under the climate and soil conditions prevalent in Alabama, accounting for their type, design features, and underlying soil characteristics. Long-term model simulations over a range of soil and design characteristics are used to determine the most accurate calculation method for the hydrologic behavior of porous pavements. Preliminary results in a porous pavement located in the Lee County have shown that the CN approach can represent the hydrological processes occurring in a porous pavement when lower values of CN are selected. Rainfall, runoff, and water level data were collected for calibration purposes. Once the CN for the porous pavement is established based on the observed data, the obtained results will be incorporated in a decision support tool based on cost optimization. This tool will provide a systematic method for stormwater planners to consider the large number of LID options and arrive at a design solution that provides sustainable stormwater management at the lowest cost possible.

Abstract No. 135. *Assessing the Geographic Representativeness of Irrigation Adoption Studies*

Pathak, R. & N. Magliocca

The University of Alabama

Nations around the world have been promoting irrigation expansion as a method for improving agricultural growth, smoothing production risk, and alleviating rural poverty for decades now. However, transitioning from rain-fed to irrigated agriculture is a complex process. This is because adoption of irrigation is the result of a multi-faceted decision-making process with several factors, acting on different levels, influencing that decision. This unevenness in irrigation adoption has highlighted the need to deepen our understanding of the several complex interacting factors that shape technology adoption decisions within the agricultural sector.

Globally, several attempts, from different disciplinary backgrounds, have been made to comprehend the challenges associated with irrigation adoption, specifically towards identifying the factors affecting a farmer's decision-making. One would think that this decision-making process would be context or place specific. However, studies on irrigation adoption everywhere highlight more or less the same set of factors. So, to be able to make generalizable inferences from these studies, it is important to first gain an understanding of the global extent of this issue, that is, where such studies are being conducted and how representative they are of these irrigation patterns. This can be achieved through a global representativeness analysis, which allows one to synthesize results from a collection of case studies in order to make claims about its global patterns, based on a set of global variables selected by the researcher.

Using this analytical approach, this exploratory research attempts to assess the geographic representativeness of irrigation adoption studies to arrive at a geographically well-representative sample of case studies. Further analysis would include examining the differences in challenges associated with irrigation adoption in high vs low irrigated regions of the world. Since, the factors affecting its adoption will vary across nations and/or within high or low irrigated regions, it is critical to identify and understand the global patterns of such climate change adaptations and accordingly, formulate a broad framework behind its decision-making process.

The results from this study can also provide deep insights for future research related to irrigation adoption within the state of Alabama, which has a large adaptation deficit, as compared to its neighboring states. Given its tremendous diversity of agroecological regions, surface and groundwater hydrological systems, and socio-economic conditions, irrigation expansion has achieved limited traction within the state. Thus, suggesting the need for developing a more holistic understanding of the different facilitating and/or constraining factors influencing irrigation adoption that can come from either the farm-level or broader social, economic, or institutional contexts.

Abstract No. 021. *Monitoring karst aquifers for the protection of Alabama Cave Shrimp and Tuscumbia Darter habitats in north Alabama, USA*

Ponta, G. [1], S. McGregor [1], R. Bearden [1] & C. Easterwood [2]

[1] Geological Survey of Alabama; [2] U.S. Army Garrison - Redstone Environmental Management Division

Cave ecosystems in north Alabama provide vital habitat for numerous species of conservation concern, including the federally endangered Alabama Cave Shrimp (*Palaemonias alabamae*) and the State of Alabama High Conservation Priority Tuscumbia Darter (*Etheostoma tuscumbia*), among others.

The Alabama Cave Shrimp population and water quality in Bobcat Cave and water quality in Matthews Cave have been monitored almost continuously since 1990 on Redstone Arsenal (RSA), a U.S. Army facility in Madison County, Alabama. The Tuscumbia Darter is a fish species known within the boundary of RSA at several springs, including Jaya Spring, which has been monitored since December 2019. Water level, specific conductance, and temperature data have been collected using data loggers on an hourly/daily schedule to evaluate and document daily and seasonal flow variability.

Water-quality sampling in 2020 indicates continued steady conditions in Bobcat Cave with little significant variation in dissolved solids, pH, and nutrient conditions compared to previous years; while water quality in Matthews Cave continues to show the effects of urban contaminant runoff (Matthews Cave is located next to/under I-565, while Bobcat Cave is about 1.7 miles south of I-565), with concentrations of chloride, sulfate, and nitrate elevated over Bobcat Cave. These populations will likely be affected by ongoing and future developments on and off RSA in the caves/spring complex watersheds.

Abstract No. 133. *Multi-Level Influences of Center-Pivot Irrigation Adoption in Alabama*

Price, A. [1], R. Pathak [1], G. Guthrie [2], C. Handyside [3] & N. Magliocca [1]

[1] The University of Alabama; [2] Geological Survey of Alabama; [3] Earth System Science Center, University of Alabama in Huntsville

Agricultural communities in Alabama are experiencing some of the nation's highest, and most rapidly increasing, rates of poverty and economic inequality. As agriculture plays a significant role in the statewide economy, one way to address this widespread disadvantage is with drastic increases in farm productivity. The transition from rain-fed to irrigation-fed (RF-to-IF) agricultural practices has been shown to significantly increase crop productivity and farm profitability elsewhere in the United States. Despite this potential to encourage stability and resilience in rural economies, irrigated cropland accounts for only 5% of the state's total cropland as numerous barriers remain to irrigation adoption in Alabama. Despite ample annual rainfall, periodic seasonal droughts can create water restrictions, riparian rights laws prevent access to surface water for most farms, and the initial investment and maintenance costs for irrigation equipment vary widely throughout the state. A more holistic approach to improving irrigation policy and practice requires identifying challenges faced by individual farms and communities.

Adoption of irrigation is the result of a farm-level decision with several factors influencing that decision. However, most studies only address individual-level factors related to the farmer's characteristics and attitudes that cannot be reliably extrapolated to a large area of study, such as state, which is generally the level at which a policy is made. Alternatively, studies that use agricultural census data provide measures of farm-level variables relevant to irrigation decisions but are aggregated to county or census block levels, which makes it difficult to connect any given farm and farmer's specific attributes and decision-making contexts to irrigation adoption outcomes.

In this regard, this research presents a multi-level mixed effects survival analysis to identify the physiographic, socioecological, and economic factors that influence farmers' receptiveness to the RF-to-IF transition. We use individual farms as the unit of analysis and integrate spatiotemporal cropland and climatological data with field-verified locations of center-pivot irrigation systems, local socioeconomic characteristics, and parcel-level data regarding surface water access, soil quality, and average well depth. The results identify the degree to which specific factors influence the timing and location of irrigation adoption by Alabama agricultural region and highlight the incentives needed to spur the RF-to-IF transition in Alabama.

Abstract No. 082. *Hydrogeological Investigation into the Physical Mechanisms of a spring-fed River System, Magnolia River, Alabama*

Puckett, M. [1], G. Guthrie [1] & G. Tick [2]

[1] Geological Survey of Alabama; [2] The University of Alabama

The Magnolia River is a spring-fed river in the Weeks Bay watershed in southern Baldwin County, Alabama. The Citronelle Formation and overlying alluvial, coastal, and low terrace deposits underlie the Magnolia subwatershed. The Citronelle Formation ranges from middle Pliocene to pre-Nebraskan Pleistocene age, and consists of non-fossiliferous reddish-brown, fine to coarse sand; orange, brown, and light-gray sandy clay; and nonmarine origin clayey gravel. In many areas, lenses with a thickness ranging from 5 to 15 ft of clayey sand and sandy clay are interbedded with gravelly sand. Strata in the formation are not continuous, often demonstrating abrupt vertical and horizontal changes over short distances. The overlying alluvial, coastal, and low terrace deposits comprise up to 200 ft of Quaternary age, gray, white and orange very fine to coarse quartz sand that locally contains orange and gray clay lenses and gravel. These strata form two major aquifers: the watercourse and the Miocene-Pliocene aquifer system. The watercourse aquifer is derived from the alluvial, coastal, and terrace deposits, is unconfined, and is hydraulically connected to the underlying Miocene-Pliocene system. The Miocene-Pliocene aquifer system consists of three distinct water-bearing units derived from the Citronelle Formation. Water-bearing intervals are semi-confined due to non-laterally extensive clay intervals.

Springs in the Magnolia River watershed provide a significant groundwater component to flow; however, they are not karst in origin like springs 20 miles to the southeast in Florida. Questions exist as to the source of the springs as there are no known structural features that could serve as preferential pathways for the springs, and there are no large differences in elevation that could cause major differences in hydraulic head. This study utilizes potentiometric surface mapping combined with radon and temperature mapping to delineate spring distributions in order to assist in the determination of the source of the springs.

Abstract No. 063. *Predicting Field-scale Daily Evapotranspiration Using Multi-Source Spaceborne Remote Sensing Imagery and Deep Learning*

Rashid, T. & D. Tian

Auburn University

Evapotranspiration (ET) plays a fundamental role in land surface processes and water management. In this study, we develop and evaluate a predictive ET framework using a long short-term memory (LSTM) deep learning architecture with spaceborne remote sensing imagery, gridded meteorological data, and ground-observed flux data from eddy covariance network. We estimate ET using Priestley-Taylor Jet Propulsion Laboratory algorithm (PT-JPL) with optical reflectance data (from the Harmonized Landsat Sentinel-2 dataset, HLS, and MODIS product) and land surface temperature (LST) data (from ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station, ECOSTRESS, and MODIS product). Three sets of input with eddy covariance observed ET from AmeriFlux network are used to train LSTM, including 1) PT-JPL ET estimates, 2) PT-JPL ET estimates and microwave backscatter data (from Sentinel-1 Synthetic-aperture radar, SAR), and 3) directly using optical reflectance data, LST data, and microwave backscatter data. Results from the three experiments show that LSTM consistently improved ET estimations compared with PT-JPL. Including microwave backscatter as a model input significantly enhanced performance, suggesting microwave backscatter is a complementary source of information for ET estimation. Through transfer learning, the LSTM-based models are able to improve ET estimations at locations without eddy covariance observations. The predictive ET framework presented here can improve ET estimations and have potential applications in water management across scales.

Abstract No. 073. *Evaluation of bacterial and mitochondrial DNA markers for microbial source tracking*

Ren, W. & Y. Feng

Auburn University

Fecal contamination of surface water is one of the primary sources of pathogens that adversely affect human health. Accurate identification of the origins of non-point source pollution could lead to effective pollution control strategies. Fecal contamination sources can be identified using quantitative polymerase chain reactions (qPCR) targeting host-associated genetic markers in fecal bacteria or host mitochondrial DNA. This study systematically evaluated the performance of bacterial and mtDNA markers associated with humans and cattle. Specific parameters evaluated were the marker sensitivity and specificity, the lower limits of detection (LLOD) and quantification (LLOQ) for qPCR assays, and genetic marker persistence in water. The bacterial markers used in the study were HF183 and CowM3 for humans and cattle, respectively, and mtDNA markers were HcytB and mtCow. All bacterial and mtDNA markers showed a high sensitivity of 100%, and the specificities of the HF183 and HcytB were 100% and 97.30%, respectively. The specificity of CowM3 (97.10%) was higher than that of mtCow (76.56%). The LLOD and LLOQ for human- and cattle-associated bacterial markers were lower than those of mtDNA. The persistence of these four markers was evaluated at different nutrients levels (eutrophication water vs. artificial freshwater) and with and without indigenous microbiota in microcosms. All markers decreased faster in the presence of indigenous microbiota, especially for the bacterial markers. The time to reach one log reduction (T90) for HF183 was one day shorter than that of HcytB (7.53 vs. 8.57 days). CowM3 reached T90 three days earlier than mtCow (3.15 vs. 7.26 days). In the artificial freshwater, the T90 for HF183 was 12.8 days, significantly longer than in the eutrophication water (T90 = 7.53 days); however, no significant nutrient effects were observed for HcytB, CowM3, and mtCow. Our results indicate that the environmental factors affected the persistence of different genetic markers to different extents. Although host-associated bacterial markers appear to be more sensitive and less persistent than mtDNA markers, it is prudent to use more than one genetic marker in microbial source tracking studies to increase the accuracy and reliability of the fecal sources identified.

Abstract No. 015. *Gulf Sturgeon Fall Spawning: Implications for Water Management in the Choctawhatchee River, Alabama*

Rider, S. [1], D. Fox[2], B. Kreiser [3], T. Powell [1] & G. Miles [1]

[1] Alabama Division of Wildlife and Freshwater Fisheries; [2] Delaware State University; [3] The University of Southern Mississippi

Gulf Sturgeon is one of the largest fishes occurring in Gulf Coast rivers from Louisiana to Florida. Populations were pushed to the brink of extinction in the late 19th and early 20th centuries due to unregulated commercial harvest and, the construction of dams and navigation locks that blocked spawning migrations. Accordingly, the species is listed as federally threatened under the Endangered Species Act and state protected by regulation. Although recovery is underway in some populations, risks still exist from more insidious factors including climate change and anthropogenic changes to hydrologic cycles. As one of the largest undammed rivers in the Gulf of Mexico, the Choctawhatchee River flows from its headwaters in south central Alabama approximately 280 km before discharging into Choctawhatchee Bay, Florida. There is ever increasing interest in higher water withdrawals and constructing impoundments for irrigation and recreational uses on this current free-flowing river, which is problematic since the Choctawhatchee River supports the second largest Gulf Sturgeon population. Spring spawning in Gulf Sturgeon has been documented, although anecdotal evidence suggests fall spawning may occur in some systems. During 2019, we employed a multifaceted approach to characterize Choctawhatchee River Gulf Sturgeon spawning characteristics using acoustic telemetry, targeted egg collections, and molecular approaches. Using these methods, we documented spawning over much longer temporal scales than previously recorded. We suggest revisions to in-stream flow requirements and/or limits on water withdrawals may be warranted as a means of ensuring recovery for this species.

Abstract No. 032. *Multi-scale Fish Diversity and Flow Variability among Streams and Beaver Ponds*

Sickler, S., C. Pettengill & J. Howeth

The University of Alabama

Identifying effects of instream flow on the biotic integrity and ecosystem function of freshwater systems is critical to sustain Alabama's natural resources in the presence of rapid human population growth and environmental change. Instream flow effects on habitat availability and water quality determine the suitability of the ecosystem to support particular species in space and time. Beavers (*Castor canadensis*), as ecosystem engineers, convert streams to ponds through the process of dam formation and may thereby alter instream flows, ecosystem stability, and the local environment. Beaver activity along stream networks yields a dam-formed pond, a below-dam downstream reach, and an undisturbed upstream reach. The impact of the resulting instream habitat heterogeneity and flows on local fish species diversity and the environment within and among habitat types remains unknown. Here, we test for effects of beaver activity on multi-scale fish species diversity, instream flows, and environmental variability within and among nine streams distributed across three watersheds in the Oakmulgee District of the Talladega National Forest in Alabama. We predict that differences in fish diversity and environmental variability among upstream, pond, and downstream reaches will be a function of ecosystem size and instream flow.

Abstract No. 112. *Alternative Approaches to Water Quality Restoration*

Sisk, L.

Jacobs Engineering Group

The U.S. Environmental Protection Agency (EPA) published "A Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program" in 2013. The vision provides a new framework for implementing the CWA 303(d) requirements and includes specific goal statements and a timeline to guide EPA, States and Tribes to achieve the goals of the Section 303(d) program.

The fourth goal statement addresses "Alternatives": "By 2018, States use alternative approaches, in addition to TMDLs, that incorporate adaptive management and are tailored to specific circumstances where such approaches are better suited to implement priority watershed or water actions that achieve the water quality goals of each state, including identifying and reducing nonpoint sources of pollution." These "Alternative Restoration Plans" are expected to offer more immediate water quality benefits and provide a more practical path to water quality restoration than the typical TMDL approach. The impaired waters remain on the list of waters awaiting TMDL development (Category 5) but are referred to as 5-Alt streams as the alternative restoration approach is implemented. Successful water quality restoration removes the waterbody from the impaired waters list without the need for a formal TMDL.

Case studies examining the use of alternatives to TMDLs will be presented and examples of potential candidate watersheds for alternative restoration plans will be discussed.

Abstract No. 060. *Effect of climate change on rainfall erosivity in Southeastern, United States*

Srivastava, P. [1], J. Lamba [2], R. McGehee [3], H. Kumar [2] & D. Tian [2]

[1] University of Maryland; [2] Auburn University; [3] Purdue University

Climate change is expected to change erosion rates as the erosive power of rainfall will most likely change due to changes in rainfall characteristics (e.g., intensity, duration, frequency, and subsequently energy). According to the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4), it is projected that by mid-21st Century the rainfall across the southeastern US will both increase and decrease in intensity. Since erosivity is greatly affected by rainfall intensity, it is expected that rainfall erosivity will be greatly altered as well. Few studies have estimated the impact of future climate changes (e.g., rainfall intensity) on rainfall erosivity across the US or around the world. Furthermore, previously published erosion indices (based on historic data) have discrepancies due to the differences in methodologies (primarily due to omission of small and low rainfall intensity) adopted by those studies. Therefore, the objective of this study was to estimate changes in erosion indices for the period 2030-2059 using the benchmark rainfall indices established for the southeastern US by a recent study. Hourly precipitation data from 2030-2059 were retrieved for two climate models from the North-American Coordinated Regional Downscaling Experiment (NA-CORDEX)) datasets under the Representative Concentration Pathway (RCP) 8.5. The data was then temporally downscaled and bias-corrected using the quantile-based mapping method. The temporally downscaled and bias-corrected rainfall intensity data were then used to calculate future erosivity and compared to the recently established erosivity benchmark to estimate expected changes in rainfall erosivity in the future. The presentation will provide the results on changes in erosion indices as a result of future climate changes.

Abstract No. 121. *Tree-Ring Reconstructions of the ACF River System to Inform Alabama Water Policy*

Therrell, M., J. Corbin, G. Tootle, E. Elliott & B. Bearden

The University of Alabama

Increasing community resilience to the hazards posed by streamflow variability requires understanding the full range of long-term natural variability as well as the frequency and magnitude of extreme hydrologic events (e.g., drought) in relevant river systems such as the ACF. We have developed annually resolved tree-ring reconstructions of warm-season (March-October streamflow for the ACF and select tributaries, for the past 500-1,000 years. These reconstructions explain ~50% or more of the instrumental streamflow variance at multiple unimpaired gages. Our reconstructions demonstrate that recent multi-year average flows (~2000 to present) were among the lowest in the ~1,000-year record and although consumptive withdrawals may exacerbate low flow conditions, observed regional precipitation and streamflow from unimpaired gages display substantially similar decadal declines. Given the current lack of a comprehensive water policy in Alabama was well as the ongoing litigation over ACF interstate water resources, it is imperative that the paleo record be used to inform water policy and management plans in Alabama.

Abstract No. 115. *Watershed Scale Assessment, Analysis, and Prioritization: A GIS Approach to Whole System Modeling*

Throneberry, J., A. Reynolds & G. Pearson

The Nature Conservancy of Alabama

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 40 conservation and restoration projects. This approach has been a case study in successful assessment, prioritization, and implementation of restoration activities in our focal watersheds.

The Nature Conservancy 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.

To prioritize conservation, protection, and restoration needs, TNC utilizes the stream assessment method known as the Bank Erosion Hazard Index (BEHI). We have automated and standardized this methodology through a custom-built ArcGIS Pro model. The model allows us to reduce analytical error and time spent on processing data after it has been collected in the field. This new modeling tool allows us to more efficiently identify the highest priority restoration areas within a watershed and target priority landowners to establish working relationships and implement conservation practices. Working with limited funds, this tool will help us focus our efforts in the most critical restoration areas of these watersheds.

Abstract No. 045. *Paleo-records of sea level, floods, and storms in the Mobile Bay and Weeks Bay estuaries: Implications for future change in Alabama*

Totten Minzoni [1], R., A. Lehrmann [1], D. Wallace [2], E. Elliott [1] & S. Monica [2]

[1] The University of Alabama; [2] University of Southern Mississippi

The Mobile Bay system began to flood during post-glacial sea-level rise during the Early Holocene, culminating in formation of the estuary during an extreme sea-level event 8.2 ka. The rate of sea-level rise today is ~3.2 mm/yr, which is similar magnitude to the rate when Mobile Bay formed. It is critical to understand the environmental and ecological changes associated with past extreme sea-level rise events so that we may better prepare for future change in these economically important estuaries and their coastlines. Associated with climatic changes is changing storm and flood frequency, which is not well constrained in the Southeastern US. We aim to address these knowledge gaps with new sediment records from the Alabama coastal system.

We collected piston cores from central bay settings of the linked Mobile-Weeks bay system, outside sandy delta lobes yet within range of suspended sand transport during large storms. Grain size and handheld X-Ray Fluorescence were measured continuously to develop long-term frequency of floods of the Mobile-Tensaw and Fish rivers, as well as frequency of land-falling marine storms. Stable carbon and nitrogen isotopes were analyzed to evaluate changes in nutrient source. Foraminifera and diatom plankton assemblages were analyzed to evaluate salinity, hypoxia, and nutrient conditions.

Here we present a flood record from Weeks Bay and a mixed flood and storm record from northern Mobile Bay. The comparison yields important information about changing flood frequency during the Holocene, with more frequent storms in the last 2,000 years than in the preceding 3,000 years. Moreover, storm and flood frequency are both characterized by relatively quiescent periods from 900 to 500 years ago and 1,800 to 1,500 years ago, which may be associated with important transitions during the Subatlantic Climate Period, including the Medieval Climate Anomaly and the Little Ice Age.

Abstract No. 070. *A State-Wide Survey of the Spatial Distribution of Perfluoroalkyl Substances (PFAS) in Alabama*

Viticoski, R., V. Mulabagal, S. Rogers, D. Blersch & J. Hayworth

Auburn University

Per- and polyfluoroalkyl substances (PFAS) are a large group of synthetic chemicals used in many industrial applications and consumer products due to their stain-, oil-, water-, and fire-resistance properties. Recently, PFAS have received increased attention because of their ubiquity in the environment and adverse health effects in humans and wildlife. PFAS have been previously identified in several areas in Alabama, but the extent of contamination in the state is still unknown. This study aimed to determine the spatial distribution and transport characteristics of 17 PFAS across ten river basins in Alabama.

Seventy-four surface water samples were collected in the summer of 2020 in the major river systems of Alabama. The 2 L samples were transported to the laboratory, processed, and analyzed for targeted PFAS using an ultrahigh-performance liquid chromatography tandem mass spectrometer (UHPLC-MS/MS). At least one PFAS was detected in 88% of samples, with sum of PFAS (∑PFAS) levels reaching up to 237.3 ng L-1. Short-chain PFAS accounted for 76% of the PFAS in the samples, likely a reflection of the phase-out of many longer-chain PFAS. The highest ∑PFAS levels were found in the Coosa and Alabama rivers, while PFAS were not detected at measurable levels in the Escatawpa, Conecuh, and Yellow Rivers.

Selected tributaries to Mobile Bay were also sampled, and ∑PFAS levels were substantially higher in the western tributaries, possibly related to the high industrial activity in that area. A mass flux analysis was conducted to better understand the transport of PFAS in Alabama's major river systems. Mass flux was calculated by multiplying ∑PFAS levels at a given location by the 48-h average volumetric discharge rate.

A consistent increase in the mass flux of PFAS was observed as rivers moved downstream through Alabama, indicating the presence of local sources within catchments and river basins. Results from this study suggest a widespread occurrence of PFAS in Alabama and are expected to aid governmental agencies in addressing PFAS contamination in Alabama.

Abstract No. 029. *Can water governance reform avert a global water crisis?*

Wallace Pitts, M.

The University of Alabama

Water – a human right but increasingly threatened globally - faces many challenges. Temporal and spatial variability and uncertainty, quantity and quality deficits, rapidly increasing climate variability and extremes, equity, diplomacy, security, and legal concerns all contribute to a vulnerable and unsustainable resource.

Global leaders in water (OECD, GWP, UNDP, WIN and others) believe that inadequate water governance lies at the heart of the global water crisis. Experts agree that change is needed but a general model for reform has not been proposed.

Using global, national, and local case studies, this paper traces the evolution of water governance and the resulting deficiencies. Proposals for reform including adaptive environmental governance models and place-based collaborative approaches are presented.

Abstract No. 033. *Ancient Algal Blooms: Did ancient societies like the Maya experience water quality degradation similar to today?*

Waters, M. [1], M. Brenner [2] & J. Curtis [2]

[1] Auburn University; [2] University of Florida

Climate change and terrestrial environmental impacts from erosion and deforestation are known stressors to ancient Maya societies. Whereas the scarcity of water has been noted from previous studies, much less is known concerning degradation in water quality. Harmful algal blooms, toxic cyanobacteria, and anoxia are frequent occurrences in modern societies where dense populations or extensive land use are adjacent to aquatic ecosystems. Here, we measured biomarkers for cyanobacteria and the cyanotoxin, microcystin, on a sediment core collected from Lake Amatitlán, Guatemala, which is currently in a toxic and hypereutrophic state.

Paleolimnological evidence shows that historic periods of harmful algal blooms and cyanotoxin production coincided with Maya occupation during multiple time periods. The most intense periods of paleo-cyanotoxin production coincide with alterations to the water system of the Maya city of Kaminal Juyu while cyanobacteria maximum abundance coincided with heightened development of the rural Valley of Guatemala. These periods of hypereutrophication and toxin production rival the modern hypereutrophic state in both magnitude and toxicity.

While water quality degradation is not considered to be a primary stressor to ancient Maya societies, the conditions of Lake Amatitlán during historic occupation could have impacted water potability as well as toxin transfer to crops and food sources associated with the lake. These historic hypereutrophic episodes demonstrate that cultural eutrophication is not a modern phenomenon and should be considered when reconstructing ancient societal stress.

Abstract No. 056. *Variations of Nutrient Deposition and Transport between Agricultural and Urban Watersheds through Time*

Webster, B. [1], M. Waters [1] & S. Golladay [2]

[1] Auburn University; [2] Jones Center at Ichauway

Reservoirs are a growing interest both nationally and globally because of their importance as a water supply to their surrounding communities. This water demand is often exacerbated by the fact that reservoirs service growing transboundary communities. Such is the case for the local ACF (Apalachicola-Chattahoochee-Flint) watershed between Alabama, Georgia, and Florida. As important as water supply is, we cannot lose sight of water quality, which can be degraded by continued stressors from anthropogenic nutrient loading. Phosphorus, possibly the most impactful freshwater nutrient, is often considered to enter streams and reservoirs from either point sources (wastewater treatment facilities or other industries) or nonpoint sources (direct landscape runoff like agricultural areas). Over the past century, watershed land use has developed larger areas of both urban and agricultural spaces. These changes to landscape in watersheds have been known to have major impacts on freshwater resources. However, there is a knowledge gap of how urban and agricultural dominated watersheds impact reservoir water supply differently. To investigate this gap, we utilized paleolimnological techniques using sediment cores, allowing us to qualitatively identify shifts in nutrient deposition through time. We collected seven total sediment cores from the reservoirs within both the Chattahoochee and Flint watershed, to determine variations and potential mechanisms between these respectively urban and agricultural watersheds.

Abstract No. 026. *Sediment Risk Index: Crossing Structure and Landscape-Level Influence on Aquatic Organism Passage in Alabama*

West, D.

Geological Survey of Alabama - Ecosystems Investigation Program

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 No. 017. *Investigating Chloride Concentrations in a Coastal Aquifer of the Gulf of Mexico: Methods and Results in the Chicot Aquifer of Southwest Louisiana*

White, V.

United States Geological Survey

Saltwater is often present in the vicinity of fresh coastal groundwater sources. As pumping conditions change over time, increases in chloride concentrations may become a concern if saltwater moves inland. Groundwater becomes increasingly unusable as it exceeds various chloride concentration thresholds for public supply, industrial, and irrigation needs. Well point samples are a common means of gathering data to characterize chloride conditions of groundwater. Typically, these points are interpolated to form 2-dimensional, aerial, representations of groundwater quality. However, there are challenges to using this method to characterize chloride concentrations including changes in concentrations due to natural vertical flows of groundwater, induced vertical flows from water-use withdrawals, and density-driven groundwater movement. In addition, temporal trends in chloride concentrations can exhibit different characteristics in different parts of an aquifer system. In the Chicot aquifer of southwest Louisiana, these issues were addressed by utilizing a combination of extensive data mining to feed an integrated analysis using geostatistical interpolation, temporal trend analysis, and depth trend analysis to produce the most comprehensive assessment of the aquifer to date. These results will serve as an adjunct to interpretation of an airborne geophysical survey of this aquifer system to be completed in the next few years. Other derivative benefits include easy adaptation to other aquifers to serve as a standalone product or as input to the growing application of machine learning analysis methods.

Abstract No. 066. *Expanding Utilization and Comprehension of Coordinated Needs Management Strategy: Understanding Where Floodplain Mapping Scope Comes From*

Zanotti, J.

Wood Environment & Infrastructure Solutions, Inc

Coordinated Needs Management Strategy (CNMS) has become a primary tool for how FEMA organizes, stores, and analyzes flood hazard mapping needs information for communities. Understanding its components helps inform how FEMA uses it current validity standards to decide which streams need to be updated and which do not. Every 5 years that a flood study has been completed it must go through a validation process to deem whether it should remain valid or be slated for restudy. This database of valid and not valid stream lines helps FEMA create the scope of which streams in your community are to be studied within a given funded watershed project. This presentation will cover how CNMS is maintained and how streams go through a stringent validation processes that guide the validation process as well as how proper maintenance of CNMS is vital to getting the most value out of flood study projects.

Poster Presentations

POSTER SESSION & SOCIAL

THURSDAY | SEPT. 9 | 5:30 PM - 7:30 PM LOCATION: GRAND REEF

STUDENT POSTERS

2. **Phosphorus Loss in Runoff from Soils with Different Soil Test Phosphorus Ratings.** Anjan Bhatta, Auburn University

3. **Validating Straight Pipe Modeling in Rural Alabama.** Aaron Blackwell, The University of Alabama

4. **Investigation of Straight Pipes in Alabama and Throughout the U.S.** Jillian Maxcy-Brown, The University of Alabama

5. **Quantification of Soil Macropores in Hillslope Pastures Using X-ray Computed Tomography.** Suman Budhathoki, Auburn University

7. **Geographically Isolated Wetlands in the Southeastern United States Serve to Store and Process Nutrients from Agricultural Watersheds.** Chloe Eggert, Auburn University

8. **Towards an Evolutionary Data Assimilation System: The Value of Soil Moisture and Evapotranspiration in Drought Monitoring.** Keyhan Gavahi, The University of Alabama

9. **Center Pivot Irrigation in Alabama.** Sara Green, The University of Alabama in Huntsville

10. **Hydroclimatic Trends in the Mobile Bay Basin from 1979 to 2018.** Henrique Haas, Auburn University

11. **Geochemical Controls on DOM-Arsenic Complexes.** Caitlyn Herron, Auburn University

12. **Drought in the West: Embedded Water Demand Stationarity Compromises System Vulnerability Analysis.** Ryan Johnson, University of Utah

13. **Evaluating the Impact of Onsite Wastewater Treatment Systems on Watershed Contamination, Choccolocco Creek Watershed, Alabama.** Mallory Jordan, Auburn University

14. **Understanding the Distribution of Phosphorus Pools in Five Alabama Soil Regions.** Gagandeep Kaur, Auburn University

15. **Phosphorus Variability in Delineated Irrigation Management Zones in the Crop Field.** Hemendra Kumar, Auburn University

16. **Rising Concentrations of *E. coli* in Choccolocco Creek.** Eleanore Larson, Auburn University

17. **Reconstructing the Cultural Eutrophication of Banana Lake, Florida Using the Sediment Record.** Susan Iott, Auburn University

18. **A Comparison of Three Smart-Irrigation Methods for Future Use by Alabama Peanut Growers.** Pierce McClendon, Auburn University

19. **Evaluation of a Living Shoreline Technique on a Southeastern United States Reservoir.** Eric Muth, The University of Alabama at Birmingham

20. **Developing a Combined Climate Extremes-Resilience Index: A Case Study on the State of Alabama.** Anuska Narayanan, The University of Alabama

21. **Analysis of Community-Level Factors Contributing to Cholera Infection and Water Testing Access in the Northern Corridor of Haiti.** Lonege Ogisma, Auburn University

22. **Understanding Spatial Variation of Surface Sediments in Two Unique Reservoir Systems, Weiss Lake and Lay Lake, AL.** Tristan Orndorff, Auburn University

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23. **Dimensions of Surface Water and Groundwater Connectivity in a Coastal Plain Headwater Stream.** Delaney Peterson, The University of Alabama

24. **Effects of Gypsum-Amended Poultry Litter on Nutrient Release and Water Quality.** Anna Powell, Auburn University

25. **Estimating Curve Numbers Across the Southeastern United States.** William Rice, The University of Alabama in Huntsville

26. **Effectiveness and Implementation of Forestry Best Management Practices for Water Quality Protection in Alabama.** Arjun Rijal, Auburn University

27. **Sediment Basin Solutions through Large-Scale Testing at the AU-ESCTF.** Jaime Schussler, Auburn University

28. **Drivers of Tree Biodiversity in Alabama's Bottomland Hardwood Forests.** Matthew Shockey, The University of Alabama

29. **Stochastic Generation of 15-Minute Precipitation for Water Resource Modeling Under Climate Change Over Southeastern United States.** Takhellambam Bijoychandra Singh, Auburn University

30. **Preliminary Water Quality Analysis of the Middle Alabama Watershed Using SPARROW Modeling.** Rachel Suhs, The University of Alabama in Huntsville

WATER PROFESSIONAL POSTERS

31. **The State-of-the-Art Machine Learning for Crop Yield Prediction.** Peyman Abbaszadeh, The University of Alabama

32. **Development and Application of Microplastic Analysis in the Sediments of Lake Weiss, Alabama.** Kathryne Bowling, Auburn University

33. **Phosphorus Stratification and Environmental Implication for Soils with Repeated Poultry Litter Application.** Debolina Chakraborty, Auburn University

34. **Incidence of Pharmaceutical and Personal Care Product (PPCP) Contamination in Alabama Waters.** Mary Dixon, Alabama Cooperate Extension System

35. **Improving the Accuracy of Flood Inundation Models Using a Modified Boundary Conditioning Approach.** Keighobad Jafarzadegan, The University of Alabama

36. **Participatory Irrigation Extension program to Increasing Adoption of Best Irrigation Strategies.** Guilherme Morata, Alabama Cooperative Extension System.

37. **2D Geologic Cross Section Creation Using Arc Hydro Groundwater Subsurface Analyst.** Kelley Rich, Wood Environment & Infrastructure Solutions, Inc.

38. **Spatial Interpolation Methods in Groundwater Projects.** Kendall Rich, Wood Environment & Infrastructure Solutions, Inc.

39. **Cost-Effective and Sustainable Biochar Has the Ability to Sorb and Facilitate Degradation of PFAS in Water.** Dengjun Wang, Auburn University

CHECK THE BACK OF YOUR NAMETAG TO DETERMINE YOUR WAVE
PINK CIRCLE: 1ST WAVE FROM 5:30-6:30 PM
YELLOW CIRCLE: 2ND WAVE FROM 6:30-7:30 PM

Abstracts (Poster Presentations)
(Ordered as listed on Conference Agenda)

Poster No. PO02. *Phosphorus Loss in Runoff from Soils with Different Soil Test Phosphorus Ratings*

Bhatta, A.[1], R. Prasad[1], D. Chakraborty[1], D. Watts[2] & A. Torbert[1]

[1]Auburn University; [2]USDA-ARS National Soil Dynamics Lab

Phosphorus (P) application at rates greater than the crop requirement leads to build-up of soil P level in agricultural lands. Soils containing high P concentrations when transported via surface runoff during storm events can accelerate the tropic status of a waterbody and promote eutrophication. The objective of this study was to evaluate the differences in P loads in runoff water from soils having distinct soil test P ratings (STP) and determine the differences in P loads in immediate and subsequent rainfall occurring within 24 hours. Artificial rainfall simulations (70 mm h-1 for 30 min runoff duration) on runoff plots (1.52 m X 3.05 m size) were conducted at 4 sites (4 plot at each sites) on a hay field receiving swine effluent multiple times during the year. Among the 4 sites, 1 and 2 had “extremely high” (143 mg kg-1 and 236 mg kg-1 Mehlich 1 P for site 1 and 2, respectively) STP rating whereas site-3 had “high” (28 mg kg-1, Mehlich 1 P) and 4 had “very low” (5 mg kg-1, Mehlich 1 P) STP rating. The runoff samples were collected at five minutes interval for 30 minutes post runoff generation and analyzed for dissolved reactive P (DRP) and total P (TP). Flow-weighted mean concentration (FWMC) was calculated as the mass of nutrient loss (total load) in 30 minutes runoff duration divided by the total volume of runoff during that period. Phosphorus loadings in runoff for each site was determined by multiplying flow-weighted mean concentration and the total discharge. In the first rainfall simulation, the sites with “extremely high” and “high” STP ratings (i.e., sites 1, 2 and 3) had a DRP loading of 35 g ha-1, 258 g ha-1 and 65g ha-1, respectively. The minimal DRP loading (7 g ha-1) was found at site-4, which had “low” STP ratings. After the second rainfall simulation (performed 24-hour after the 1st simulation) the total DRP load were 35 g ha-1, 251 g ha-1, 57 g ha-1 and 15 g ha-1 for sites 1, 2, 3 and 4, respectively. The TP loads in first rainfall simulation were 57 g ha-1, 310 g ha-1, 79 g ha-1, and 28 g ha-1 whereas the TP loads in second rainfall simulation were 46 g ha-1, 416 g ha-1, 102 g ha-1 and 18 g ha-1 for the sites 1, 2, 3, and 4, respectively. The TP load increased after second rainfall simulation in sites 2 and 3 whereas there was slight decrease in TP loadings in site 1 and site 4. The findings suggested that the soils with higher STP levels are of greater environmental concern and best management practices to reduce P loadings should be implemented wisely.

Abstract No. PO03. *Validating Straight Pipe Modeling in Rural Alabama*

Blackwell, A. [1], A. Greer[2], S. Cohen[1] & M. Elliott[1]

[1]The University of Alabama; [2]Oregon Institute of Technology

Roughly one quarter of US residents lack access to a centralized sewer system, leaving them to rely on conventional onsite septic systems that require subsurface discharge. However, local stakeholders report that raw sewage discharges to the ground surface (via so-called straight pipes) are common in some poor rural areas of Appalachia and the Southern US. They report that straight pipes are especially common in the impermeable clay soils and shallow chalk of central Alabama. In some US counties, up to 50% of unsewered homes use straight pipes (Maxcy-Brown, et al 2021). These discharges are estimated to result in hundreds of thousands of gallons of raw sewage discharged to the ground every day. Despite reports that straight pipes are widespread and their troubling potential to impact health, there has been no national effort to assess the problem.While there are many areas in rural Alabama suffering from impermeable soil and rural poverty, the prevalence and location of straight pipes are unknown; site-by-site surveys would be prohibitively expensive and may face opposition from local residents. Estimating the number and location of straight pipes and the volume discharged would allow legislators and stakeholders to prioritize wastewater projects and justify spending based on clearly defined benefits. The prevalence of straight pipes varies across counties and communities. Our preliminary analysis indicates that these differences are likely based on two main factors: soil characteristics and rural poverty. We have developed a GIS model to map the risk of straight pipes in rural areas of Alabama. The model was built using available data including USDA soil surveys, USGS digital elevation models, and property information from county tax assessors. We are working to validate the model in spite of the data gap for this problem, using local expert knowledge surveys. We are also working on novel methods of visualizing the model output to better contextualize and communicate the problem, including estimating the number of people directly impacted and the accumulation of raw sewage into local streams.

References: Maxcy- Brown, J., Elliott, M., Krometis, L., Brown, J., White, K., and Lall, U. (2021) Making Waves: Right in our Backyard - Surface Discharge of Untreated Wastewater from Homes in the United States. Water Research, Volume 190, 2021.

Abstract No. PO04. *Investigation of Straight Pipes in Alabama and throughout the U.S.*

Maxcy-Brown, J.[1] & M. Elliott[1]

[1]The University of Alabama

The surface soils of the Black Belt region of Alabama are largely impermeable shrink- swell clays that prevent wastewater infiltration, causing conventional septic systems to fail. The poverty and lack of access to sewer systems in the region has led to widespread septic system failure and the use of so-called “straight pipes”. These straight pipes and failing systems produce conditions in which raw sewage is found on the ground adjacent to 50% or more of the rural homes in some Alabama counties (White and Jones, 2006). For example, Wilcox County surveys show >60% of unsewered homes had straight pipes that were visible upon inspection (Elliott et al., 2017); it is estimated that nearly 400,000 gallons of raw sewage are discharged daily in Wilcox County alone. These challenges are not unique to the Black Belt region or to Alabama, septic system failures and straight pipes occur throughout the country. Straight pipes have been documented in 15 U.S. states with more than 40% of homes having straight pipes in some counties (Maxcy-Brown et al., 2021). Despite preliminary evidence of water quality and health effects from elevated concentrations of fecal microbes and evidence of parasitic worm infections (Badham, 1993; Elliott et al., 2017; McKenna et al., 2017), there has been no national effort to estimate the use or impacts of straight pipes. This situation developed and persists due to diverse and complex geological, technical, regulatory, social and financial challenges. We identify the characteristics of areas with large proportions of straight pipes, propose ways to improve quantification of straight pipes and discuss efforts to increase knowledge of their adverse effects. We also describe the role of new and pending government programs in encouraging reporting and providing solutions. Numerous parallel efforts are underway with an interdisciplinary team across multiple universities to characterize the nature and scope of the problem in addition to developing and implementing solutions.

References:Badham, A. (1993). Wilcox County Needs Assessment. University of Alabama at Birmingham School of Public Health.

Elliott, M., White, K., Jones, R., Das, P., Price, M., Stevens, Z., & Lu, Y. (2017). Surface Discharge of Raw Wastewater among Unsewered Homes in Central Alabama. EPA Decentralized Wastewater Webinar Series. https://www.epa.gov/septic/surface-discharge-raw-wastewater-among-unsewered-homes-central-alabama

Maxcy-Brown, J., Elliott, M. A., Krometis, L. A., White, K. D., Brown, J., & Lall, U. (2021). Making Waves: Right in our backyard- surface discharge of untreated wastewater from homes in the United States. Water Research, 190, 116647. https://doi.org/10.1016/j.watres.2020.116647

McKenna, M. L., McAtee, S., Bryan, P. E., Jeun, R., Ward, T., Kraus, J., Bottazzi, M. E., Hotez, P. J., Flowers, C. C., & Mejia, R. (2017). Human Intestinal Parasite Burden and Poor Sanitation in Rural Alabama. The American Society of Tropical Medicine and Hygiene, 97

Abstract No. PO**05.** *Quantification of soil macropores in hillslope pastures using X-ray computed tomography*

Budhathoki, S. [1], J. Lamba[1], P. Srivastava[2], K. Malhotra[1] & T. Way[3]

[1]Auburn University; [2] University of Maryland; [3] USDA-ARS National Soil Dynamics Lab

Soil macropores largely control the transport phenomenon of water and solutes in the subsurface. Macropores act as preferential flow paths between surface and groundwater, which has major effects on land degradation and groundwater quality. Hence, it is necessary to quantify soil macropore characteristics to relate it with the preferential flow behavior and contribute to the development of some reasonable mathematical model. In the past few years, X-ray Computed Tomography (CT) has emerged as a powerful technique to quantify and visualize the 3D soil macropore characteristics. The objective of this study is to use Xray Computed tomography and image analysis to characterize soil pore structure, which is essential for developing realistic models that describe the water and solute flow. A total of 18 undisturbed soil columns (150 mm diameter and 500 mm depth) were collected from the sand mountain research extension center, Alabama, during May 2019. Six different replicates were collected from each topographical location within the field and scanned using a medical computed tomography (CT) scanner to produce images with a voxel size of 0.3516*0.3516*0.625 cubic mm. A public domain software program Fiji (a distribution of ImageJ) was used to analyze and quantify the images obtained from the CT scanner. Results on variability in soil macropore characteristics, including macroporosity, macropore number, and macropore equivalent diameter as a function of soil depth and slope positions within the 500 mm soil profile were interpreted from X-ray computed tomography, to analyze soil structure. Thus, the results of this study provided quantitative information of different soil macropore characteristics that have significant implications for the flow prediction and modeling.

Abstract No. PO07. *Geographically Isolated Wetlands in the Southeastern United States Serve To Store and Process Nutrients from Agricultural Watersheds*

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The karst geology of the southeastern United States promotes many geographically isolated wetlands (GIWs). Although GIWs offer flood mitigation, pollution filtration, and habitat-supporting biodiversity, they are excluded from federal legal protections under the Clean Water Act. The Dougherty Plain region supports intensive pivot- irrigated agriculture, which can degrade wetland quality through the runoff of sediment and reactive nutrients (N, P, and organic C). However, the spatial distribution and temporal storage of these materials are poorly understood. Here, we investigated the biogeochemical deposition of agricultural runoff in GIWs through the use of paleolimnological techniques to determine the temporal and spatial alterations of nutrient delivery and deposition. Surface sediment samples and sediment cores were collected from agricultural and forested reference-areas. Results show that agricultural wetlands exhibit organic matter deposition deeper into core stratigraphy suggesting increased storage and preservation when compared to reference wetlands. Unexpectedly, N in the agricultural wetlands is low but constant through time (0.2±0.08%). It is proposed that seasonal drying has led to elevated denitrification thus reducing N storage. Phosphorous levels, on the contrary, are elevated in the agricultural wetland (0.9±0.2 mg g-1) compared to the reference wetland (0.2±0.2 mg g-1). Elevated micronutrients Mg (0.7±0.1ppm) and Ca (3±0.3ppm) in the agriculture wetlands could be indicative of the application of Dolomitic limestone used to neutralize soils. Spatial distribution of sediment deposited differs with reference wetlands displaying heterogeneous organic matter accumulation in comparison to homogenous distribution in agriculture wetlands. Even in intensively farmed areas, remaining GIWs provide processing and storage of nutrients capable of improving water quality prior to groundwater recharge. This study is designed to provide recommendations to stakeholders on best practices to manage runoff and maintain wetland function at a field and landscape scale.

Abstract No. PO08. *Towards an Evolutionary Data Assimilation System: The Value of Soil Moisture and Evapotranspiration in Drought Monitoring*

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The University of Alabama

Soil moisture (SM) and evapotranspiration (ET) are two important variables in hydrologic and land surface modeling with a strong relationship. In this study, the effect of multivariate assimilation of remotely sensed soil moisture and evapotranspiration on drought monitoring is examined. Numerous efforts have gone into the assimilation of satellite soil moisture observations into land surface models, but little attention has been given to the combined use of soil moisture and evapotranspiration. In this study, we assimilate two remotely sensed data, namely SMOPS, and MODIS evapotranspiration (MODIS16 ET), at the 1-km spatial resolution, into the VIC land surface model utilizing an evolutionary particle filter method. To attain this, a fully parallelized framework based on model and domain decomposition using a parallel divide-and-conquer algorithm was developed and implemented over the Apalachicola–Chattahoochee–Flint (ACF) basin in the Southeastern United States. The findings show improvement in soil moisture predictions by multivariate assimilation of both ET and SM as compared to univariate assimilation scenarios. Moreover, monthly and weekly drought maps are produced using the updated root-zone soil moisture percentiles over the ACF basin. The results were then compared against the corresponding US Drought Monitoring System archive maps. The findings of this study are consistent with the USDM maps during the winter and spring season considering the drought extents, however, the drought severity was found to be slightly higher according to the DA method. Additionally, we found out that ET assimilation results in wetter conditions comparing to open-loop and univariate SM-DA while the multivariate DA then combines the effects of the two variables and provides an in-between condition.

Abstract No. PO09. *Center Pivot Irrigation in Alabama*

Green, S.

The University of Alabama in Huntsville

The Alabama Water Use Reporting Program, administered by the Alabama Office of Water Resources, is used to register and collect data on agricultural water use across the state, but this program may not include all irrigated land and there is no way of checking to see the accuracy or validity of reported acreage. Because of this, there is a lack of a comprehensive inventory of statewide irrigated acreage that is widely available. Irrigation in Alabama can be a substantial water consumer, therefore it is important to monitor and manage water demand especially as the amount of irrigated acres increases. The goal of the Center Pivot Survey project is to address this lack of data by creating an acreage and irrigation map of center pivot locations across the state of Alabama, which is not the only irrigation method used but is common with crops like corn, cotton, and soybeans. Visual interpretation was applied over a very high-resolution dataset to estimate the total irrigated acreage, mapping each field's location and area. The data used for this project is from the USDA National Agricultural Imagery Program (NAIP) and is digital ortho-photography taken during the growing season. Because this process is done by visual survey, there are some limitations, such as pivot locations not being identified or incorrectly identified. Furthermore, as center pivot irrigation is not the only irrigation method used, this will not be a comprehensive list of irrigation in Alabama. Despite these limitations, this dataset can be used for a wide variety of things, such as agriculture and irrigation modeling or as a resource for decision makers. This poster will highlight the preliminary analysis of the most recent survey underway (2017 and 2019) and compare the results with the past surveys.

Abstract No. PO10. *Hydroclimatic trends in the Mobile Bay Basin from 1979 to 2018*

Haas, H., L. Kalin & D. Tian

Auburn University

Sustainable watershed management and planning may increase the availability of water resources while reducing flood and drought risks. To achieve this, a comprehensive understanding of streamflow trends and regimes is essential. Declining trends in streamflow have been reported at many streamgages throughout the Southeastern U.S. However, a thorough assessment of streamflow trends and its key drivers in the Mobile Bay watershed (MBW), a nationally relevant basin, is lacking. This study addresses this issue by analyzing streamflow trends during the period 1979-2019 at 35 watersheds (HUC 10) within the MBW domain using the Mann-Kendall test. A decreasing trend in mean annual streamflow has been identified in 28 out of the 35 selected USGS gauges. Results from a cluster analysis of the trends revealed similar spatial pattern of (i) streamflow, precipitation, and Normalized Difference Vegetation Index (NDVI), and (ii) temperature and evapotranspiration (ET). The findings suggest that watersheds that have undergone deforestation also witnessed decreasing precipitation trends, which combined with the simultaneous increasing trends of temperature and ET resonating in declining trends of mean annual streamflow. Additionally, a series of geographically weighted regression models (GWRM) were developed to identify the key drivers of annual streamflow across the MBW. Results demonstrate that precipitation explains most of the streamflow variation in the basin and that additional data (e.g., land use and land cover change, irrigation, surface water withdrawals) are required to enhance the model's explanatory power.

Abstract No. PO11. *Geochemical Controls on DOM-Arsenic Complexes*

Herron, C., N. Malina & A. Sullivan Ojeda

Auburn University

Arsenic (As) contamination is a worldwide environmental health issue, and it is crucial to understand mechanisms responsible for As mobility in aqueous systems. Dissolved organic matter (DOM) provides binding sites for As therefore impacting the As mobility in these systems. However, changes in environmental conditions (e.g. pH and salinity) can impact complexation of DOM and As. This work focuses on dissolved organic matter-arsenic (DOM-As) complex formation over a range of pH and salinity. Our experiments will be completed using three separate types of DOM covering a range of molecular weights and molecular structures: Suwanee Reverse Osmosis Humic acid, DOM derived from two distinct coal samples, and local pond water. We hypothesize that complexation is not only determined by changes in pH and salinity but is dependent on molecular size and molecular structure of DOM. Various concentrations of sodium arsenite (0 – 500 µg/L) will be added to each DOM solution in water. Solutions will be prepared with a range of pH conditions (3-10) and salinity (0-20 psu) representing a variety of geochemical conditions. Each solution will be fractionated using size-exclusion filters, then the total arsenic concentration in each solution will be determined through inductively coupled plasma mass spectrometry (ICP-MS). With each fraction, we will analyze average molecular weight and certain molecular structures (e.g. aromaticity) of DOM. Average molecular weight will be quantified using high performance liquid chromatography coupled with a size exclusion column (HPLC- SEC) and a fluorescence and absorbance detector; specific ultraviolet absorbance (SUVA254), a proxy for aromaticity, will be analyzed with an Agilent UV-VIS. Our results will determine the geochemical conditions with the highest complexation efficiency furthermore contributing to current understanding of As bioavailability.

Abstract No. PO12. *Drought in the West: Embedded Water Demand Stationarity Compromises System Vulnerability Analysis*

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Hydrological drought is challenging managers of western U.S. snowpack-dependent urban water systems. Snowpack, reservoir storage, streamflow dynamics, and demand interactions guide water system management and operations, assuming per-capita demand stationarity. Using the Salt Lake City Department of Public Utilities and two drought scenarios, we investigate water system vulnerability differences between unchanging industry per-capita forecasting methods and dynamic demands driven by hydro-climate-demand relationships. The introduction of dynamic demands estimates a 42% reduction in system vulnerability during supply limiting conditions than the industry methods. These modeled water use behaviors also suggest a reduction in the peak timing and volume (September 2, 55MGD vs. August 2, 89MGD), duration (114 days vs. 144 days), and seasonal volume (16,000ac-ft vs. 25,000ac-ft) of out-of-district supply requests during extreme drought conditions. By relying on forecasts embedded with per-capita demand stationarity assumptions, significant and unlikely system vulnerabilities can misinform operational actions.

Abstract No. PO13. *Evaluating the Impact of Onsite Wastewater Treatment Systems on Watershed Contamination, Choccolocco Creek Watershed, Alabama*

Jordan, M., S. Rogers & A. Ojeda

Auburn University

Onsite wastewater treatment systems (OWTSs), such as septic systems, are utilized by approximately 20 percent of U.S. homes and 45 percent of homes in Alabama. OWTSs effectively treat wastewater when located in suitable environmental conditions and regularly maintained. However, these criteria are not always met and OWTSs may become susceptible to failure. Consequently, harmful pathogens, such as E. coli, may enter the surrounding environment, posing public health risks. Additionally, OWTSs are managed by individual landowners with limited OWTS performance data recorded after installation. Furthermore, there is increasing evidence that OWTSs can be a significant, and possibly underestimated, source of water contamination. Thus, more information is needed to assess how OWTS location and performance may lead to surface water contamination. The purpose of this study is to locate OWTSs and model the susceptibility of OWTS failure in the Choccolocco Creek watershed, Alabama. The Choccolocco Creek, a tributary to the Coosa River, is listed on the Alabama 303(d) List of Impaired Waterbodies for E. coli contamination, meaning the creek does not meet the Alabama Department of Environmental Management water quality standards. The objectives will be met by addressing the following research questions: (1) Within the Choccolocco Creek watershed, where are OWTSs located, and what is the OWTS density? (2) What criteria lead to high susceptibility of OWTS failure in the Choccolocco Creek watershed? We hypothesize that OWTSs are most prevalent in densely populated areas, and soil characteristics and OWTS density will have the greatest influence on the susceptibility to OWTS failure. We will use GIS to organize data and conduct spatial analyses to answer our research questions. First, table-based septic system permit data from the Alabama Department of Public Health spanning the years 2000 to 2020 were geocoded. Next, a raster-based multi-criteria decision analysis (MCDA) model was used to map OWTS susceptibility to failure. The MCDA input criteria included environmental and OWTS design factors, such as OWTS density, OWTS age, proximity to surface water, soil characteristics, and slope of the terrain. Input criteria were then classified, weighted, and aggregated. Preliminary results show approximately 3,800 septic system permits were issued from 2000 to 2020 in the watershed, with the majority of septic systems located in Calhoun County, proximal to Oxford and Anniston, Alabama. Further, preliminary MCDA models indicate OWTS susceptibility to failure is highest in the central portion of the watershed. Future steps include joining OWTS points to parcel data and using the parcel center as a more accurate estimate of OWTS location. Also, MCDA classification and weighting schemes will be validated by a sensitivity analysis and industry expert review. Ultimately, understanding the distribution and performance of OWTSs is key to effective watershed management.

Abstract No. PO14. *Understanding the Distribution of Phosphorus Pools in Five Alabama Soil Regions*

Kaur, G., D. Chakraborty & R. Prasad

Auburn University

Alabama soils are inherently low in phosphorus (P) and hence be supplied externally for optimum crop yield. Repeated application of P above the crop removal or the recommended rates result in build-up of P in soil over time. In addition to this, Alabama's high intensity rainfall lead to the loss of P through dissolution and erosion in surface runoff. This loss of P from agricultural lands, when transported to waterbodies, deteriorates the quality of water. The enhanced levels of P in these water systems is one of the leading causes of eutrophication, resulting in major ecological changes. Strategies for the mitigation of P pollution cannot be implemented without an understanding of the P dynamics and distribution of P pools at various soil depths. Limited studies have documented the distribution of P pools in highly weathered Alabama soils. Phosphorus fractionation procedures have been used to quantify various P pools present in soil and study the effect of land management practices on P dynamics within the soil profile. The objective of this study was to determine the distribution of various P pools (highly reactive, moderately reactive, and non-reactive) at different soil depths for five Alabama soil regions namely Appalachian Plateau, Piedmont Plateau, Blackbelt Prairies, Limestone Valleys, and Coastal Plains. Soil samples were collected from Alabama fields under pasture and row crops, from four soil depths: 0-5 cm, 5-15 cm, 15-30 cm, and 30-45 cm. Phosphorus forms were sequentially extracted using modified Hedley procedure which included extraction with DH2O, 0.5 M NaHCO3 (pH 8.5), 0.1 M NaOH, and 1 M HCl. Results will be presented on distribution of P forms within the soil profile under pasture and row crop systems of five Alabama soil regions.

Abstract No. PO15. *Phosphorus variability in delineated irrigation management zones in the crop field*

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Understanding spatial and temporal variation of phosphorus (TKP) in agricultural fields is challenging. Variation in TKP levels across a field can impact crop yield. The aim of this study was to investigate TKP variation in cropland during the 2019 crop growing season in the Tennessee Valley Region (TVR) of North Alabama. Three different management zones (MZ) were delineated based on ten years' historical records of crop yield, soil texture, measured topography, and electrical conductivity data in the field. Multiple locations were selected in these management zones (MZ1, MZ2, and MZ3) for soil sampling at 0-15, 15-30, and 30-60 cm depth increments at different crop growth stages. Soil samples (n = 360) at four different locations in each MZ with three replicates for each depth were collected for analysis. The precipitation data were recorded by an installed weather station in the field and irrigation records were also maintained during the season. Total irrigation amounts in all three MZs were not significantly different during the growing season. The fertilizer application was kept uniform in each MZ of the field. The classical statistics were used to understand the spatial and temporal variation in phosphorus during the growing season. The normalized data approach was adopted to distinguish three MZs for TKP levels. According to the analysis, it has been found that MZ1 and MZ2 had higher phosphorus concentration than the average phosphorus of the field. However, MZ3 was deficient in phosphorus concentration as compared to the average phosphorus concentration of the field. This variation in phosphorus in these MZs was found due to topographical variation and differences in soil properties in the field. The low yield was recorded in MZ3 and high yield in MZ1 and MZ2 as compared to the average yield of the field during the 2019 growing season. Therefore, it can be concluded that TKP levels could have affected crop yield.

Abstract No. PO16 *Rising Concentrations of E. coli in Choccolocco Creek*

Larson, E., N. Malina & A. Ojeda

Auburn University

Choccolocco Creek is a tributary of the Coosa River, a major waterway in eastern Alabama. In recent years, the concentration of E. coli within Choccolocco Creek has steadily increased and the creek has been 303(d) listed by ADEM due to water quality concerns. The high concentrations of E. coli in the creek puts the health and safety of the community at risk as high E. coli increases the risk of bacterial infections and digestive illnesses. Our research investigates the potential sources of E. coli contamination in Choccolocco Creek. There are several possible human sources of E. coli: failing septic tanks, leaky sewer lines, and wastewater treatment plants. Two wastewater treatment plants discharge their effluent directly into Choccolocco Creek and there is a high density of residential septic tank systems in the region. There are natural inputs of E. coli as well, including local wildlife and livestock. We want to know: (1) What effect do wastewater treatment plants and failing sewer systems have on E. coli contamination in Choccolocco Creek? (2) Can certain proxies in conjunction with spatial data allow us to distinguish between E. coli from wastewater treatment plants and E. coli from onsite septic tank systems? We hypothesize that anthropogenic inputs along Choccolocco Creek contribute to the total pathogen loading. We will utilize a combination of microbial and chemical source tracking techniques as well as integrated water quality parameters to identify human waste and its possible source(s). Water quality parameters will be measured onsite and in the lab. Water samples will be collected once a month during the recreational season (April through September 2021) at nine sample sites along Choccolocco Creek. One gallon of water will be collected from the center of the creek using a dipper cup and analyzed at Auburn or sent to Eurofins for analysis. Animal sterols including β -sitosterol will serve as animal proxies, while the human sterol, coprostanol, and a series of pharmaceuticals (caffeine, acetaminophen, ibuprofen) will serve as human proxies. To address the hypothesis, traditional water quality parameters and human proxies will be used to identify statistically significant correlations and clusters within the data. Spearman correlations will be analyzed to identify relationships between anthropogenic markers, such as caffeine, ibuprofen, and coprostanol, and E. coli. Multiple linear regressions will explore the interactive effects of these different variables along with a partial least square regression will be used to understand the covariance. We will also use principal component analysis to understand clustering within the data. Collection of high dimensional data should allow us to better understand the occurrence of E. coli and source-specific markers in the creek.

Abstract No. PO17. *Reconstructing the Cultural Eutrophication of Banana Lake, Florida Using the Sediment Record*

Iott, S., M. Waters & T. Clift

Auburn University Department of Crop, Soil, and Environmental Sciences

Alterations to land use and urban development around lake systems can lead to the influx of nutrients and the formation of dense blooms of algae and cyanobacteria, called cultural eutrophication. While most monitoring programs successfully document eutrophication, the development of eutrophic characteristics occurred prior to recent monitoring efforts. To reconstruct historic lake change, paleolimnological techniques and the sediment record can be used to provide data preceding monitoring programs. Here, we measured nutrients (C, N, P) and photosynthetic pigments in a sediment core collected from Banana Lake, Florida. Banana Lake is a shallow, hypereutrophic lake located in the urban area of Lakeland, FL and labeled as impaired by Polk County. Shallow lakes have a unique system of nutrient cycling through resuspension due to their high surface area to volume ratio. In the case of Banana Lake, excess nutrients have allowed cyanobacteria to become the dominant primary producers utilizing lake nutrients and creating a positive feedback loop that intensifies eutrophication. By combining nutrient and pigment data, our results show that cyanobacteria have existed in the lake long before monitoring efforts began in the system. Banana Lake's eutrophication has already led to a fish consumption advisory, and the cyanobacteria associated with hypereutrophic lakes produce toxins that could be harmful to human health. However, management efforts based on the last 10 years of monitoring data would benefit from understanding the drivers of eutrophication rather than the endpoint.

Abstract No. PO18. *Agronomic and Economic Benefits of Peanut Irrigation Scheduling*

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In the Southeast, insufficient rainfall during the growing season is one of the primary risks associated with yield loss in peanuts. Alabama farmers are turning to irrigation to prevent these losses more and more, but are not necessarily seeing increased crop yield and decreased water stress. In order to gain a greater understanding of various irrigation scheduling practices, two locations, Headland and Fairhope in South Alabama were used to compare the economic and agronomic impacts of two irrigation scheduling methods: common farmer-based irrigation scheduling, soil sensor-based irrigation scheduling and evapotranspiration-based irrigation scheduling (via the IrrigatorPro app. The comparisons between the two methods will be based on water used, yield differences, as well as farmers perceptions towards the use of both technology'based-methods.
Throughout the growing season, farmers were also introduced to, and educated on the impacts of modern irrigation technologies and their impacts on yield, crop health, and the environment.

Abstract No. PO19. *Evaluation of a living shoreline technique on a southeastern United States reservoir*

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Despite the impoundment of Alabama's rivers, the state still maintains its status as the most biodiverse in freshwater species. Alabama Power is responsible for overseeing more than 3500 miles of shoreline; however, individual property owners and businesses have the ability to obtain permits to implement retention systems on their shoreline. This typically involves some sort of heavy armament - block, stone, concrete, wood, metal, rip rap, or combinations of these. The hard armament strategy is resulting in several negative outcomes as the reservoirs are becoming large bath tubs as they lose ecological functionality and increase the cost that most are built to avoid. These retention 'walls' are typically installed to avoid loss of property (decrease erosion), yet because of the subsequent increase in escarpment at the base and ends of such systems, the result is eventual failure and additional repair/replacement cost. The erosion that they contribute to decreases biodiversity and the exchange of nutrients from upland to the water. On coastal shoreline and marine ecosystems, living shorelines have shown to be an ecologically and economically superior choice. As the Army Corp of Engineers is looking to increase the implementation of natural and nature based features as compared to heavy armament, living shorelines are an alternative. It should be considered that public opinion inland might be different than that of coastal areas. As part of this study, a survey will be provided to reservoir shoreline owners, but more importantly, Alabama Power has permitted an example to be installed and it is in the testing phase.

Abstract No. PO20. *Developing a combined Climate Extremes-Resilience Index: a case study on the state of Alabama*

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One of the major effects of climate change is the increased occurrence of extreme weather events. In recent decades, changes in temperature and precipitation throughout the southeastern United States have led to increases in the occurrences of both floods and droughts. These extreme weather events can have devastating effects on communities causing destruction to property and croplands and 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 climate extremes and disaster resiliency over a 20-year period (1990 to 2010) within the state of Alabama 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 resilience, the Climate Extremes Resilience Index (CERI). This index will be then used to identify high risk regions within the state. We plan on including the U.S. Census data from 2020 and climate data for the 2011-2020 decade as it becomes available. Preliminary results suggest that between 1990 and 2010, Alabama as a whole has decreased in disaster resiliency. In 1990, 52.24% of all counties had a resiliency score greater than the state average; in 2010 however, that number dropped to 40.29%. These results also reveal that in 1990 and 2000 the number of counties, experiencing climate extremes were very low; but in 2010, each county in the preliminary sample experienced extremes. Combining decreases in overall resilience with increases in the occurrence of extreme climatic events, Alabama may be vulnerable to climatic events in the future. From 1990-2010 north Alabama experienced the greatest decline in resiliency. Despite this, the north continues to have some of the highest resiliency scores within the state. Combining high resiliency scores with minimal occurrences of extreme climatic events, we suspect that north Alabama will have a higher CERI score than the rest of the state. Southern Alabama, especially nearing the coast, is suspected to be the most at risk and is predicted to have the lowest CERI scores. Though southern regions have experienced some of the most growth in resiliency over the past 20 years, this growth has been relatively small and sometimes stagnant. We envision the Climate Extremes Resilience Index to be used as a tool to help policymakers plan for climate related disasters. By assessing a community's resilience against climate change, policies and measures for allocating aid towards less resilient yet more exposed communities can be put in place.

Abstract No. PO21. *Analysis of community-level factors contributing to cholera infection and water testing access in the Northern Corridor of Haiti*

Ogisma, L., F. O'Donnell, J. Molnar, T. Li & H. Xiao

Auburn University

Households in rural areas of Haiti have a very low livelihood level due to the low agricultural incomes which is the main economic activities. Hence, they have limited access to water and sanitation utilities putting these communities at risk for waterborne diseases. Thus, when cholera was introduced to Haiti in 2010, with point of sources located at the UN Nepalese Contingent base, the disease spread throughout the country within two months. Improved access to drinking water testing and treatment in remote areas may reduce the impact of the disease. This research assessed the community-level factors affecting the cholera infection rate in remote areas of the Northern Corridor of Haiti. It also determines the degree to which water testing access would be improved by the establishment of a laboratory at the State University of Haiti/Université d'Etat d'Haïti Campus Henri Christophe-Limonade (UEH-CHCL) through a partnership with Auburn University and the United States Agency for International Development (USAID). . Additionally, development of affordable innovative water treatment technologies as strategically sound approach is discussed to address these issues. Correlation and regression analysis were used to identify the main community- level factors that lead to high cholera infection rates among communities in the Northern Corridor of Haiti. Analysis of travel time data collected by USAID employees working in the region was used to determine which areas would be able to access the water testing laboratory. The presence of springs in a community has a significant positive correlation with cholera infection rates in the Northern Corridor. However, community-level socioeconomic factors had no significant correlation with cholera infection rate. Poor road conditions, mountainous terrain, and limited transportation options lead to high travel times up to 5.7 minutes/km between remote communities and drinking water testing facilities. It is necessary to consider road conditions and the availability of transportation options in addition to distance when assessing laboratory access. The results of this study will be used to plan the implementation of the new drinking water testing lab near the city of Cap-Haitian and other programs for vulnerable remote areas.

Abstract No. PO22. *Understanding Spatial Variation of Surface Sediments in Two Unique Reservoir Systems, Weiss Lake and Lay Lake, AL*

Orndorff, T. & M. Waters

Auburn University

Reservoirs have increasingly trapped large loads of sediments behind dams from their river watersheds. These sediments hold onto important macronutrients such as organic carbon (OC), nitrogen (N), and phosphorus (P), but also heavy metals such as lead (Pb), zinc (Zn), and arsenic (As). Multiple mechanisms have been described as regulating the distribution of sediments in reservoirs, but different reservoir types (large vs. small, sinuous vs. linear, etc.) have received less consideration. In this study, I investigated the mechanisms that influence the spatial distribution of sediments in two reservoirs with different morphologies, age, and management, Weiss Lake and Lay Lake on the Coosa River, AL, USA. Objectives were to 1) identify drivers of material delivery and deposition for key nutrients (OC, N, P) and heavy metals (As, Pb, Zn), and 2) connect depositional hot spots with material sources and local ecosystem health. I collected 86 surface sediment samples between the two reservoirs using a PONAR grab sampler and measured each sample for total concentrations of each element. Samples were grouped and analyzed according to hydrology, reservoir zonation, water depth, location in the reservoir, and differences in watershed land cover. Both reservoirs revealed a complex system that involved multiple different parameters controlling the distribution of surface sediments and material deposition, but both reservoirs maintained a strong relationship to the perennial river channel. In both reservoirs, nutrients seemed to be locally sourced through land use and distributed through hydrologic pathways, while metals mainly originated from upstream sources carried downstream by the river channel. Results reveal the dynamic nature of reservoirs and the need for individual reservoir-based management when considering sedimentary processes.

Abstract No. PO23. *Dimensions of surface water and groundwater connectivity in a Coastal Plain headwater stream*

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Holistic water resource management requires that we conceptualize watersheds as systems with integrated surface water-groundwater interactions and connectivity. In the southeastern Coastal Plain, this connectivity is poorly understood, and is complicated by complex land use histories, low-gradient topography, and prevalence of preferential flowpaths. In this study, we work to fill this key gap by examining vertical, horizontal, and longitudinal dynamics of hydrologic connectivity in a 90ha watershed at the Tanglewood Biological Station in west Alabama. We identified three distinct hydrogeomorphic units based on degree of stream incision, in which we compared water table dynamics. To characterize vertical connectivity, we installed nested groundwater monitoring wells screened above and below clay confining layers. To characterize horizontal connectivity, we arranged these well nests into transects from hillslope to stream in each hydrogeomorphic unit. Additionally, we performed seasonal stream network surveys to visually quantify longitudinal connectivity throughout the watershed. Initial results suggest that vertical connectivity is constrained by shallow clay layers, horizontal connectivity is driven by the degree of stream incision, and that longitudinal connectivity is likely a function of seasonal patterns of precipitation and evapotranspiration. This work provides an initial characterization of an understudied low-relief headwater system, which will help inform future watershed and water-quality management efforts in Alabama and across the southeastern Coastal Plain.

Abstract No. PO24. *Effects of Gypsum-Amended Poultry Litter on Nutrient Release and Water Quality*

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Alabama is the second largest poultry producer in the United States. Poultry mass production contributes to a large amount of poultry litter (PL), which consists of poultry excreta, bedding material, and excess feed. The large amounts of poultry litter produced in the southeast has traditionally been land applied to hayfields as a means of disposal and fertilization. However, dissolved phosphorus runoff from manure applications is well known to negatively affect inland aquatic ecosystems and degrade water quality. Additionally, ammonia emissions associated with poultry production is a health and environmental concern. Recently, use of gypsum (Ca (SO4) • 2 H2O) as a bedding material has shown positive results in reducing ammonia volatilization in poultry houses. Gypsum is also effective in reducing environmental nutrient losses from poultry litter, particularly dissolved soluble phosphorus from land manure applications. The objective of the experiment was to evaluate the effect of gypsum amended litter on post application losses of total phosphorus, orthophosphate, ammonia, and nitrate from a hay field. A rainfall simulation study was conducted immediately after litter application and then five weeks after litter application to determine total phosphorus, orthophosphate, ammonia, and nitrate loss from the collected water samples. The treatments comprised of using poultry litter bedding that received either no gypsum, gypsum (1600 lbs/1000 ft2), or PLT (poultry litter treatment - industry standard) as a litter treatment between flocks. These three treatments were compared to control plots in which no litter was added. Results will be presented.

Abstract No. PO25. *Estimating Curve Numbers across the Southeastern United States*

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The University of Alabama in Huntsville

The USDA-SCN curve number method is one of the most widely used approaches for estimating runoff from incoming rainfall. It is useful over large areas as it needs very few inputs, only requiring soil type, moisture condition, and landcover. Because of this, it is very applicable over large areas that receive varying amounts of rainfall over the year, such as the southeastern United States.This project seeks to estimate curve numbers across the southeastern united states under three different antecedent moisture conditions. The amount of water soil can absorb can vary significantly depending on moisture conditions — a rain event that could cause flash flooding in moist soils might only cause nuisance flooding, or no flooding at all, in dry soils. The resulting curve number map can be paired with model storm scenarios and varying soil moisture conditions to estimate impacts from rainfall events over large areas. In addition to flooding, runoff estimates can provide important information for overland nutrient flows and resulting concentrations, especially in agricultural fields. The only inputs this project uses are landcover and USDA-SCN soil type maps. What makes it unique from other projects is that it factors in dual-type soils, which behave differently when dry than when moist or saturated. This is due to shallow water tables present in some areas. Accounting for this more accurately estimates soil absorption capability during dry periods, which provides more accurate flood risk maps during dry seasons.

Abstract No. PO26. *Effectiveness and Implementation of Forestry Best Management Practices for Water Quality Protection in Alabama*

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Implementation of forestry best management practices (BMPs) during forest operations is important for water quality protection. Alabama forests are among the most productive forests in the US and rank number two in commercial forestry in the US. Forest operations in the US South tend to involve heavy mechanized equipment that can potentially impact the environment if BMPs are not implemented or implemented incorrectly. Forest operation activities such as the construction of roads and skid trails have the greatest potential of erosion and sedimentation. Timber harvesting activities can result in nonpoint-source (NPS) pollution by altering the natural phenomenon that regulates water quality. NPS pollution from forest operations may cause problems with water quality if BMPs are not implemented. Alabama is ranked as one of the top states in aquatic diversity and this shows the importance of implementing BMPs during and immediately following forest operations. Some states have laws that prescribe regulatory BMPs, Alabama uses a quasi-regulatory approach. Despite BMPs being recognized as an effective practice in protecting water quality, there is no up-to-date information in the scientific literature about the status of BMPs implementation and effectiveness in Alabama. Therefore, an updated assessment and periodic monitoring of BMP implementation rates and effectiveness would be valuable to assess and evaluate the status of Alabama forestry BMPs. The purpose of this study is to 1) assess the implementation status of BMPs according to state guidelines through the use of unmanned aerial vehicles (UAVs) and traditional on-the-ground surveys and 2) to conduct quantitative analysis of erosion rates corresponding to forestry BMPs using the Universal Soil Loss Equation (USLE). Study sites will be in mountains, piedmont, and coastal plain physiographic regions. We will evaluate the use of a UAV (DJI Air2S) for BMP implementation inspections via live feed footage and UAV created orthomosaic maps along with conducting traditional on-the-ground implementation surveys. Accuracy, precision, and time consumption of each method will be recorded and compared. UAV based remote sensing is becoming more widely used and needs to be evaluated for its use in forest operations. The expected outcome of this study is to assess the effectiveness and implementation of forestry BMPs in Alabama using UAVs and erosion modeling. Thus, this study will have significant management implications for forestry professionals and other stakeholders in Alabama as well as other US states.

Keywords: Forest operations, BMPs, sedimentation, soil erosion, unmanned aerial vehicles

Abstract No. PO27. *In-Channel Sediment Basin Performance Evaluation using Large-Scale Testing*

Schussler, J., M. Perez, W. Donald, X. Fang

Auburn University

Under the National Pollutant Discharge Elimination System Construction General Permit, construction developers must implement stormwater pollution prevention plans to minimize downstream implications from site discharge. Sediment basins are a temporary sediment control practice typically employed on construction site perimeters to detain sediment from stormwater runoff before discharge. Sediment basins are heralded in the construction industry for effective sediment capture; however, design and installation techniques vary nationwide. Researchers at the Auburn University Erosion and Sediment Control Test Facility (AUESCTF) are currently examining the performance of in-channel sediment basins, which minimize the site footprint and resources, and are common in the Midwest. This project follows a field-monitoring effort of sediment basins on the highway expansion of U.S. 30 in Tama County. From field data, water samples indicated negligible turbidity and total suspended solids reduction during residence. Site basins were constructed with earthen berms in the perimeter channels to minimize site footprint and dewatered through perforated riser pipes but had no other structural components. The current project aims to quantify improvements through large-scale, controlled flow and sediment introduction testing. Treatments to the basin include (1) upstream forebay, (2) geotextile lining, (3) porous flow baffles, (4) a floating surface skimmer, (5) flocculant, and will be evaluated for the most feasible and effective combination for site implementation. The basin will be subjected to first flush and overflow events during testing. The analysis will include water quality and soil retention data. Research findings are expected to guide the design and implementation of effective, in-channel sediment basins for enhanced environmental stewardship during construction.

Abstract No. PO28. *Drivers of tree biodiversity in Alabama's bottomland hardwood forests*

Shockey, M., N. Jones, C. Atkinson, C. Staudhammer & L. Davis

The University of Alabama

Bottomland hardwood (BLH) forests are unique and important ecosystems prevalent across the Southeastern United States. Over the past 200 years, BLH forest's extent has declined due to timber harvesting, water control structures, and urban expansion. While contemporary restoration efforts often aim to restore BLH forests, restoration projects often fail to achieve ecosystem function targets. In this study, we are beginning to address this challenge by examining drivers of BLH tree species composition and diversity. Specifically, we examine the relationship between species diversity metrics, topography, and inundation regime along a 10km reach of the Sipsey River in western Alabama. To characterize species diversity, we performed vegetation surveys across 50 experimental plots. At each plot, we measured plot elevation, characterized microtopography, and estimated height above nearest drainage (HAND) using a combination of field measurements and data from remotely sensed digital elevation models. To characterize inundation regime, we estimated inundation extent using a digital-terrain derived inundation model and 92 years flow record from an adjacent USGS stream gage. Initial results highlight the role inundation duration and topography (i.e., HAND) as important drivers of species biodiversity. Our results provide unique insight into drivers of biodiversity in bottomland hardwood forests and can be used to improve BLH restoration efforts across the Eastern Gulf Coastal Plain region.

Abstract No. PO29. *Stochastic generation of 15-minute precipitation for water resource modeling under climate change over Southeastern United States*

Srivastava, P.[1], J. Lamba[2], R. McGehee[3], H. Kumar[2] & D. Tian[2]

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In addition to the changes in rainfall volume, climate change is projected to change the characteristics (e.g., intensity, duration, and frequency) of precipitation. The changes in precipitation characteristics will undoubtedly alter the hydrologic characteristics, such as peak flows, time to peak, and erosion potential of watersheds. Unfortunately, much of the currently available climate change datasets are inadequate to truly quantify changes in hydrologic characteristics of a watershed. Since the design of structural (e.g., dams and culverts) and non-structural (e.g., agricultural best management practices) controls for the management of watersheds depend on high temporal-resolution precipitation data, it is critical to temporally-disaggregate coarse resolution precipitation data to high-resolution data. For example, changes in rainfall erosive power (due to changes in rainfall intensity) is expected with the changes in future climate. Thus, for adequate erosion control in the future, estimation of rainfall erosivity under projected climate changes is needed. This study evaluated a stochastic disaggregation method to generate high temporal resolution quarter-hour precipitation for the years 2030-2059 over southeaster, US. Results show that the selected stochastics disaggregation method was able to conserve the mass of precipitation. Furthermore, the statistical result of the probability of zero rainfall, variance, as well as maximum precipitation values showed similarity between the measured and simulated precipitation, thus confirming that the selected stochastic method is appropriate for temporal disaggregation of precipitation data.

Abstract No. PO30. *Preliminary Water Quality Analysis of the Middle Alabama Watershed Using SPARROW Modeling*

Suhs, R., M. Estes & J. Cruise

The University of Alabama in Huntsville

Alabama's agriculture sector is lagging behind those of the surrounding states in the Southeast. Only 140,000 acres of farmland are irrigated according to USDA's National Agricultural Statistics Service. The lack of irrigated farmland puts the agricultural economy at risk to changes in rainfall patterns and droughts. The purpose of this project is to identify regions that are likely to experience elevated levels of Total Nitrogen following irrigation expansion on existing agricultural land. Elevated Total Nitrogen concentrations can lead to ecosystem vulnerability and environmental threats, such as eutrophication, and are therefore important to explore. The USGS SPARROW model (SPAtially Reference Regression of Watershed attributes) was used to estimate and evaluate the potential impact of expanded irrigation on water quality in the Middle Alabama watershed. The SPARROW model is based on a non-linear regression equation that describes the transportation and loading of contaminants. The model includes sources for fertilizer applied to farmland, livestock manure, wastewater discharge, wet deposition of inorganic nitrogen, and area of impervious surfaces. A baseline scenario was run in addition to two other scenarios where fertilizer loads were manually altered. For the scenarios, fertilizer loads were altered based on amount of additional irrigated area and needed fertilizer rates for irrigated versus rainfed fields. One scenario is based on 10% of the watershed area being irrigated and the other is based on all agricultural land in the watershed being irrigated. The resulting outputs were then mapped using GIS to determine appropriate areas for irrigation expansion. The scenarios run have shown that an expansion of irrigation would not have an impact of high significance on the water quality in the majority of the Middle Alabama Watershed. The baseline scenario showed that no Hydrologic Unit Code (HUC) in the Middle Alabama exceeds a Total Nitrogen Concentration of 6 mg/L, an EPA threshold for healthy aquatic ecosystems. However, the irrigation on 10% of the watershed area scenario predicts two HUCs would exceed 6 mg/L and the irrigation on all agricultural land scenario predicts eight HUCs would exceed 6 mg/L.

Abstract No. PO31. *The state-of-the-art Machine Learning for crop yield prediction*

Abbaszadeh, P., K. Gavahi, A. Alipour, P. Deb & H. Moradkhani

The University of Alabama

An imperative aspect of agricultural planning is accurate yield prediction. Artificial Intelligence (AI) techniques, such as Deep Learning (DL), have been recognized as effective means for achieving practical solutions to this problem. However, these approaches most often provide deterministic estimates and do not account for the uncertainties involved in model predictions. This study presents a framework that employs the Bayesian Model Averaging (BMA) and a set of Copula functions to integrate the outputs of multiple deep neural networks, including the 3DCNN (3D Convolutional Neural Network) and ConvLSTM (Convolutional Long Short-Term Memory), and provides a probabilistic estimate of soybean crop yield over a hundred counties across three states in the United States. The results of this study show that the proposed approach produces more accurate and reliable soybean crop yield predictions than the 3DCNN and ConvLSTM networks alone while accounting for the models' uncertainties.

Abstract No. PO32. *Development and application of microplastic analysis in the sediments of Lake Weiss, Alabama*

Bowling, K., B. Webster, M. Waters

Auburn University

Microplastics are a growing concern for the ecological health of aquatic systems. While microplastics have been successfully characterized in coastal areas, the occurrence and distribution in inland waters is beginning to be investigated. Given the high organic content of lake and reservoir sediments, some of the techniques developed for coastal sandy-areas are confounded and problematic. Here, we present exploratory research on the occurrence and distribution of microplastics in the sediments of Lake Weiss, Alabama. Lake Weiss is a reservoir in NE Alabama on the Coosa River and receives inputs from the NW corner of Georgia known for decades of carpet manufacturing. We collected 25 surface sediment samples and developed extraction techniques focused on the unique characteristics of lake and reservoir sediments, such as high organic content. Results show that microplastic identification benefits from pretreatment to remove organic matter from the sediments as well as epiflourescent microscopy. Distribution of microplastics in Lake Weiss was heterogeneous and appeared to be based on hydrology rather than input area.

Abstract No. PO33. *Phosphorus stratification and environmental implication for soils with repeated poultry litter application*

Chakraborty, D. & R. Prasad

Auburn University

Although phosphorus (P) is a limiting nutrient for plant growth however, excess P loading arising from repeated poultry litter (PL) applications result in soil P accumulation. The accumulated P is subjected to loss risk during runoff events which eventually can lead to degradation of water quality. The objective of this study was to understand soil P stratification and its environmental implication in agricultural lands impacted with PL. Soil samples from agricultural lands belonging from Piedmont regions of Alabama with long term PL application history were collected and separated into four depths: 0-5, 5-15, 15-30, and 30-45 cm. Soil extractable P was determined using water, Mehlich-1, Mehlich-3, and oxalate. Phosphorus fractionation was performed using sequential Hedley fractionation method to identify the organic (Po) and inorganic (Pi) forms. Environmental P loss risk was evaluated using P saturation ratio (PSR, molar ratio of P/(Fe + Al)). Results of this study indicated that P concentrations were stratified within the soil profile with highest concentration in 0-5 cm soil depth. Phosphorus fractionation study showed Po and Pi concentrations decreased with soil depth. The residual or non-reactive P constituted the highest percentage of soil total P. Mean soil PSR was higher for 0-5 cm depth and decreased significantly down the soil profile. High PSR in the surface 0-5 cm depth indicated P saturation potentially due to repeated PL application. Elevated PSR and extractable P concentrations in the surface 0-5 cm depth can potentially lead to high P loss risk from the soils. For long-term sustainable PL management, subsurface applications will be beneficial to prevent further P saturation in the surface soils and to protect the water quality.

Abstract No. PO34. *Incidence of Pharmaceutical and Personal Care Product (PPCP) Contamination in Alabama Waters*

Dixon, M.[1], A. Shabel[1], R. Robinson[1], P. Okweye[2] & K. Garner[1]

[1]Alabama Cooperative Extension System; [2]Alabama A&M University

Incidence of Pharmaceutical and Personal Care Product (PPCP) Contamination in Alabama WatersMary Dixon1, Allyson Shabel1, Roosevelt Robinson1, Paul Okweye2, and Karnita Garner11Alabama Cooperative Extension System (ACES), Alabama A&M University/ACES, Normal, AL 357622Department of Physics, Chemistry, and Mathematics, Alabama A&M University, Normal, AL 35762Highly soluble pharmaceuticals and personal care products (PPCPs) released into surface waters contaminate aquatic ecosystems and have been shown to affect fish and animal populations adversely. In 2015, a total of 60 samples were collected from targeted watersheds across Alabama. PPCP concentrations were determined by US EPA Method 1694 for multi-residue analysis, using solid-phase extraction and ultra-performance liquid chromatography- electrospray tandem mass spectrometry (LC/MS/MS). The detection ranges for acetaminophen (26-45 ppb), bisphenol-A (150-220 ppb), caffeine (91-220 ppb), N, N- Diethyl-meta-toluamide (41-280 ppb), salicylic acid (62-84 ppb), sulfamethoxazole (22- 120 ppb), and trimethoprim (13-16 ppb) revealed concerning levels. Water quality measurements were also taken for pH, temperature, and electrical conductivity. Electrical conductivity varied across the state, ranging from 263.9-411.6 mS/cm. Temperature and pH did not show significant spatial variation. A greater frequency of PPCP detection was shown to occur in south Alabama. This 2021 study investigates current PPCP levels at locations proximate to those of the 2015 study. The detection ranges of the contaminants and water quality indicators were compared to the previous data to determine trends. Our findings highlight the need for more efficient PPCP management as well as added evidence-based water quality guidelines.

Abstract No. PO35. *Improving the accuracy of flood inundation models using a modified boundary conditioning approach*

Jafarzadegan, K., A. Alipour, K. Gavahi, H. Moftakhari & H. Moradkhani

The University of Alabama

In the United States, flooding is the most frequent natural disaster that causes huge losses and damages annually. To properly simulate fluvial floods, hydrodynamic models are commonly used to estimate the spatiotemporal distribution of water depth across river networks and generate flood inundation areas during flood events. In this study, we show that the standard upstream/downstream boundary conditions (BC) used to set up these models fail to accurately estimate the inundation areas during extreme floods. Here we propose a modified BC that adjusts lateral flows, adds direct precipitation over channels and incorporates hydrological bias into modeling. The basis for applying these BC modifications is to conserve the water mass flux into the river systems during extreme flood events. To evaluate the effectiveness and robustness of the proposed BC approach, we simulate two flood events, Hurricane Harvey in 2017 and a flash flood in 2016 occurred in the San Jacinto watershed, a large basin that covers Houston and its north neighborhood. We utilize two well-known hydrodynamic flood inundation models, LISFLOOD-FP and HEC-RAS 2D, and demonstrate that modeling with standard BCs highly underestimates the flood hydrographs and inundation areas while using the proposed BC approach can significantly improve the modeling performance.

Abstract No. PO36. *Participatory Irrigation Extension program to Increasing Adoption of best Irrigation Strategies*

Ortiz, B. [1], G. Morata[2], B. Lena[1], P. McClendon[1] & H. Kumar[1]

[1]Auburn University; [2]Alabama Cooperative Extension System

Farmers in Alabama, Tennessee and other US southeastern states lack experience on irrigation water management and adoption rate of the state-of-the-art technologies and practices to increase irrigation water use efficiency. Several federal funded projects are being implemented to demonstrate and train farmers and consultants on irrigation scheduling strategies and variable rate irritation. Half dozen of on-farm demonstration sites are being used to evaluate, demonstrate, train farmers and consultants several irrigation technologies to better manage irrigation water. At each site we are comparing the irrigation farmer's practices versus the technology-based practice. Some of the technologies demonstrated include: FieldNet advisor and soil water tension sensors for irrigation scheduling, and variable rate irrigation. Four farmers focus groups have been established to train farmers and consultants and share project findings. One-to- one farmers engagement have been key to increase skills and knowledge on how best to use technology to management irrigation. Farmers are not only learning how these technologies can be used to schedule irrigation but also applying the right rate and the right place and time, and the productivity and environmental benefits of technology-based irrigation management.

Abstract No. PO**37.** *2D Geologic Cross Section Creation Using Arc Hydro Groundwater Subsurface Analyst*

Rich, K.

Wood Environment & Infrastructure Solutions, Inc

Aquaveo's Arc Hydro Groundwater (AHGW) Subsurface Analyst is an ArcGIS groundwater and subsurface processing tool that facilitates the creation of two-dimensional geologic cross sections using boring, groundwater well construction, geophysical, and groundwater elevation data. The tool allows for relatively quick and accurate plotting of lithologic data and groundwater parameters along a user-defined section line, enabling the user to interpolate geologic units between dataset locations and create a graphic representation of underlying geology and groundwater information. Wood E&IS would like to present some examples of our application of AHGW Subsurface Analyst to various sites in Alabama and showcase some of the abilities of this ArcGIS-based processing tool for water resources projects.

Abstract No. PO38. *Spatial Interpolation Methods in Groundwater Projects*

Rich, K.

Wood Environment & Infrastructure Solutions, Inc

As populations grow, groundwater projects are of increasing importance in terms of evaluating impacts to supply, the environment, and public health, among others. It is useful and often necessary to quantify variables spatially across each subject site to help describe the site setting and to observe groundwater conditions during the project life cycle. Examples of variables that may be represented spatially include groundwater elevations, geochemical concentrations, and intrinsic geochemical parameters such as pH, temperature, and specific conductance. Additionally, numerical physical characteristics such as top-of-bedrock elevations, lithologic-boundary elevations, and permeability of groundwater-bearing lithology may be used to assist in development of conceptual site models, which help establish initial conditions and provide feedback to the observer during the project. These variables are typically measured and recorded at specific locations by drilling, well installation, water-level gauging, and/or groundwater sample collection. Since it is not possible to measure variables at every point within a subject site, mathematical interpolation methods may be used to reasonably approximate quantities between known data collection points. Interpolation results may be visualized in the form of raster data, which then may be utilized to construct contours that delineate areas of common quantities across the subject site. A description of and comparison of various interpolation tools and mathematical methods, such as kriging, nearest neighbor, and inverse distance weighting are provided in this session, and examples of interpolated groundwater data, including potentiometric contours and geochemical concentrations are displayed using GIS software.

Abstract No. PO39. *Cost-Effective and Sustainable Biochar has the Ability to Sorb and Facilitate Degradation of PFAS in Water*

Wang, D. & S. Krebsbach

Auburn University

Global efforts have been made for PFAS remediation during the past years. However, remediating PFAS-impacted matrices (e.g., water, soil, and sediment) remains largely challenging, due partially to the strong carbon-fluorine bond and high remediation cost. Compared to the commonly used granular activated carbon (GAC), biochar is well-positioned to addressing the issues and challenges associated with PFAS remediation due to the following facts. (I) Biochar is cost-effective (e.g., USD $246/ton biochar vs. $1,500/ton GAC) (Ahmad et al., 2012). (II) Biochar is sustainable; ~20 gigatons of agricultural and forestry wastes are readily to be pyrolyzed for biochar mass production annually (Bentsen and Felby, 2010). (III) Large surface area, controllable pore structure, tunable surface charge, and rich surface chemistry of biochar make it competitive for removing a wide spectrum of PFAS (long- and short-chain cationic, anionic, and zwitterionic) through hydrophobic interaction, electrostatic attraction, and other interactions. And (IV) Biochar has the ability to be used in tandem with other destruction techniques (e.g., advanced reduction process using hydrated electrons for PFAS reductive destruction) for PFAS sorption and remediation. In particular, the redox properties of biochar can be tuned to prolong the life span of hydrated electrons, which is critical for PFAS destruction. These attributes and uniqueness of biochar, if harnessed appropriately, can contribute to the joint global efforts in remediating PFAS-impacted matrices in a cost-effective and sustainable manner.

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