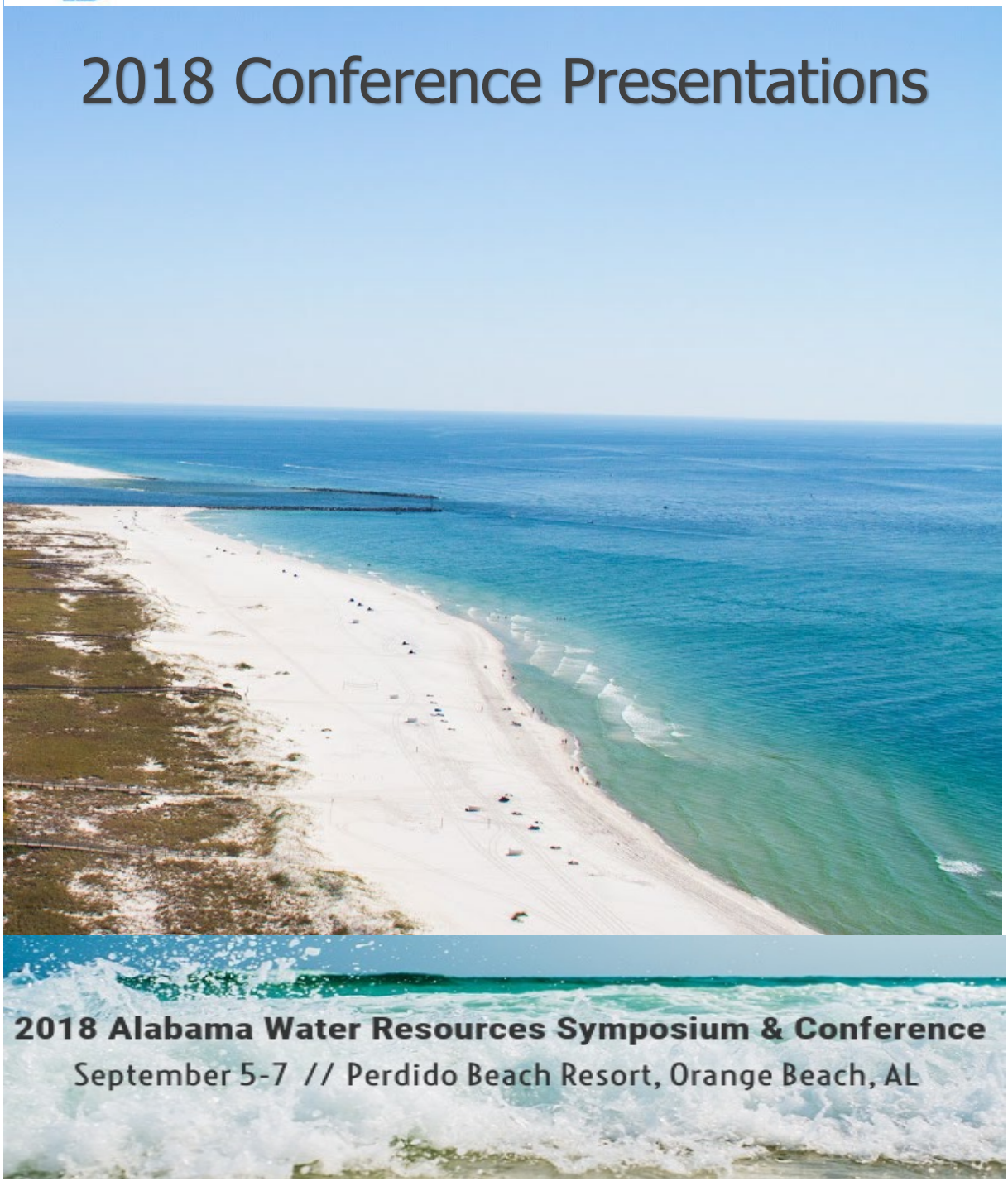
Alabama Water Resources Conference and Symposium

2018 Conference Presentations



Abstract Citation Format Suggestions

Metz, A.**;** M. Waters (Auburn University) & J. Smoak (University of South Florida), 2018. *Spatiotemporal Analysis of Pollutant Inputs and Biologic Responses in Perdido Bay*. Paper presented at the 30th Annual Alabama Water Resources Conference; 5–7 Sep 2018; Orange Beach, AL. Proceedings of the 2018 AWR Conference: Abstract No. 107, p. 55

Jiménez, A. (Universidad de los Llanos) & B. Ortiz (Auburn University), 2018. *Development of an Artificial Intelligent System for Irrigation Applications Using Heterogeneous Sensors.* Poster session presented at the 30th Annual Alabama Water Resources Conference; 5–7 Sep 2018; Orange Beach, AL. Proceedings of the AWR Conference: Abstract No. 85, p. 89.

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 Program

September 5 - 7, 2018 **Perdido Beach Resort - Orange Beach, Alabama**

Alabama Water Resources Conference & Symposium

Alabama Section of the American Water Resources Association

Symposium Program

Theme: The Many Faces of Aquatic Restoration

Wednesday, September 5

12:00 PM	**Registration Open (Lobby)**
2:00 - 2:10 PM	**Welcome & Introductions** - *Eve Brantley, AWRA President* **(Salons E-H)**
2:10 - 2:20 PM	**Symposium Introduction** - *Patrick O'Neil, AWRA President-Elect*
2:20 - 3:00 PM	**The ABC's of Stream Restoration and Why it is Important** - *Greg Jennings, North Carolina State University*
3:00 - 3:40 PM	**Restoration of Water Quality in Alabama Streams - Lessons Learned and Highlights of 25 Years of 319 Work** - *Shannon McGlynn and Amanda LoCascio, Alabama Department of Environmental Management*
3:40 - 4:10 PM	**Networking Break**
4:10 - 4:50 PM	**Restoration of Hydrologic Connectivity and Biological Condition Through Removal of Dams and Barriers** - *Eric Spadgenske, U.S. Fish and Wildlife Service*
4:50 - 5:20 PM	**Restoration Through Green Infrastructure - Where We've Been, Where We're Going, Where We're Headed** - *Barry Fagan, Volkert, Inc.*
5:20 - 5:30 PM	**Announcements and Adjournment** - *Eve Brantley, AWRA President*
6:30 PM	**Social and Dinner** - **Flora-Bama** (casual/beach attire)

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AWRC Conference Program
Session Topics and Presenters

Alabama Water Resources Conference

Concurrent Session One

Thursday, September 6: 9:15 a.m. - 10:35 a.m.

WATER QUALITY I - PATHOGENS - SALON D

SESSION CHAIR: SHANNON WEAVER, USDA - NATURAL RESOURCES CONSERVATION SERVICE

1. **Raw Sewage Surface Discharge from Homes in Rural Alabama- Impacts on Surface Water Quality.** *Parnab Das, University of Alabama*
2. **Assessment of Fecal Contamination Sources in Surface Water.** *Yucheng Feng, Auburn University*
3. **Tracking Wastewater Influence in a Freshwater Dominated Urbanized Estuary.** *Haley Gancel, Dauphin Island Sea Lab*
4. **Sources of Water Quality Indicators to a Shellfish Growing Area in Portersville Bay, AL.** *Ashley Frith, Dauphin Island Sea Lab*

CONNECTING AGENCIES - SALON E

SESSION CHAIR: BENNETT BEARDEN, GEOLOGICAL SURVEY OF ALABAMA

1. **TNC's Watershed Approach to Restoring the Gulf.** *Darryl Boudreau, The Nature Conservancy*
2. **Partnering with State Agencies to Provide Environmental Education to Schools.** *Ashley Campbell, City of Daphne*
3. **Exploring Technology in Water Resources.** *Amanda Fleming, Kleinschmidt*
4. **Engaging Stakeholders in Water Resources Planning.** *Andrew Leeds, STRADA Professional Services*

AQUATIC ECOLOGY - SALONS F-H

SESSION CHAIR: TACONYA GOAR, ALABAMA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

1. **Buy One, Get One Free: Integrating Ecology and Hydrogeology to Conserve Alabama's Burrowing Crayfish Populations and Groundwater Resources.** *Rebecca Bearden, Geological Survey of Alabama/University of Alabama*
2. **Species Status Assessments for Informing Endangered Species Act Decisions.** *Jennifer Grunewald, U.S. Fish and Wildlife Service*
3. **Survivability of Mussels during the 14-Week Drawdown of Point A Reservoir, Andalusia, AL.** *Jonathan Miller, Troy University*
4. **There's No Crying in Watershed Restoration: Collaborative Decision-Making to Restore the Moores Creek Watershed.** *Alex James, Auburn University*

Alabama Water Resources
Conference
Concurrent Session Two
Thursday, September 6: 10:45 a.m. - 12:05 p.m.

WATER QUALITY II - SEDIMENTS - SALON D
SESSION CHAIR: AMANDA FLEMING, KLEINSCHMIDT

1. **Sediment Fingerprinting to Identify Sources of In-Stream Sediment in an Urbanized Watershed.** *Kritika Malhotra, Auburn University*
2. **The Success of the Duck River Watershed Management Plan.** *Steve Newton, TTL*
3. **Land Use Effects on Water-Related Dynamic Soil Properties of Southeastern Coastal Plain Kandiudults.** *Joey Shaw, Auburn University*
4. **Reconstructing Environmental Conditions of Southern Alabama Utilizing the Sediment Record of Ditch Pond: Evidence of Climate Change, Fire, and Eutrophication.** *Matthew Waters, Auburn University*

WATER POLICY/LAW - SALON E
SESSION CHAIR: BARBARA GIBSON, CHOCTAWHATCHEE, PEA AND YELLOW RIVERS WATERSHED MANAGEMENT AUTHORITY

1. **Who's on First? The Status of Water Law and Policy in Mississippi and Alabama.** *Bennett Bearden, Geological Survey of Alabama*
2. **The Long and Winding Road to an Alabama Water Plan: Lessons Learned and Moving Forward.** *Cindy Lowry, Alabama Rivers Alliance*
3. Panel Discussion **(Moderator -** *Emily Elliott, University of Alabama***):**
   - **a. Using Paleohydroclimate Studies of Mobile Basin Rivers to Inform Alabama Water Policy.** *Matthew Therrell, University of Alabama*
   - **b. Policy Implications and Increasing Community Resilience in Coastal Watersheds of Alabama by Risk Assessment of Past, Present and Future Trends in Hydrologic and Hydroclimatic Extremes.** *Glenn Tootle, University of Alabama*
   - **c. Application of Future Climate Projections of Tombigbee and Alabama Rivers to Future Alabama Water Policy.** *Jonghun Kam, University of Alabama*

DROUGHT/CLIMATE ISSUES - SALONS F-H
SESSION CHAIR: ROY MCAULEY, ALABAMA PULP AND PAPER COUNCIL

1. **Global Warming Impacts on Drought and Water Security in Southeast U.S.** *Ali Ahmadalipour, University of Alabama*
2. **Water Use Efficiency of Hybrid Bermudagrass Cultivars for Southeastern Turfgrass Management.** *Beth Guertal, Auburn University*
3. **A Decade of Climate in the Apalachicola-Chattahoochee-Flint River Basin: What Has Changed?** *Sandra Guzmán, Auburn University*
4. **Toward an Operational High-Resolution Probabilistic Drought Monitoring and Forecasting Across the CONUS: the Value of Remotely Sensed Land Data Assimilation System.** *Hamid Moradkhani, University of Alabama*

Alabama Water Resources
Conference
Concurrent Session Three
Thursday, September 6: 1:40 p.m. - 3:00 p.m.

WATER QUALITY III - NUTRIENTS - SALON D
SESSION CHAIR: CHRIS JOHNSON, ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

1. **The Role of Morphometry and Hydrology in Promoting Eutrophication and Harmful Algal Blooms in Reservoirs.** *Reed Green, U.S. Geological Survey – Lower Mississippi Gulf Water Science Center*
2. **Spatiotemporal Evolution of Organic and Inorganic Nutrient Exports in Agricultural Watersheds in Northern Alabama.** *Yuehan Lu, University of Alabama*
3. **Development of the Locust Fork and Village Creek Nutrient TMDL.** *James Mooney, Alabama Department of Environmental Management*
4. **Determination of Environmental Phosphorus Loss Risks for Alabama Soils.** *Rishi Prasad, Auburn University*

GIS IN WATER MANAGEMENT - SALON E
SESSION CHAIR: TOM LITTLEPAGE, ALABAMA OFFICE OF WATER RESOURCES

1. **Deriving Actionable Intelligence from NOAA's National Water Model to Support Impact-Based Decision Support Services.** *Whitney Flynn and Monica Stone, National Water Center*
2. **GIS Water-Info: Enhanced Water Related GIS Applications.** *Lynn Ford, Alabama Department of Environmental Management*
3. **Understanding the Drivers of Stream Restoration Setbacks and Failures.** *Frances O'Donnell, Auburn University*
4. **Comprehensive Flood Information at Your Fingertips.** *Jeff Zanotti, Wood*

RESTORATION I - SALONS F-H
SESSION CHAIR: TODD BOATMAN, U.S. ARMY CORPS OF ENGINEERS

1. **Innovative Financing Options for Green Infrastructure to Support Water Quality Improvement.** *Kevin Middlebrooks, Jacobs*
2. **Resilience and Recovery: A Three Year Biodiversity Assessment of Oil-Impacted Salt Marsh and the Effect on Denitrifying Microbial Communities.** *Nikaela Flournoy, University of Alabama*
3. **Using Spatial Data to Predict Faunal Distributions for Alabama Barrier Island Restoration Assessment on Dauphin Island, Alabama.** *Kristie Ouellette Coffman, ALCFWRU/Auburn University*
4. **Partnering to Reestablish Habitat for a Keystone Species: Pensacola East Bay Oyster Habitat Restoration.** *David Stejskal, Jacobs*

Alabama Water Resources
Conference
Concurrent Session Four
Thursday, September 6: 3:30 p.m. - 4:50 p.m.

WATER QUALITY MONITORING - SALON D
SESSION CHAIR: LYNN SISK, JACOBS

1. **U.S. Geological Survey NAWQA Surface-Water Quality Sampling in Alabama – Summary of Recent Results.** *Amy Gill, U.S. Geological Survey*
2. **ADEM Water Quality Monitoring Programs: Current Status.** *Fred Leslie, Alabama Department of Environmental Management*
3. **EPA's Update to the How's My Watershed Characterization Tool.** *Amy Newbold, U.S. EPA - Gulf of Mexico Program*
4. **Biological Filtration Performance for Water Treatment: Evaluating the Effects of Extended EBCT, Temperature and DOM Character.** *Leigh Terry, University of Alabama*

MODELING AND WATER MANAGEMENT - SALON E
SESSION CHAIR: PATTY SOBECKY, ALABAMA WATER INSTITUTE

1. **The National Water Center and the Future of Water Information.** *Karen Bareford, National Water Center/University of Alabama/Sea Grant*
2. **Using Uncertainty Quantification to Develop a Groundwater Model of the Coastal Lowlands Aquifer System.** *Linzy Foster, U.S. Geological Survey*
3. **Assessing Input Uncertainty and Sensitivity of the Process-Based Wetland Water Quality Model Wetqual.** *Recep Kanber, Auburn University*
4. **Effect of Current and Projected Agricultural Irrigation Water Withdrawals on Upper Floridan Aquifer in the Lower Apalachicola-Chattahoochee-Flint River Basin, USA.** *Ritesh Karki, Auburn University*

RESTORATION II - SALONS F-H
SESSION CHAIR: SABRA SUTTON, JACOBS

1. **On-Site Stream Mitigation Design and Construction for an Over Widened Bedrock Channel.** *Ken Barry, S&ME*
2. **The Long-Term Effects of Stream Restoration on Water Quality, Nutrient Uptake, and Whole-Stream Metabolism in Sandy-Bottom, Coastal Plain Streams.** *Sam Bickley, Auburn University*
3. **Dam Removal Monitoring on Big Canoe Creek Using the High Definition Stream Survey.** *Brett Connell and Dr. James Parham, Trutta Environmental Solutions*
4. **Update on NFWF-Funded Stream Restoration Projects in the D'Olive Watershed in Baldwin County, Alabama.** *Paul Lammers, Mobile Bay National Estuary Program*

Alabama Water Resources
Conference

Concurrent Session Five

Friday, September 7: 9:15 a.m. - 10:35 a.m.

WATER QUANTITY - SALON D

SESSION CHAIR: ATHENA CLARK, USGS, ALABAMA WATER SCIENCE CENTER

1. **Characterizing the Hydrology and Water Quality Function of Headwater Slope Wetlands.** *Rasika Ramesh, Auburn University*
2. **Protecting and Restoring Flows in Our Southeastern Rivers: A Review of State Policies for Water Security and Sustainability in the Southeast.** *April Ingle, River Network*
3. **Update on Water Use and Surface Water Assessments in Alabama.** *Tom Littlepage, Alabama Office of Water Resources*
4. **Water Use in the Tennessee Valley for 2015.** *Amanda Turk, Tennessee Valley Authority*

WATER MANAGEMENT AND AGRICULTURE - SALON E

SESSION CHAIR: EVE BRANTLEY, ALABAMA COOPERATIVE EXTENSION SYSTEM

1. **Impact of Agricultural Management Practices on Soil Health and Water Dynamics.** *Audrey Gamble, Auburn University*
2. **Statewide Resource Assessment for Irrigation Watershed Planning.** *Cameron Handyside, University of Alabama in Huntsville - Earth System Science Center*
3. **Using Bayesian Spatial Statistics to Better Estimate Irrigation Water Productivity.** *Thorsten Knappenberger, Auburn University*
4. **Statistical Post-Processing of Reference Evapotranspiration Forecasts Based on Multi-Model Ensemble Numerical Weather Predictions.** *Hanoi Medina, Auburn University*

COASTAL ISSUES I - SALONS F-H

SESSION CHAIR: JEFF POWELL, U.S. FISH AND WILDLIFE SERVICE

1. **Observations of Wind Forcing Effects on Estuary Length and Salinity Flux in a River-Dominated, Microtidal Estuary, Mobile Bay, AL.** *Jeffrey Coogan, Dauphin Island Sea Lab*
2. **Fowl River Marsh Study: If You Try Sometimes You Just Might Find You Get What You Need.** *Jason Kudulis, Mobile Bay National Estuary Program*
3. **The Impact of Nutrient Loading on Nitrogen Removal in a *Juncus roemerianus* and *Spartina alterniflora* Saltmarsh in the Northern Gulf of Mexico.** *Taylor Ledford, Dauphin Island Sea Lab*
4. **Making Watersheds Great Again.** *Christian Miller, Mobile Bay National Estuary Program*

Alabama Water Resources
Conference

Concurrent Session Six

Friday, September 7: 10:55 a.m. - 12:15 p.m.

STORMWATER - SALON D

SESSION CHAIR: BRIAN ATKINS, ALABAMA OFFICE OF WATER RESOURCES

1. **Developing a Voluntary Green Infrastructure Program.** *Byron Hinchey, S&ME*
2. **Alabama's Erosion and Sediment Control Handbook: Is it Perfect? No, But Getting Better.** *Perry Oakes, Alabama Soil and Water Conservation Committee*
3. **Preventing Sediment Resuspension with Cellular Confinement Systems.** *Jose Vasconcelos, Auburn University*
4. **Rainfall Simulator to Demonstrate BMPs Effectiveness to Prevent Erosion/Runoff.** *Tibor Horvath, USDA-Natural Resources Conservation Service* ***outdoor demonstration near entrance of the underground parking/drop off***

WATER MANAGEMENT AND ENERGY - SALON E

SESSION CHAIR: CHARLES STOVER, ALABAMA POWER

1. **Developing a Watershed Group Approach for Invasive Species Management.** *Kevin Jenne, Choccolocco Creek Watershed*
2. **Streamflow Alteration Assessments to Support Bay and Estuary Restoration in Gulf States – Overview.** *Rodney Knight, U.S. Geological Survey - Lower Mississippi Gulf Water Science Center*
3. **Hydropower in the U.S. – A National, Regional and State Perspective.** *Kelly Schaeffer, Kleinschmidt*
4. **Karst Features and Aquifer Systems in Alabama.** *Gheorghe M. Ponta, Geological Survey of Alabama*

COASTAL ISSUES II - SALONS F-H

SESSION CHAIR: KENNETH ODOM, SOUTHERN COMPANY

1. **GeoCoast: A Decision-Support System for Assessing Sea Level Rise Impacts.** *John Cartwright, Mississippi State University*
2. **Digital Coast: Resources for Coastal Decision Making.** *Brenna Sweetman, NOAA's Office for Coastal Management*
3. **Does Black Mangrove Expansion Alter Salt Marsh Nitrogen Removal Capacity?** *Corianne Tatariw, University of Alabama/ Dauphin Island Sea Lab*
4. **Spatiotemporal Analysis of Pollutant Inputs and Biologic Responses in Perdido Bay.** *Alex Metz, Auburn University*

Abstracts
(alphabetical order by author's last name)

Oral Presentations

Global warming impacts on drought and water security in southeast US. **Ali Ahmadalipour** & Hamid Moradkhani**,** University of Alabama
(Abstract No. 1)

Drought is a natural recurring hazard with prolonged duration and large spatial extent, which can have severe consequences on society and economy. According to the National Centers for Environmental Information (NCEI), Alabama and Georgia have been impacted by four major drought events in the past decade (in 2008, 2011, 2012, and 2016). Global warming is expected to increase the potential and actual evapotranspiration rate in many regions, leading to decreased water availability and subsequently exacerbating droughts and threatening water security. In this study, we utilized 21 bias corrected and downscaled CMIP5 Global Climate Models (GCMs) provided by NASA (NEX-GDDP) to investigate seasonal characteristics of meteorological droughts across the southeastern US. The analyses are carried out for the historical period of 1950–2005 as well as two future scenarios of RCP4.5 (corresponding to 2°C global warming by the end of 21st century) and RCP8.5 (business as usual future), for the period of 2006–2099. The Standardized Precipitation Index (SPI) and Standardized Precipitation Evapotranspiration Index (SPEI) are calculated at a seasonal timescale to project and analyze drought characteristics. Three main characteristics of drought, i.e. areal extent, intensity, and frequency, are studied and statistical methods are employed to evaluate the significance of changes in future drought projections. Results show that accounting for the combined effects of precipitation and temperature changes, significant aggravation is projected for future drought extent in most regions along with a tendency towards more frequent and intense summer droughts.

Introduction to the National Water Model. **Karen Bareford**, National Water Center, University of Alabama,
(Abstract No. 3)

Stakeholders increasingly request enhanced and integrated water resources forecasts and services to help address more complex societal issues related to too much, too little, and poor-quality water. Recent engagements with water resources stakeholders across the US have revealed the need for consistent, high space and time-resolution, integrated water analyses, predictions, and data to address critical unmet information and service gaps related to floods, droughts, water quality, water availability, and climate change. In response to these growing stakeholder demands and needs, the National Oceanic and Atmospheric Administration (NOAA) has begun a transformation of its operational water prediction capabilities. The National Water Model (NWM), launched in 2016, is a continental scale hydrologic model that forecasts streamflow and other elements of the water budget. The NWM is an evolution of the WRF-Hydro architecture developed by the National Center for Atmospheric Research and its international collaborator community. The NWM is a NOAA-led interagency effort that leverages model topology within the National Hydrographic Dataset-Plus (NHDPlus) version 2 from the U.S. Geological Survey (USGS) and the Environmental Protection Agency. The NWM represents NOAA's first foray into high-performance computing for water prediction and expands NOAA's current water quantity forecasts, at approximately 4,000 USGS stream gage sites across the country, to forecasts of flow at 2.7 million stream reaches. This new NWM guidance augments and supports the generation of official forecasts at NWS River Forecast Centers. NWM output also includes spatially-continuous forecasts of soil moisture, evapotranspiration, run-off, snow water equivalent, and other components of the water cycle. Early evaluation of the model at validation locations nationwide indicates promising skill, particularly in unregulated areas (natural flow). In addition, initial case studies have demonstrated valuable forecast skill at current Advanced Hydrologic Prediction Service (AHPS) locations and in areas which lack both stream gage observations and AHPS forecasts. Although these early results are promising, significant model development and validation remains to be done. NOAA envisions that the NWM will eventually support water quality applications for challenges, such as harmful algal blooms, hypoxic zone development, and contaminant tracking. The vision is for a suite of systems that can:

- Show and predict the movement of water onto and through the nation's land and water bodies.
- Report current weather and water conditions, and make short- (18-hour), medium- (10-day), and long-range (30-day) predictions for all water conditions across the United States.
- Forecast flooding, drought, and water quality events and predict how long these conditions will last. This session will provide a non-technical overview of the NWM and upgrades planned over the next few years.

On-site stream mitigation design and construction for an over widened bedrock channel.
Ken Barry S&ME, Inc.
(Abstract No. 5)

Many stream mitigation projects use the natural channel design methodology. But this approach is not always applicable, particularly when performing on-site mitigation, where the constraints of the site often dictate what is possible. This presentation provides a look at the challenges of designing and constructing an on-site stream mitigation project comprising the enhancement of 850 feet of perennial stream channel lying on bedrock with adjacent fringe wetlands. Because the stream profile follows existing bedrock and the fringe wetlands were not to be disturbed, neither plan form realignment nor profile modification were proposed. For this reason, a reference reach was not considered in the final design. The project challenges included design and construction of an appropriately dimensioned channel on bedrock while minimizing impacts to the adjacent wetlands. Baseline data for the existing stream were collected and used to establish a bankfull discharge for the proposed design. The existing channel dimension values were compared with published regional curve data for Ecoregion 71i to calibrate bankfull for the observed cross sections. Following calibration to the observed bankfull discharge, the slope was calculated based on the length of the existing alignment, and a new riffle cross section was developed. This restoration design implements a novel approach for using coir blocks to form the new channel cross section on the bedrock surface.

Who's on First? The Status of Water Law and Policy in Mississippi and Alabama. **Bennett Bearden,** Geological Survey of Alabama, Jimmy Palmer, Attorney at Law, Oxford, Mississippi, Nate Broadhurst, Water policy and Law Institute.
(Abstract No. 7)

Water law and policy are linchpins for sound water resources management. Responses to water management typically focus on economic, technical, and political solutions that emphasize augmenting supplies, reducing demand, encouraging efficiency and conservation, and proposing various policies and governance schemes. Such approaches often do not address functional legal and policy regimes which can serve as a foundation for implementing the solutions. Water laws and policies enable states to analyze fundamental water resources issues critical to the vibrancy of a water-dependent economy. While it is common knowledge that Mississippi's water resources laws and policies are significantly more robust than those in Alabama, what is commonly overlooked is how this reality came to be in the first place. To be sure, the citizens of Alabama and Mississippi are true kindred spirits in virtually every aspect of our heritage, our values, our cultures, our laws, and our never-ending efforts to ensure an enhanced quality of life for our peoples. But, these commonalities acknowledged, the two states have evolved at different paces with respect to how their land, air, and water resources are now utilized, managed, and protected, and that evolution is most evident regarding water resources.

Buy One, Get One Free: Integrating Ecology and Hydrogeology to Conserve Alabama's Burrowing Crayfish Populations and Groundwater Resources. **Rebecca Bearden**
Geological Survey of Alabama
(Abstract No. 6)

Combine the desire to establish conservation opportunities for a diverse and understudied group of aquatic species with the need to learn more about Alabama's groundwater resources, and the result is a research direction that uses borrowing crayfish habitat preferences to bridge the gap between ecology and hydrogeology. Because burrowing crayfish spend most of their lives in subterranean burrows far from surface water, they rely heavily on access to shallow groundwater, a resource that may be more limiting during periods of drought or subject to periodic withdrawals to satisfy human demands. In order to better understand the dynamics of shallow groundwater movement and its relationship to the habitat needs of burrowing crayfish, I am measuring groundwater flow, groundwater quality, soil characteristics, and the floodplain inundation frequency of a 10 km reach of Bogue Chitto Creek in the Blackbelt Prairie region of Alabama. The results of this research will provide information needed to address potential habitat threats through a watershed management plan focused on burrowing crayfish conservation and supply groundwater flow data useful in the development of a statewide groundwater monitoring program.

The long-term effects of stream restoration on water quality, nutrient uptake, and whole-stream metabolism in sandy-bottom, coastal plain streams. **Sam Bickley, A**uburn University, Dan Isenber[2], Natalie Griffiths[3], Brian Helms[2] & Jack Feminella, Auburn University, [2] Troy University, [3] Oak Ridge National Laboratory,
(Abstract No. 8)

Instream restoration through coarse woody debris (CWD) addition is a low-cost and simple process that increases retention of organic matter, increases hydrologic complexity, and decreases water velocities. Few restoration projects evaluate efficacy after restoration, and even fewer look at long-term (decadal) responses. Here, we evaluate the long-term efficacy of stream restoration, 14 years later, on water quality, nutrient uptake, and whole-stream metabolism (ecosystem respiration and gross primary productivity). Four streams within Fort Benning Military Installation, GA were restored with the addition of CWD dams in 2003 and evaluated for 1-3y. Following restoration, nutrient uptake and ecosystem respiration rates increased, whereas water quality metrics and gross primary productivity rates did not change, as compared to 3 unrestored streams. Beginning in spring 2017, we measured ammonium uptake, stream metabolism, and water-quality metrics in all 7 streams. Preliminary results suggest that ammonium uptake and ecosystem respiration rates are no longer elevated in restored vs unrestored streams 14-years after CWD addition. Further, water-quality metrics and gross primary productivity rates have still not responded to restoration. Data will continue to be collected through fall 2018. Our 1.5 year-long dataset will be one of the few that assesses the long-term efficacy of restoration on stream ecosystem function.

TNC's Watershed Approach to restoring the Gulf. **Darryl Boudreau**, The Nature Conservancy
(Abstract No. 10)

Billions of dollars will be spent on restoration in the Gulf of Mexico as a result of the Deepwater Horizon (DWH) Oil Spill. Although that is a huge amount of funding, it dwarfs the needs in each of the five Gulf states. Therefore, it is imperative that the funds are spent wisely, on the projects that will have the greatest impact on restoring and protecting the Gulf's natural resources. In Florida's Panhandle, this challenge is being met using a watershed-based approach. Recognizing the opportunity and challenge, the Florida Chapter of The Nature Conservancy (TNC) has been leading the effort to create Estuary Programs (EPs) in Florida's Panhandle based on the Environmental Protection Agency's highly successful National Estuary Program (NEP) model. The goal of the NEP process is simple and elegant "protect and restore the water quality and ecological integrity of estuaries" by identifying the most important problems facing the estuary and fixing them. To accomplish that goal, NEPs bring federal, state and local governments, businesses and industry, academia, non-governmental organizations, and citizens together using a science-based, collaborative, and non-regulatory, process. The process is locally driven and involves all stakeholders to ensure that the community and watershed issues and solutions are clearly understood from all perspectives. Issues having the greatest impact on the health of the watershed are identified and projects that have the greatest return on investment to address the issues are developed, prioritized and funded. The value of the NEP process is clearly demonstrated by the success of the Tampa Bay NEP (TBNEP). The TBNEP's goal was to restore the seagrass coverage in Tampa Bay to pre-development coverage. Using the NEP process, they met that goal years ahead of schedule. Establishing EPs in Florida's Panhandle early in the DWH restoration process, will help ensure the greatest impact of those restoration dollars. This session will provide an overview of TNC's effort to create Estuary Programs in the Panhandle and the successes to date which include: generating broad based support for and use of the watershed approach as an organizing principle for allocating DWH funds; three Panhandle watershed regions vying for RESTORE funds to develop an Estuary Program; $2M from RESTORE to create the Perdido/Pensacola Bay Estuary Program; formation of the Choctawhatchee Bay Estuary Program (currently being self-funded by Okaloosa County using a portion of their DWH funding); and the funding of several watershed scale projects. It will be vital for AL and FL organizations to participate in this process to ensure its success. Applying a watershed-based approach throughout the Gulf will bring economic and environmental stakeholders together to work cooperatively on improving the health and economic well-being of gulf coast communities and their watersheds.

Partnering with State Agencies to Provide Environmental Education to Schools. **Ashley Campbell**, City of Daphne
(Abstract No. 11)

Through funding with an ADEM 319 Grant, the City of Daphne had planned on creating an education outreach program for Daphne schools. But to their surprise, the City found a hidden jewel in the Master Environmental Education (MEE) Program. The MEE Program was created by the Baldwin County Alabama Cooperative Extension Systems to allow volunteers to use their skills and passion for the environment to teach students about its value to their quality of life.

A Decision-Support System for Assessing Sea Level Rise Impacts. **John Cartwright**
Mississippi State University
(Abstract No. 12)

Effects of rising sea levels are already evident in many coastal communities. State and local decision-makers need to be pro-active in evaluating impacts of sea level rise on critical infrastructure. The cost of remediation following a flooding event is considerably higher than the preparations to avert or limit the impact of sea level rise on coastal communities. The Geosystems Research Institute at Mississippi State University has developed an interactive, web-based tool to allow decision-makers to simulate sea level rise along the Mississippi coast. GeoCoast is a publicly accessible website allowing users to select a potential elevation above current sea level, and evaluate and visualize the effect. Current capabilities include traffic routing over the local road network allowing users of GeoCoast to identify an origin and destination to witness the model's rerouting of traffic around the inundated landscape, including impacts on critical infrastructure. A graphic overlay is also displayed depicting the depth of flooded areas. The user is also able to identify critical infrastructure either flooded or isolated due to inundated conditions around the facilities. The inundation model employed is based on the relatively simplistic "bathtub" or linear superposition approach, using QL2 lidar data from 2015. Efforts are currently underway to develop a more robust sea level rise model utilizing readily accessible data inputs while maintaining a user interface suitable for non-technical state and local decision-makers. Additionally GeoCoast3D (Beta) is being tested to improve visualizations of sea level rise scenarios in these communities.

Dam removal monitoring on Big Canoe Creek and others using the High Definition Stream Survey. **Brett Connell** & James Parham**,** Trutta Environmental Solutions
(Abstract No. 13)

The High Definition Stream Survey (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. Big Canoe Creek was first surveyed using the HDSS system in 2013 prior to the removal of Goodwins Mill Dam. A follow up survey was completed in 2016 with the same Bank Condition assessment being completed on each tracklog and the results easily compared. Results from this analysis will be discussed as well as other findings and recommendations for optimal restoration.

Observations of Wind Forcing Effects on Estuary Length and Salinity Flux in a River-Dominated, Microtidal Estuary, Mobile Bay, AL. **Jeffrey Coogan** & Brian Dzwonkowski
Dauphin Island Sea Lab / University of South Alabama
(Abstract No. 14)

Using long-term records (11 years) of salinity and 390 days of ADCP data, aspects of the estuary length and salinity flux were evaluated in Mobile Bay under a range of river discharge, tidal, and wind conditions. The temporal variability in the salinity structure was represented by the estuary length, and showed a relationship of Q_R^{-1/7} with respect to river forcing, similar values have been observed in San Francisco Bay and Delaware Bay. Local wind forcing was observed to play a role in modifying this Q_R^{-1/7} relationship, in which estuary length responded asymmetrical to along-channel winds with up estuary winds reducing the salinity intrusion length. To further explore potential salinity transport changes associated with the wind, a 1D salinity flux was calculated using the ADCP and salinity profile data. River discharge was the main forcing condition driving seasonal changes in salinity flux. At shorter time scales the wind became a dominate forcing condition, and drove large changes in the salinity flux during low discharge periods. At all discharge levels down estuary wind conditions enhanced the shear, and subtidal exchange. During up estuary wind conditions, the two-layer flow was inhibited and reduced the exchange. These results indicate that in a shallow microtidal system, wind can play a large role in modifying the estuary length and intrusion on scales comparable to the spring-neap changes observed in other systems.

Raw Sewage Surface Discharge from Homes in Rural Alabama- Impacts on Surface Water Quality. **Parnab Das,** Aaron Blackwell, & Mark Elliott – The University of Alabama (Abstract No. 15)

The 80 million people in US are responsible for treating their own wastewater onsite; most of these use a conventional septic system. Conventional septic systems require percolation of wastewater through the subsurface, which enables further treatment through filtration and natural degradation processes. Some soil and geological conditions (e.g., impermeable clay, shallow bedrock, and high water tables) cause conventional septic systems to fail; in these conditions, expensive alternative systems are employed typically. When lack of access to sewer coincides with unsuitable soil conditions and poverty, rural residents are left with no affordable options to treat their wastewater. In large parts of central Alabama, soils are characterized by impermeable clay and a shallow impermeable chalk layer. There have been various reports on the use of so-called 'straight pipes' in rural Alabama where the residents instead of treating their wastewater are discharging them onto the ground but there has been no quantification of this contamination reported so far. Our preliminary data from a site inspection survey of 10% of unsewered homes in Wilcox County indicate that the majority of these homes discharge untreated wastewater onto ground based. Based on the population and typical daily wastewater production and pathogen concentrations in untreated wastewater, conservative estimates indicate that hundreds of thousands of gallons per day of raw sewage are discharged onto the ground in Wilcox County alone, resulting in tens of millions of infectious pathogens discharged into the environment daily. Not surprisingly given these statistics, there is also troubling evidence of adverse health impacts. Due to storm, all these contaminants coming from the failing septic systems and the straight pipes might wash off in large water bodies like lakes and rivers. The people who are using this water for their recreational and irrigation purposes might be introducing the bacteria and other contaminants in their system unknowingly. Thus, there was a need to establish a research plan, which primarily involved the following major tasks: (1) site identification and drainage feature map development, (2) multiple-indicator water sampling, principal component analysis (PCA) and preliminary conclusions, and (3) outreach and raising awareness with numerous stakeholders. We started sampling at eight sites on Big Prairie Creek (upstream, midstream and downstream) of Newbern, a town in central Alabama known to have a high prevalence of straight pipes. Fecal indicator bacteria (FIB) increased only slightly from upstream to downstream during dry weather but following storms increased up to 1000x. We also used molecular methods to detect human bacteroides, total bacteroides and enterococcus markers in the tested water. These results indicate that wastewater discharge from straight pipes accumulates on the ground during dry periods and washes into nearby streams during precipitation.

Assessment of fecal contamination sources in surface water. **Yucheng Feng**, Auburn University
(Abstract No. 18)

Fecal contamination of surface water is a significant public health concern because environmental waters serve as drinking water supplies and are used for recreational activities and food production. Despite efforts to minimize fecal input into waterways, fecal contamination persists worldwide. Fecal contamination in a watershed often comes from multiple sources. Without source identification, pollution cannot be controlled cost-effectively. In the past two decades, advancements in molecular biology have led to tremendous progress in the identification of fecal contamination sources. The library- and cultivation-independent microbial source tracking (MST) methods, based on polymerase chain reaction (PCR) assays that target host-associated molecular markers, have been widely used. These MST methods can provide information that reflects recent fecal pollution and pinpoint sources, thus facilitating implementation of better strategies to protect humans against health risks posed by polluted water. The recent developments in the MST field and case studies conducted in Alabama will be discussed.

Exploring technology in water resources. **Amanda Fleming**, Kleinschmidt
(Abstract No. 19)

Effectively communicating data and science in layman's terms to diverse public audience attendees is a challenge for many Water Resource professionals. This session will describe new tools and activities that can change the perception of Water Resources work, as we succeed in helping others understand the work we do. It will focus on specific technology examples and the topics will include: mobile applications, websites, media in presentations, 3D modeling, and drone usage. The session will also include an interactive forum for participants to discuss both the use of new technologies and using existing tools in unique ways.

Resilience and Recovery: A Three Year Biodiversity Assessment of oil-impacted Salt Marsh and the Effect on Denitrifying Microbial Communities. **Nikaela Flournoy**, Corianne Tatariw, Patrice Crawford, Behzhad Mortazavi, & Patricia Sobecky, The University of Alabama
(Abstract No. 20)

Salt marshes are coastal wetlands that support critical services (e.g., water quality protection, mitigation of shoreline erosion, sediment trapping, fisheries nursery, recreation/tourism). As these coastal wetlands undergo more frequent and intense threats in this century arising from chronic (e.g., rising sea levels, climate change, invasive species) and pulse (i.e. oil spills, flooding, superstorms) disturbances, communities are faced with daunting economic losses. Events such as the 2010 Gulf of Mexico oil spill disaster coupled with significant population changes in human land use and an expanding invasive population of *Avicennia germinans* (black mangrove) act as add-on catalysts to further accelerate deterioration and loss of barrier islands, particularly those at low-elevation such as the Chandeleur Island chain. The Chandeleur island chain's native vegetation is primarly *Spartina alterniflora* (saltmarsh cordgrass). However, black mangrove (*Avicennia germinans*), an invasive species is also present. Oil impacted the barrier island chain to varying degrees; therefore, it was important to investigate the microbally-driven ecosystem service, denitrification, a nitrogen (N) cycle pathway. While oil can inhibit microbially mediated denitrification, nitrification and denitrification processes have been found to be relatively low in A. germinans sediment. The objective of this three-year study was to: i– determine microbial biodiversity along an oiled vs non-oiled/S. alterniflora vs A. germinans sampling gradient, ii– compare and contrast the impact of expanding black mangrove on microbial biodiversity and iii– determine the effect of oiling on denitrifier biodiversity and denitrification potential using nirS, norB, and nosZ functional marker genes. Alpha diversity indices, measured Year 1-3, were highest during warmer months. *A. germinans* sites exhibited a higher diversity of microbial taxa associated with Deltaproteobacteria (known sulfur oxidizing/hydrocarbon degraders) when assessed in Y3 as compared to Y2. Interestingly, denitrifier alpha biodiversity was consistent for *S. alterniflora* marsh samples for the three-year study and were variable among sites that were either oiled or were associated with *A. germinans*. As weathered oil continues to be detected at our study sites 8-years post spill, it will be important to continue to evaluate the impact of oil and invasive species such as *A. germinans* on vital microbial geochemical processes which act to remove nitrate so as to reduce available N in the system that contributes to eutrophication and further poor water quality.

Deriving Actionable Intelligence from NOAA's National Water Model to Support Impact-Based Decision Support Services. **Whitney Flynn** & Monica Stone, National Water Center (Abstract No. 21)

As a significant step forward in transforming NOAA's water prediction services and providing forecast streamflow guidance to underserved locations, NOAA implemented the National Water Model (NWM) in August 2016. A continental-scale water resources model, the NWM is an implementation of the WRF-Hydro architecture developed by the National Center for Atmospheric Research (NCAR) and its international collaborator community. Users of the NWM output need to be able to visualize and quickly synthesize key water budget variables of the water cycle (e.g. streamflow, precipitation, soil moisture, etc.). This is especially challenging because the NWM generates hundreds of gigabytes of data each day (with over 1 billion streamflow values in the short-range forecasts alone). Thus, methods are needed not only to display model output, but also to detect and evaluate events of interest, such as floods and droughts. This presentation will highlight some of the development work being done at NOAA's National Water Center (NWC) in Tuscaloosa, Alabama to post-process, visualize, and disseminate NWM data in such a way that it can be used to inform decision support services.
One of the locations of the National Weather Service (NWS) Office of Water Prediction (OWP), the NWC has begun to develop a platform that will host a series of dynamic, interactive web maps and applications that will display hydrologic information for the nation - both current and forecast conditions - in near real-time. This will be accompanied by a set of geoprocessing tools that will allow users to generate similar visualizations on their own for other dates and times and/or areas of interest (i.e. for retrospective studies or local analysis). Visualizing NWM hydrologic data requires consistent methods for defining high flow, low flow, bankfull, and flood conditions, all of which are being continuously evolved and validated. Examples of these methods, services, web maps, and tools will be demonstrated during the course of this presentation. Through stakeholder engagement and continuous validation of these tools and services, this effort ultimately seeks to effectively conceptualize NWM output through visualization services (dynamic maps, tools, etc.) and communicate that information in a language that is useful and supports decision making.

GIS Water-Info: Enhanced Water Related GIS Applications. **Lynn Ford**, ADEM
(Abstract No. 22)

The Alabama Department of Environmental Management (ADEM) strives to assure for all citizens of the State a safe, healthful, and productive environment. Our web-pages and applications are designed to inform the citizens as they live and work in Alabama. In the past year, ADEM was involved in several projects to enhance some of our water related GIS web-pages. This presentation will discuss these projects and the GIS web-pages that were created as a result. It will show how providing relevant and timely information can be made possible using GIS. This presentation will demonstrate how to use these applications and discuss the benefits derived from them. We will look at Fish Consumption Advisories and Sanitary Sewer overflows. We will also review some of our older application and tell you what to expect for the future.

Using uncertainty quantification to develop a groundwater model of the Coastal Lowlands Aquifer System. **Linzy Foster** U.S. Geological Survey - Texas Water Science Center (Abstract No. 23)

Traditional groundwater model development proceeds from model dataset construction to deterministic history-matching (calibration), where model parameters are adjusted to reproduce past observations of system state, such as water levels, fluxes, and base flow. A subsequent step in a traditional model-development workflow is creation of a predictive forecast model to answer a question regarding a potential future scenario. Uncertainty quantification (UQ) is rarely applied to groundwater models. When applied, UQ provides quantifiable estimates of both parameter uncertainty and the effects of parameter uncertainty on model predictions. In contrast to traditional model development, with a forecast-first model-development workflow, quantities of interest (QoIs) are specified early in the process, and UQ is used to guide further model improvements. This forecast-first workflow is being applied to a new groundwater model of the coastal lowlands aquifer system (CLAS), a principal aquifer which extends geographically along the Gulf of Mexico from the U.S. (Texas)/Mexico border through the Florida panhandle. In 2016, the U.S. Geological Survey began a 5-year study focused on understanding groundwater availability, water budgets, and the existing monitoring-well network in the CLAS. A new MODFLOW 6 groundwater model is in development to improve understanding of the groundwater system and make predictions of QoIs, such as water levels, subsidence, and base flow in streams. First-Order Second-Moment (FOSM) analysis is being implemented early in the development process using the USGS PEST++ and pyEMU suite of software. The UQ is used to guide next steps in development by quantifying changes in predictive uncertainty resulting from a specific model update. Given the large extent of the CLAS and the importance of the groundwater resources to users, many groundwater models have been developed in the study area in recent decades. Data from these models and literature values are being compiled to provide initial estimates of property and boundary-condition uncertainty, which is called the prior. These models also provide a jumping-off point for model development through use of model-derived time series of pumping, aquifer properties, recharge, and other boundary conditions. Incorporation of the prior uncertainty with FOSM analysis will allow for early estimation of the groundwater model's predictive uncertainty. As the model is improved, knowledge of predictive uncertainty will help guide additional model refinement as part of an iterative process. For example, if an updated hydrogeologic framework is implemented, the UQ may indicate how much that framework improved the model's reliability in making a forecast. As a result, the final model ensemble will provide improved estimates of regional groundwater resources and the water budget, while also giving scientists and users an evaluation of the strengths and weaknesses of the model in making predictions of QoIs.

Sources of Water Quality Indicators to a Shellfish Growing Area in Portersville Bay, AL
Ashley Frith, University of South Alabama, Dauphin Island Sea Lab, Kevin Calci, U.S. Food and Drug Administration, Ruth Carmichael, University of South Alabama, Dauphin Island Sea Lab.
(Abstract No. 105)

We evaluated sources of water quality degradation to Portersville Bay, AL, an important area for shellfish aquaculture, by measuring water quality indicators in West Fowl River, adjacent shoreline sites, and a wastewater treatment plant outfall. We measured bacterial and viral indicators of fecal pollution, fecal coliforms (fc) and male-specific coliphage (MSC), respectively; nutrients; and stable isotope (δ15N, δ13C) ratios as indicators of water quality at potential source sites and near shellfish farms under different temperature and rainfall conditions. Fc concentrations across all sites ranged from <5 to 5250 CFU/100 mL, with the highest fc concentrations consistently in West Fowl River. The river system was strongly influenced by rainfall, with elevated fc concentrations at all sites after rain events. Within West Fowl River, one tributary associated with greater human population density had high fc concentrations regardless of environmental conditions, suggesting a persistent source of pollution at this location. In contrast, other tributaries had increased fc concentrations only during wet periods, suggesting that these sites are fed by runoff and may be a pulse source to the river following rainfall events. Although MSC were found, 46% of samples were below the limit of detection (9.9 CFU/100 mL). Nutrient concentrations varied throughout the study but did not show consistent differences across sites. Carbon stable isotope ratios were heavier in river sites than in other areas and decreased at all sites during wet sampling periods, indicating greater freshwater influence following rain events. Nitrogen stable isotope ratios were lighter during wet sampling periods, and 40% of samples with fc >200 CFU/100 mL had light δ15N ratios (<5‰), which could suggest a source of animal waste. These results indicate that sources of contamination in West Fowl River are largely driven by rainfall, and specific locations in the river may be hotspots that represent potential sources of contamination to shellfish farms in Portersville Bay. These data contribute to our identification and understanding of fecal sources of water quality degradation to Portersville Bay, which can inform modeling, further sampling, and enforcement efforts to improve the local water quality for recreation and aquaculture.

Impact of Agricultural Management Practices on Soil Health and Water Dynamics,
Audrey Gamble, Auburn University
(Abstract No. 24)

Many soils in the Southeast are severely degraded due to the humid climate, coarse soil texture, and intensive row cropping systems used in the region. As demand for food increases under a variable and changing climate, methods for sustainable crop production must be identified to improve soil health, reduce nutrient runoff, and increase soil water retention. Increased adoption of cover crops (i.e. crops grown to provide benefits to the soil when cash crops are not actively growing) in Alabama has potential to create sustainable row-crop production systems while protecting Alabama soil and water resources. Studies in the Southeast have shown that soil conservation management practices which combine cover crops with conservation tillage can improve soil health by increasing soil organic matter storage, improving soil fertility, reducing soil water evaporation, and enhancing soil water infiltration. Approximately 7.2% of Alabama producers reported using cover crops in the 2012 agricultural census. An effort to increase acreage of cover crops in Alabama is currently being led by Auburn University, the Alabama Cooperative Extension System, the USDA Agricultural Research Service, the USDA Natural Resources Conservation Service, and the Alabama Soil and Water Conservation Committee. An overview of outreach efforts to increase cover crop adoption will be presented during this presentation, as well as a summary of past and current research on soil and water dynamics related to soil conservation practices and cover cropping.

Tracking wastewater influence in a freshwater dominated urbanized estuary. **Haley N. Gancel** & Ruth H. Carmichael, Dauphin Island Sea Lab / University of South Alabama, Kevin Calci & William Burkhardt III, Food and Drug Administration Gulf Coast Seafood (Abstract No. 25)

In freshwater-dominated urbanized estuaries, the combination of wastewater treatment plant (WTP) and riverine discharge increase nutrient and microbial loads to coastal systems. These inputs can degrade water quality in shellfish harvesting areas and limit commercial harvest of shellfish such as oysters. To determine wastewater influence on oyster grow-out locations in the Mobile Bay/Mississippi Sound (MB/MS) system, we measured nutrients (NO3, NO2, NH4, PO4, TDN) in water and indicators of sanitary quality (fecal coliforms and E. coli [bacterial], male-specific coliphage [viral]) and C, N, and S stable isotope (SI) ratios in water and tissues of transplanted adult oysters. To determine the relative influence of wastewater sources, WTP and riverine nutrient and microbial loads were calculated and compared to nutrient and indicator microorganism concentrations at transplanted oyster sites. Nutrients and indicator microorganisms were typically highest at northern sites (nutrients: 2-10X; microbial indicators in oysters: 50X [bacterial] and 133X [viral]) near the Mobile River discharge and a major WTP (>25 MGD); however, during periods of high riverine discharge (>5000 m3/s) to the MB/MS system, nutrients and indicator microorganisms in water increased 2X and 7X, respectively, at sites down-Bay. In MS, wastewater indicator concentrations were not related to this high discharge event and quickly decreased with distance from river and WTP sources, likely due to a combination of inactivation and sedimentation of indicator microorganisms. SI ratios in water and oysters typically incorporated N SI signatures of nearby riverine sources within 0.5 and 1.5‰ respectively (with the exception of those closest to a major WTP outfall), indicating the dominant influence of local river inputs to nutrient loads. Nutrient and microbial loads to transplanted oyster sites further showed that riverine discharges are the major source of wastewater influence to the system, but WTPs can still be a dominant source of nutrient and microbial input when the flow rate is high (>32 MGD). The major riverine sources, including discharge from the Alabama-Tombigbee river system and local Mobile County riverine inputs, to the MB/MS system are concentrated in northern MB and have limited influence on the primary shellfish harvesting areas located in MS. Future land-use change and anthropogenic effects, however, may alter current patterns of wastewater influence, potentially increasing nutrient and microbial pollution to local shellfish harvesting areas.

U.S. Geological Survey NAWQA Surface-Water Quality Sampling in Alabama – Summary of Recent Results. **Amy Gill,** U.S. Geological Survey
(Abstract No. 26)

The U.S. Geological Survey (USGS) National Water Quality Assessment (NAWQA) Project collects and interprets water-quality data to describe the status of our Nation's water resources. Since 1991, surface-water samples have been collected from long-term monitoring sites to evaluate trends in stream water quality throughout the U.S. Two surface-water sites are located in Alabama: Tombigbee River below Coffeeville Lock and Dam near Coffeeville (USGS Station 02469762) and Alabama River at Claiborne (USGS Station 02429500). Together these two sites represent approximately 92 percent of the drainage area in the 44,000 square mile Mobile River basin. Land use is similar between the Alabama and Tombigbee basins, predominantly forested with approximately 20 percent agricultural use. Samples are collected semimonthly to bimonthly with more samples collected during the spring and summer growing season. Since 2013, samples have been analyzed for nutrient, major ion, pesticide, and selected metal concentrations. These data were examined in relation to changes in season and streamflow and compared to historical datasets. Recent (2013-2017) nutrient concentration data indicated that nitrate plus nitrite as nitrogen concentration in the Alabama River ranged from less than 0.01 to 0.30 milligrams per liter(mg/L) and Tombigbee River concentrations ranged from less than 0.01 to 0.57 mg/L. Total dissolved phosphorus concentrations ranged from 0.011 to 0.038 mg/L at the Alabama River site and less than 0.003 to 0.070 mg/L at the Tombigbee River site. Pesticide data from the same period indicated that atrazine and simazine were among the most frequently detected pesticide compounds. Atrazine and simazine were detected in91 and 89 percent of the samples, respectively, collected from the Alabama River, and 94 and 61 percent of the samples respectively, collected from the Tombigbee River. Median atrazine concentrations were similar at the 2 sites, 25.8 nanograms per liter (ng/L) in the Alabama River and 28.4 ng/L in the Tombigbee River. Median simazine concentrations, however, varied from 22.7 ng/L in the Alabama River to 10 ng/L in the Tombigbee River.

The role of morphometry and hydrology in promoting eutrophication and harmful algal blooms in reservoirs. **Reed Green**, U.S. Geological Survey, Lower Mississippi-Gulf Water Science Center
(Abstract No. 27)

Reservoirs store “legacy” phosphorus in trapped sediment that washes off the surrounding landscape. Historically, internal phosphorus loads in reservoirs have been considered “decimal dust” relative to the large external loads delivered from the contributing watershed. Internal loading occurs under anoxic conditions when stored phosphorus is released from bed sediments and transported to the photic zone during mixing events which promotes algal growth and blooms during the summer thermal stratification season. In this study, the U.S. Geological Survey examined the use of six water-body morphometric measures, hydrology based on a flushing rate, and external nutrient (nitrogen and phosphorus) loads and concentrations as predictors of Secchi depth and concentrations of chlorophyll a and microcystin in 114 natural lakes, 183 headwater reservoirs, and 61 reservoirs downstream of an upstream control structure. All lakes and reservoirs are greater than 0.1 km2 and are located within the eastern United States (National Hydrography Data Set, major river basins 1 and 2). Results will provide a basis for examining the susceptibility of natural lakes, headwater reservoirs, and downstream reservoirs to eutrophication and susceptibility to harmful algal blooms.

Water use efficiency of hybrid bermudagrass cultivars for southeastern turfgrass management. **Elizabeth Guertal**, Auburn University
(Abstract No. 29)

Hybrid bermudagrass (*Cynodon dactylon* x *Cynodon traansvalensis*) is the most common turfgrass for southern home lawns, athletic fields and golf courses. As such, it is critical that we understand the water needs of this grass, especially as new bermudagrass cultivars with touted drought tolerance enter the market. The objective of this research was to evaluate the most common hybrid bermudagrass ('Tifway') and a new release ('TifTuf') for quality and performance under a range of irrigation based on replacement ET. Conducted for two years at the Auburn University turfgrass unit, the study examined color, quality, recovery, rooting and shoot development of the grasses as affected by 4 ET scenarios based on replacement (100, 60, 40 or 25% of ET, with a 60% crop coefficient). Regardless of cultivar, hybrid bermudagrass maintained satisfactory quality at 40 to 60% ET, while the TifTuf often maintained quality at the lowest irrigation rate (25% of ET). Over two years TifTuf had excellent performance in drought, and could be considered for lower maintenance turfed areas, in addition to use on high maintenance surfaces. Both bermudagrass cultivars clearly demonstrated the ability of that grass to withstand continued dry conditions, and that they quickly recover from extended drought when precipitation does occur. Irrigation at 60% of ET was sufficient for most the time this experiment was conducted (April - Sept of each year), as this irrigation rate kept the bermudagrass at an 'adequate' quality rating. Results from this work provide information for landscapers, extension employees and turfgrass managers regarding appropriate watering regimes for hybrid bermudagrass, findings that could result in significant reductions in water use in southern landscapes.

A decade of climate in the Apalachicola-Chattahoochee-Flint river basin: What has changed? **Sandra M. Guzmán** & Puneet Srivastava, Auburn University
(Abstract No. 30)

It is known that droughts and changes in the frequency/intensity of precipitation have a significant effect on the hydrological and agricultural sustainability of a watershed. Over the last decade, we have experienced several intense drought events and intense precipitation patterns. As climate events become more intense, the need to develop strategies that can help ameliorate negative impacts of changing climate increases. One of these strategies is effective communication and presentation of information regarding recent important climate events and their impacts. The National Integrated Drought Information System (NIDIS) in conjunction with the Auburn University Water Resources Center and various state and federal agencies, has been conducting monthly drought early warning webinars for the Apalachicola-Chattahoochee-Flint (ACF) river basin in Alabama, Georgia, and Florida since 2011. These webinars provide an update of the basin's current drought status, streamflow and groundwater conditions, reservoir levels, and salinity. The webinars also provide information about excepted climate conditions, stream flows, groundwater levels, and reservoir levels for the following two months. In this presentation, I will provide a synthesis of the most important drought and rainfall events from these early warning webinars. Also, suggest ways the information contained in the webinars can be used to reduce impacts of impending droughts and other severe climate events.

Statewide Resource Assessment for Irrigation Watershed Planning. **Cameron Handyside,** The University of Alabama in Huntsville - Earth System Science Center & **Eve Brantley** Auburn University - Crop Soil & Environmental
(Abstract No. 31)

Although the Southeast enjoys more annual rainfall than most of the US, it still experiences periodic droughts and the rainfall distribution throughout the year is not ideal for agriculture. In Alabama, agriculture is further impacted because of relatively poor water holding soils and lack of widespread irrigation. In the early part of the last century, the Southeast was a major agricultural producer. It led the country in cotton production and had millions of acres planted in corn as well as a substantial vegetable, nut, sugar cane and rice industries. However, beginning in the 1930s the appearance of the boll weevil and the rise of Western irrigated cotton rapidly reduced cotton production in the Southeast. Southern cotton farmers whose output and quality were hurt by frequent drought losses could not compete with irrigating cotton farmers in California, New Mexico and Texas. For example, cotton acres planted in Alabama dropped from 1.6 million acres in 1952 to 200,000 acres in 1985. There is a need to pursue irrigation expansion and resource conservation in water rich states such as Alabama. According to the agricultural census, Florida had about 1.5 million acres under irrigation (16.8% of all farm land), Georgia irrigated around 1 million acres (10%), Mississippi had 1.4 million (11.9%), and Alabama had only 112, 800 irrigated acres (1.2%). The Natural Resources Conservation Service (NRCS) Alabama office is working with the Alabama Soil and Water Conservation Committee to allocate funding for expansion of irrigation in Alabama. This effort requires a statewide resource assessment (SRA) to prioritize focus areas for expanded irrigation and to identify natural and cultural resources in Alabama that might be negatively impacted by expanding irrigated agriculture. The SRA will include a wide variety of factors at the HUC 8 scale that includes environmental, economic, social and cultural considerations. Each factor will be weighted and mapped to create a list of prioritized watersheds where there is strong interest in irrigated agriculture, limited environmental impact and effective economic development. This presentation will cover aspects of both the overall project and the statewide resource assessment completed to-date.

Developing a Voluntary Green Infrastructure Program. **Byron Hinchey** – S&ME Inc. (Abstract No. 34)

Green Infrastructure (GI) is an approach to stormwater management on land developments that uses vegetation and soil to mimic the natural hydrologic cycle. In Alabama, as in many other states, the use of GI is predominately driven by Municipal Separate Storm Sewer System (MS4) permits. In some states, the MS4 permit mandates the use of GI, while in others it is viewed as a voluntary approach. National politics notwithstanding, the move toward GI will continue and communities subject to MS4 permits will be required, at some point, to incorporate GI into their stormwater management regulations. Some communities are choosing to develop a voluntary green infrastructure program before a program is mandated by state and federal regulations. Developing a voluntary program in advance of regulatory mandates has the advantage of providing much needed lead time to partner with the development community and jointly develop locally desirable and effective green infrastructure practices, regulations, design criteria, and incentives. Naturally, a voluntary program in advance of a regulatory mandate also allows the development community time to adjust to another paradigm shift in stormwater management.

Rainfall simulator to demonstrate BMPs effectiveness to prevent erosion/runoff
Tibor Horvath, USDA - NRCS
(Abstract No. 106)

Soil and water relationships can be described by soil porosity, water infiltration, permeability and available water capacity. Soil porosity refers to the space between soil particles, which consists of various amounts of water and air at any time dependent upon rainfall and evapotranspiration. Porosity depends on both soil texture and structure. Water infiltration is the movement of water from the soil surface into the soil profile. Soil texture, soil structure, and slope have the largest impact on infiltration rate. Permeability refers to the movement of air and water through the soil and is related to porosity. Available water is retained in the soil after the excess has drained, from field capacity to wilting point. Unavailable water is soil moisture that is held so tightly by the soil that it cannot be extracted by the plant. Water remains in the soil even below a plant's wilting point. Soil and water relationships can be adversely affected by soil compaction. The effects of soil health management on soil water relations was demonstrated using soil from the same soil types managed under different cropping systems. Healthy soils which were managed in long term no-till, long term sod or cover crops were compared to soils which were managed using long term conventional tillage with no cover crops. The different soil managements greatly impacted the water infiltration rates, where the healthy soil with good vegetation cover had high infiltration and generated little runoff, while the poorly managed soil with no cover produced high rate of runoff and soil erosion. Conservation Demonstrations LLC of Salina, Kansas developed rainfall simulator equipment to educate farmers and ranchers about the importance of good soil health management practices to improve water infiltration and water holding capacity. Promoting good soil health can be very beneficial in urban conservation where construction sites generate huge amount of sediment movement due to poor soil structure and high runoff rates. During this conference I will bring our soil health demonstration trailer to present on good soil health management practices with a comparative experiment to show how much runoff can be prevented by good soil cover and improved soil structure.

Protecting and Restoring Flows in Our Southeastern Rivers: A Review of State Policies for Water Security and Sustainability in the Southeast. **April Ingle** & Katherine Baer, River Network
(Abstract No. 35)

This session will provide an overview of the findings from the "Protecting and Restoring Flows in Our Southeastern Rivers: A Synthesis of State Policies for Water Security and Sustainability" report. The report covers a comprehensive set of policies starting with the scientific foundations of water budgets, moving to supply management, flow protection, and demand management, and finally management of the built environment. Specifically, the report synthesizes and compares the status of 15 flow-related policies in five Southeastern states and provides recommendations and models for ways to strengthen these policies.
The report examines the following state policies in South Carolina, Alabama, Georgia, North Carolina, and Tennessee:

- Water budgets– Policies relating to gathering and utilizing information on how much water is being used and returned to river basins.
- Managing supply – Policies relating to management of water supply and river flows, including water withdrawal permitting and tracking, interbasin transfer evaluation and water planning.
- Flow protection – Policies relating to both science-based environmental flow criteria as well as mechanisms or policies to apply the criteria, including water allocation and withdrawal permitting policy and water quality standards.
- Reducing Demand – Policies relating to water conservation and efficiency, including managing water loss and integrating conservation and efficiency into withdrawal requirements.

Built Environment – Policies relating to reducing the demand for water and creating more natural systems in the "built environment" that contribute to and replenish our streams and rivers. One example is requiring water fixture and appliance efficiency above federal requirements. Another is encouraging or requiring development, through stormwater permitting, to more closely mimic natural landscapes and hydrology by retaining certain amounts of water on-site.

Developing a Watershed Group Approach for Invasive Species Management.
Kevin Jenne, Choccolocco Creek Watershed; Gayle Macolly Harris & Carol Kirk, Eastman; John Loper & Thomas Loper, The Loper Group, Michael Price, Genesis; & Alan Fowler, Geosyntec Consultants
(Abstract No. 37)

The Choccolocco Creek Watershed is a watershed group formed to protect the waters and riparian corridor of Choccolocco Creek located in northeast Alabama. Choccolocco Creek flows for approximately 65 miles from its head waters in the Talladega National Forest southeast to its confluence with the Coosa River and receives inputs from a surrounding drainage basin that is approximately 500 square miles in size. The upper half of Choccolocco Creek is largely surrounded by undeveloped forestlands, and the lower portion is bordered by a combination of active agricultural lands and managed forestlands. Multiple tributaries provide surface water flow to Choccolocco Creek with several of these feeding the lower half of the creek. One of these tributaries, Snow Creek, flows for approximately six miles through highly developed urban and industrialized areas before entering Choccolocco Creek near its midpoint. In addition to the urban and industrial inputs from Snow Creek, the lower portion of Choccolocco Creek is the receiving waters for several permitted discharges, including two wastewater treatment plants and two industrial point sources. The agricultural lands bordering much of lower Choccolocco Creek are also potential sources for nonpoint pollutants, including nutrients. This presentation provides an update of watershed group activities including a focus on invasive species management activities. There are multiple invasive species in the watershed including aquatic, riparian and upland zones and initial efforts are targeted on invasive vegetation in the riparian zone that is a direct threat to Choccolocco Creek. Several of the critical invasives are vines including kudzu (*Pueraria montana*), English ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), Japanese climbing fern (*Lygodium japonica*), and wisteria (*Wisteria sinensis* and W*. floribunda*). These vines strangle and kill the native species leading to creek bank erosion, nutrient loading, increased sunlight raising surface water temperatures and decreased biodiversity. Our presentation will present plans for developing an invasive species management plan such that location-specific goals within the watershed can be established using a combination eradication, containment or suppression techniques. An important part of developing the invasive species management plan is use of the Early Detection and distribution Mapping System (EDDMapS) to develop a quantitative understanding of the challenges. Results from this mapping will be used during a technical workshop with local and regional stakeholders and subject matter experts to assist in developing the location-specific goals. These goals will assist the Choccolocco Creek watershed in prioritizing plans and resources to address this threat to the watershed.

Assessing Input Uncertainty and Sensitivity of the Process-Based Wetland Water Quality Model WetQual. **Recep Tayyip Kanber,** Auburn University
(Abstract No. 39)

Wetlands are natural ecosystems that have numerous beneficial functions for people and wildlife. One of the most important missions of the wetlands is purifying water through the absorption of sediments and other pollutants from water-bodies. Wetland water quality models are developed to represent real ecosystems and used to monitor changes in aquatic ecosystems; they can be used to make predictions of future wetland water quality. WetQual is a process-based wetland model which simulates nutrients and carbon transformations in wetlands. In this research, two main analysis are conducted in the wetlands that are located Central Valley, CA and Kent Island, MD by using WetQual. Firstly, the impact of wetland bathymetry on wetland water quality and its measurement sensitivity is studied. Simple methods are used to determine the wetland's shape due to the difficulty of measurement in natural wetland geometry. In this part, three different geometries of the selected wetlands are created by using in a range of 10%, 20% and 30% measurement tolerance to identify the effect of wetland geometry on the wetland uncertainty, water quality and what sensitivity the modelers are needed for bathymetry input. Also, the bathymetry of the selected wetlands is changed to make them shallower and deeper to see how the depth and surface area affects the model results. Secondly, the coefficient efficiency of the temperature conversion equation on the wetland model prediction uncertainty is tested. Temperature is the one of the key factors in the wetlands because almost all operations and processes are temperature dependent. Water temperature is needed for the calculations in the model. Due to the lack of water temperature data, the conversion equation is used in the model.

The equation;

$Twater = 5.0 + 0.75\ Tair$

is changed to;

$Twater = a + b\ Tair$

and the coefficients (a, b) are created in Monte Carlo simulations 100000 times with other model parameters to create simulations in a range for 'a' between 1 and 10 and for 'b' between 0.1 and 0.9. The effect of the temperature equation and its sensitivity is identified in this part of the study.

Effect of Current and Projected Agricultural Irrigation Water Withdrawals on Upper Floridan Aquifer in the Lower Apalachicola-Chattahoochee-Flint River Basin, USA. **Ritesh Karki**, Sandra Guzman & Puneet Srivastava, Auburn University
(Abstract No. 40)

The Upper Floridan aquifer (UFA) is one of the most productive aquifers in the United States and is the principal water source for irrigation, industrial, and domestic water uses in the lower Apalachicola-Chattahoochee-Flint (L-ACF) River Basin in Alabama, Georgia, and Florida. With nearly 500,000 irrigated acres from about 4,000 wells, the UFA is a major source of water for agricultural irrigation in the L-ACF River Basin. In recent years, stress on the UFA has increased with increasing agricultural acreage, population, industry, and more frequent drought conditions. This has become a major concern in the region and has led to increasing conflict for water allocation between Georgia, Florida, and Alabama. An increasing trend in monthly withdrawals from the UFA for crop production in the L-ACF is projected by the Georgia State-wide Water Management Plan, which will likely cause further decreases in groundwater levels and increased stress on the UFA. The objective of this study was to evaluate the effects of current and future irrigation water withdrawals from UFA on groundwater levels, groundwater budget, and stream-aquifer fluxes. A three-dimensional groundwater flow model over an area of 4,632 sq-mi of UFA in the L-ACF was developed using the USGS Modular Three-Dimensional Finite- Difference Ground-Water Flow Model (MODFLOW) to simulate the effect of projected increases in water withdrawals on the UFA. The model was calibrated for steady-state and transient conditions for the period 2010 to 2015, which included both wet and dry climate periods. The model was then used to simulate projected irrigation scenarios and quantify the effects of the projected water withdrawals on the UFA.

Using Bayesian Spatial Statistics to Better Estimate Irrigation Water Productivity.
Thorsten Knappenberger, Joey Shaw, & Eve Brantley Auburn University
(Abstract No. 41)

Farmers in Alabama invest into irrigation systems to increase crop yield in normal years and to secure yield during droughts. Data analysis on the field scale for stationary treatments like pivot irrigation is challenging because standard methods under normal theory don't apply. Blocking and replication are essential methods necessary to perform statistical modeling and inference and are widely used in agricultural field experimental designs. Small-plot statistical analysis generally does not work when treatments are deployed on larger sections of a field. Treatments such as irrigation or tile drainage are stationary treatments, which make randomization impossible and statistical analysis a challenge. Such experimental designs result in only a few experimental units but with a large number of observations. Multiple observations per experimental unit are considered as pseudo-replicates and usually the mean value per experimental unit is computed so that any statistical analysis is not skewed in favor of a treatment effect. Without replication, statistical analysis is then not possible because of the lack of residual degrees of freedom. Because blocking and replicating treatments is so widely used only few methods were developed to deal with results from non-replicated and non-randomized experiments. Large on-farm experiments with irrigation and drainage treatments may result in a big number of observations per experimental unit. For instance, thousand of yield data points are collected by a combine harvester - enough data for statistical inference even without replication. Bayesian inference is merely the reallocation of credibility across a space of candidate possibilities and is better suitable to analyze on-farm data than null hypothesis significance testing because it does not require replication and normal distribution of residuals like methods under normal theory do. Additionally, newer Bayesian methods allow to include spatial effects resulting in a better treatment effect estimate. We will present four years of soybean yield data that has been assessed with spatial Bayesian methods to estimate effects of irrigation and drainage on soybean yield and irrigation water productivity on Alabama Black Prairie soils. We will discuss how including spatial components to the statistical model affects treatment estimates and consequently irrigation water productivity assessment. Results from this analysis support farmers estimating how irrigation will affect yield and predicting return on invested capital for irrigation systems. Crop management can then be adjusted to maximize profits and minimize impacts on surface waters.

Streamflow Alteration Assessments to Support Bay and Estuary Restoration in Gulf States – Overview. **Rodney Knight,** USGS, Lower Mississippi-Gulf Water Science Center (Abstract No. 42)

Human alteration of waterways has affected the minimum and maximum streamflow in more than 86 percent of monitored streams nationally and may be the primary cause for ecological impairment in river and stream ecosystems. Restoration of freshwater inflows can positively affect shellfish, fisheries, habitat, and water quality in streams, rivers, and estuaries. Increasingly, state and local decision-makers and Federal agencies are turning attention to the restoration of freshwater flow as part of a holistic approach to restoring water quality and habitat in rivers and streams and to protecting and replenishing living coastal and marine resources and the livelihoods that depend on them. In 2017, the U.S. Geological Survey, in collaboration with the U.S. Environmental Protection Agency, began a comprehensive, large-scale, state-of-the-science project to provide vital information on the timing and delivery of freshwater to streams, bays, estuaries, and wetlands of the Gulf Coast. Ecologically relevant streamflow metrics and measures of streamflow alteration will be developed for streams throughout the five Gulf States and made available via an online mapping tool. An assessment of trends in streamflow delivery to Gulf Coast estuaries will improve the understanding of potential drivers of change in estuarine health. A streamflow accounting model will be developed for one large watershed in the five Gulf States to evaluate and understand how streamflow alteration at locations in the upper basins may influence the magnitude, timing, duration, and frequency of freshwater flows to the Gulf. This model will provide local, state, and Federal officials the ability to evaluate how streamflow withdrawals and reservoir operations throughout the watershed may have altered streamflow metrics and affected freshwater inputs to the estuary.

Key questions this study will help address include:

Gulf-Wide Assessment

- Which streams in the Gulf States have the largest amounts of streamflow alteration?
- What are the gaps in streamflow data for assessing streamflow alteration in Gulf States?
- Are shifts in magnitude, timing, duration, and frequency of freshwater delivery to estuaries due to altered streamflow distinguishable from natural signals?

Large Watershed Assessment

- How far downstream from alteration points do substantial shifts in streamflow metrics occur?
- How sensitive are estuary freshwater inputs to upstream streamflow alterations?
- Is there a threshold of freshwater alteration below which no signal is detected in an estuary?

Fowl River Marsh Study: If You Try Sometimes You Just Might Find You Get What You Need. Alex Beebe University of South Alabama, Ruth Carmichael, Just Cebrian & Brian Dzwonkowski Dauphin Island Sea Lab; **Jason Kudulis**, Mobile Bay National Estuary Program; & John Lehrter Dauphin Island Sea Lab
(Abstract No. 43)

The Fowl River Watershed is one of several intertidal watersheds along the Alabama coast identified for restoration. In 2016, a comprehensive watershed management plan (WMP) for the Fowl River Watershed was developed with funding from the National Fish and Wildlife Foundation Gulf Environmental Benefit Fund (GEBF). The WMP provides a strategy for conserving and restoring coastal habitat types that provide critical ecosystem services and are identified by the Mobile Bay National Estuary Program (MBNEP) as most stressed by human activities. Degraded marsh-covered spits were identified as a top priority in the Fowl River WMP based on severity of threats, stakeholder concern, desire to preserve and protect habitat, ecological value, and cost. To assess current Fowl River marsh health and inform future engineering and design, management decisions, and restoration activities in the Fowl River Watershed, GEBF funds were awarded to undertake a Fowl River Marsh Health and Recovery Study (Marsh Study). Before releasing a traditional Request for Proposals for the Marsh Study, MBNEP sought input from its Science Advisory Committee (SAC). Comprising technical experts with a diverse range of skill sets, the SAC is charged with assessing the health of the estuary and coastal resources through identification of areas of stress and data gaps. After brainstorming a Marsh Study in anticipation of RFP development, it became clear that no other group or firm was better suited to undertake this comprehensive project than active SAC members. MBNEP extended an invitation to interested SAC members with appropriate expertise to come together to develop a Scope of Work. The greater SAC reviewed the team's multi-pronged approach to characterize Fowl River sediment, vegetation, and hydrology. With no objections and a high level of enthusiasm, the proposed Scope of Work was approved, and principal investigators were contracted. Currently underway, this SAC-driven pilot project represents the first time MBNEP has formally charged SAC members with undertaking a project of this magnitude. To date, the collaboration, resource sharing, and cooperation have borne fruit as the project team works together to find answers to questions that will vastly improve understanding of conditions in Fowl River. When completed, we may better understand conditions in the brackish transitional zone of Fowl River than in any other estuarine system in coastal Alabama. Information gathered during this comprehensive assessment of marsh condition will also be transferable to other coastal watersheds facing similar threats, ultimately saving time and money and adding value to restoration efforts elsewhere.

Update on NFWF-Funded Steam Restoration Projects in the D'Olive Watershed in Baldwin County, Alabama. **Paul Lammers**, Mobile Bay National Estuary Program
(Abstract No. 44)

The Mobile Bay National Estuary Program secured National Fish and Wildlife Foundation and Alabama Department of Environmental Management Section 319 grant funds to comprehensively restore degraded streams and wetlands to reduce sedimentation into D'Olive and Mobile bays. The D'Olive Creek Watershed Management Plan (2010) described factors underlying excessive erosion and sedimentation, identified most critically-degraded stream reaches, and recommended immediate restoration measures to prevent future degradation, reduce sediment sources, and prevent future degradation. The watershed's three principal tributaries (along with two unnamed tributaries) are included on the State's 303(d) list of Impaired Waters due to excessive sediment and habitat alteration.

Stream restoration along the Eastern Shore of Baldwin County is not a trivial pursuit. With significant topographical relief, layers of erodible sand and clay, an average of five and a half feet of hard rain falling annually, and hardened urban landscape, this area represents "the perfect storm" of stormwater impacts, including flooding and flashiness, streambank erosion, wetlands degradation, and sedimentation. Already benefitting from sediment loading analyses provided by the Geological Survey of Alabama, MBNEP secured the services of a nationally-recognized stream restoration expert to guide the design, engineering, and management of projects being implemented simultaneously. Local engineering contractors also sought input from consultants to design restoration strategies capable of withstanding enormous sheer stresses to which the coastal streams of south Alabama are frequently subjected.

With over 12 projects completed or in some stage of advancing through design and implementation phases, MBNEP will provide an update, share lessons-learned and solutions developed to the challenges encountered in implementing the steam restoration projects.

The impact of nutrient loading on nitrogen removal in a Juncus roemerianus and Spartina alterniflora saltmarsh in the northern Gulf of Mexico. **Taylor Ledford**, Corianne Tatariw, Julia Cherry, Alice Kleinhuizen. & Behzad Mortazavi, The University of Alabama / Dauphin Island Sea Lab
(Abstract No. 45)

Increased human-derived nutrient input to coastal waters can lead to eutrophication, anoxia or hypoxia, and/or loss of native or important species. Coastal marshes help to counteract eutrophication by removing excess nitrogen (N) through microbially-mediated denitrification. Vegetation type can regulate marsh N removal by modifying redox potential and altering the microbial community structure within sediments. Carbon (C) release and uptake between terrestrial and atmospheric pools are also greatly affected by plant community structure. While plant productivity drives atmospheric C uptake through photosynthesis, terrestrial C can be released to the atmosphere after respiration. The role of different plant types in mediating N removal and C exchange, and their responses to increased N loading, remains to be determined. The objectives of this study are to evaluate rates of denitrification in marshes dominated by two common marsh grasses (*Juncus roemerianus* and *Spartina alterniflora*) and changes in N removal capacity and C dynamics in response to elevated N loading.

We are conducting a field study in a salt marsh located on Dauphin Island, AL, where we are increasing inputs of N and phosphorus (P) by 20 g N m-2 yr-1/ 1.25 g P m-2 yr-1, or 40 g N m-2 yr-1/2.5 g P m-2 yr-1, in plots dominated by either J. *roemerianus* or S. *alterniflora*. Treated plots (n=3 per treatment, per species) are enriched with nutrients at monthly intervals while controls (n=3 for each species) only receive ambient nutrients. We are measuring seasonal rates of denitrification, anaerobic ammonium oxidation (ANAMMOX), and dissimilatory nitrate reduction to ammonium (DNRA) in the plots using the isotope pairing technique.

In the controls, N removal was 4X higher in J. *roemerianus* than in S. *alterniflora* plots (LME, p=0.015). However, denitrification rates in J. roemerianus plots were similar across all treatments (LME, p = 0.0858). Conversely, N loss in S. *alterniflora* plots receiving excess N and P exceeded losses in the control plots by an order of magnitude (p = 0.009). DNRA rates were 54% higher in S. alterniflora plots than J. *roemerianus* plots (LME, p = 0.0006), although there is no treatment effect for vegetation types (LME, p=0.355). Primary productivity was 14% higher in J. *roemerianus* plots than S. *alterniflora* across all treatments (LME, p = 0.017). Primary productivity in J. *roemerianus* plots was 32% higher in high treatment compared to the other two treatments (LME, p=0.0002), while S. *alterniflora* plots receiving higher N&P inputs were 60% more productive (LME, p=0.0001). Our results suggest the J. *roemerianus* is better at removing N at current nutrient input levels; however, with increasing nutrient inputs, S. *alterniflora* has a higher N removal capacity. Furthermore, while C uptake rates are typically higher in J. *roemerianus*, S. *alterniflora* will be more productive at higher nutrient inputs.

Engaging Stakeholders in Water Resources Planning. **Andrew Leeds,** Scott Phillips & Ronald Thompson, STRADA Professional Services
(Abstract No. 46)

Stakeholder engagement is more than just a legal requirement. It is vital for the long-term success of many projects, but even more so in the field of water resource planning. Since many water planning projects are expensive and complex, a higher standard of engaging stakeholders is necessary. Stakeholders in water resource projects include the general public, corporations, environmental groups, local government(s), regulators, as well as upstream & downstream water users. The interconnected nature of the water system spreads the effects of water-related projects to a much larger area. Therefore, it is vital to consider who a project influences and affects, and to make an effort to educate and engage them in a positive way. The objectives of stakeholder engagement vary, but typically include: input and acceptance from the affected public, management of risks and uncertainties, and education. The difference between effective and poor stakeholder engagement is often a poor mindset or approach, not a confusion of these objectives. Effective stakeholder engagement is proactive, not reactive. It strives to identify stakeholders and engage them early in the process. Stakeholders may be critical or confrontational if they feel they are being informed of fundamental decisions that have already been made, rather than being included in the early stages of the process. Thorough stakeholder engagement should inform both sides. An informed public can better participate in the decision-making process. In return, parties involved in the project can learn what aspects of the project excite or worry the public, and what levels of risk they are willing to tolerate. While stakeholders cannot directly set policy or make decisions, they can help inform those who do of the complex interests of the affected parties. Long-term success of water resource projects often depends on this process being given the time and resources it deserves. One of the biggest challenges in this process is identifying the difference between interested parties and true stakeholders. True stakeholders are local groups and individuals who are affected by the project. Interested parties, however, may feel strongly about an issue or aspect of the project, but are not likely to be affected directly by it. Due to their passion on an issue, these interested parties often compete with stakeholders for meaningful cooperation and education. This shift into more confrontational discourse puts true stakeholders in a position of trying to choose sides. Unless carefully prepared for, this situation can replace the initial intent of stakeholder engagement with a desire to merely check a box and continue a project with minimal outside “interference”. Using effective stakeholder education and engagement tools and techniques can improve the ability to plan for and implement necessary water resource projects; even if the ultimate solution isn't what was presented at the start.

ADEM water quality monitoring programs: current status. **Fred Leslie,** ADEM
(Abstract No. 47)

In 1974 the Alabama Water Improvement Commission, ADEM's predecessor, created the initial surface water quality monitoring program with a network of 51 ambient trend monitoring stations statewide. In 1997, ADEM developed the initial water quality monitoring strategy to focus and document the Department's surface water quality monitoring mission. The strategy was updated in 2005, with the 2003 EPA Elements of a State Water Monitoring and Assessment Program as the basic framework. The 2005 Strategy outlined quality assurance plans, data management, data analysis, reporting, program review, and overall resource needs. The ADEM 2005 Monitoring Strategy was a coordinated monitoring approach designed to characterize water quality, to identify impacts from a variety of sources, and to provide a systematic and integrated framework for gathering necessary information to support the ADEM decision-making processes.
The Strategy was primarily comprised of four programs defined by waterbody type:

1. Rivers and Streams Monitoring Program (RSMP), wadeable rivers and streams;
2. Rivers and Reservoirs Monitoring Program (RRMP), nonwadeable rivers and reservoirs;
3. Coastal Waters Monitoring Program (CWMP), coastal waters; and
4. Wetlands Monitoring Program (WMP), wetlands.

The overall strategy was implemented on a 5-year rotation by river basin and incorporated a combination of targeted, probabilistic, and long-term monitoring stations to meet state monitoring goals and objectives. This approach was continued in the 2012 Monitoring Strategy, providing statewide data from two full monitoring cycles. In 2014, ADEM began development of the 2015 Monitoring Strategy with a comprehensive review of the 2005 and 2012 Strategies. The review was conducted by personnel from the Field Operations Division, Water Division, and Nonpoint Source Unit to ensure that the Strategy met overall monitoring objectives, as well as the objectives of the assessment/§303(d) listing, Total Maximum Daily Load (TMDL), and Non-Point Source (NPS) programs; to identify the Department's 2015-2019 monitoring priorities; and to revise the Strategy as needed to meet these new priorities. Priorities identified by the Department during this process included monitoring impaired, unimpaired, and un-assessed waters, evaluating the effectiveness of restoration efforts, and collaboration with partner agencies and stakeholders. Progress made during the last 10 years and changes to program priorities within ADEM and EPA allow ADEM to now conduct monitoring statewide each year, while continuing to meet the ADEM monitoring goals over a five-year period. This change enabled ADEM to provide frequent, intensive monitoring within each basin group to more accurately measure trends in water quality before and after implementation of restoration efforts, respond to data needs more quickly, and to minimize the impact of weather-related events on data collected within any one basin.

Update on Water Use and Surface Water Assessments in Alabama. **Tom Littlepage**, Michael Harper, & Dow Johnston – AOWR Alabama Office of Water Resources (Abstract No. 48)

In December of 2017, the Alabama Office of Water Resources (AOWR) released a comprehensive surface water assessment of the State of Alabama. That report, "2017 Alabama Surface Water Assessment Report", was based on the 2010 water use information and is available for download on the AOWR website (http://water.alabama.gov). Now, the AOWR is working to develop an update to that report using water withdrawal and use data from the 2015 Alabama Water Use Census. This presentation will provide an overview of the 2015 water use data as well as the implications of that data on the 2017 surface water assessment report. The 2015 water use data will be presented in the water use categories established by the USGS. The information will include a review of the methodologies and procedures for data collection and analysis in the following eight primary water use sectors:

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

The presentation will also provide information on how the Water Use in Alabama series fits into the overall water use assessment process.

The Long and Winding Road to an Alabama Water Plan: Lessons learned and moving forward. **Cindy Lowry** Alabama Rivers Alliance
(Abstract No. 50)

A great deal of work has been done over the past several years since Governor Bentley formed the Alabama Water Agencies Working Group and directed them to develop recommendations for a water plan and to gather the appropriate data necessary to inform the development of a water plan. In spite of the work that has been done, there is still significant disagreement on what a water plan should look like and how we can get there. Those differences coupled with changes in political leadership have put the state in a perpetual "plan to plan" cycle that is slowing down, if not, stalling any forward momentum that has been achieved.

This session will begin with a short documentary film that lays out the case for why Alabama still needs a comprehensive water plan to ensure sustainable water supplies and healthy river ecosystems for the present and future generations. The film is being created this summer as part of the Southern Exposure Film Fellowship program sponsored by the Alabama Rivers Alliance. The filmmaker for this film is Amelia Tyson of American University.

Following the film, the presenter will analyze lessons learned from the work of the AWAWG and from the various stakeholder processes utilized over the past several years, including a review of public opinion data about an Alabama Water Plan and its components. The session will conclude with suggestions for next steps and discuss how the accomplishments and lessons learned thus far should guide our continued efforts toward an Alabama Water Plan.

Spatiotemporal Evolution of Organic and Inorganic Nutrient Exports in Agricultural Watersheds in Northern Alabama. **Yuehan Lu** & Shuo Chen, University of Alabama (Abstract No. 51)

Surface water nutrient enrichment has been recognized as a leading cause of deterioration of water quality and ecosystem health around the nation including in Alabama. Relating nutrient loading to point and non-point sources in watersheds, as well as to ecological responses within aquatic environments, are one of the priority research topics to address water challenges in Alabama. Over the past three years, we have performed bimonthly assessments of organic and inorganic nutrients exported from watersheds across a large gradient of agricultural lands in northern Alabama. In addition to regular inorganic nutrient analysis, we characterized the amount, source, and composition of dissolved organic nutrient (C and N), a component that has been largely ignored in previous water quality studies. Nutrients exports from the study watersheds displayed clear spatial and temporal patterns. Spatially, the amount of organic carbon and inorganic nitrogen exported from agricultural watersheds were up to eight times higher than that from pristine, less impacted watersheds. Organic nutrients in agricultural streams were sourced mostly from microbial sources and showed high reactivity to microbial degradation. In contrast, those in forested streams originated mostly from soils and were less likely influencing aquatic microbial activity. Temporally, we found a rapid rise in microbial sources contributing to organic nutrients from 2014 to 2017, demonstrating an increasing influence of agricultural lands on nutrient exports. Precipitation events following a hot dry summer represented 'hot moments' of nutrient exports when nutrients flushed to receiving streams were 35-fold higher than the annual average. These results demonstrate that agricultural activities change the amount and compositions of organic and inorganic nutrients from soils to fluvial waters, which not only degrades water quality but also alters aquatic ecosystem metabolism. From the perspective of watershed management, we identified hot spots and hot moments of nutrient exports, and we will further propose monitoring and management priorities targeting those sources disproportionately responsible for high nutrient loads in agricultural streams.

Sediment fingerprinting to identify sources of in-stream sediment in an urbanized watershed. **Kritika Malhotra,** Jasmeet Lamba, Puneet Srivastava, & Stephanie Shepherd, Auburn University
(Abstract No. 53)

Excessive delivery of fine-grained sediment and sediment-bound nutrients to surface waters results in water quality impairment. Information on the relative contribution of different sources contributing sediment to river systems is a prerequisite to target management practices. Sediment fingerprinting technique can help to estimate sediment contributions from various sediment sources to fluvial sediment load. The overall goal of this study was to determine the sources of in-stream sediment (stream bed and suspended) at a subwatershed scale using sediment fingerprinting approach in an urbanized, 31 km2 Moore's Mill Creek watershed in Southern Piedmont region in Alabama. The relative source contribution from construction sites and stream banks to in-stream sediment was quantified for two different particle size fractions, 63-212 m (fine sand) and <63 m (silt and clay). Results of this study showed that both construction sites and stream banks were important sources of stream bed sediment. The contribution from construction sites and stream banks to stream bed sediment within this watershed ranged from 0 to 100% and 0 to 100%, respectively. The stream bed sediment in the upstream reaches originated largely from channel bank sources, and in the lower reach (watershed outlet), construction sites were the dominant sources of stream bed sediment. Also, this study showed that the construction sites were the dominant sources of suspended sediment in the watershed with contribution ranging from 0 to 100%, varying temporally. The relative source contribution from different sources is dependent on the particle size of the sediment, time and location of sampling within a watershed, riparian buffers, and areas of construction activities in proximity to the sampling sites. Also, it was observed that different source contributions could be obtained with different fingerprinting procedures as apportionments are sensitive to the statistical procedures employed. Soil and Water Assessment Tool (SWAT) was used in parallel to assess valuable information of watershed-level hydrological processes that affect sediment erosion and transport within a watershed. SWAT identified areas that generate high surface runoff and water yield and have the potential to contribute disproportionately high amount of sediment to streams. Targeting best management practices (BMPs) in these areas can significantly reduce the sediment loadings to the streams. Overall, this study underscores the importance of considering the spatial and temporal variability of sediment sources as a function of sediment particle size for targeting BMPs. The combined use of sediment fingerprinting technique and watershed-level modeling can provide valuable information of sediment transport processes and dynamics within a watershed.

Statistical post-processing of reference evapotranspiration forecasts based on multi-model ensemble numerical weather predictions. **Hanoi Medina** & Di Tian Auburn University (Abstract No. 54)

Reference evapotranspiration (ETo) forecasts are useful for water resources planning and management. Statistical post-processing techniques become essential for downscaling and improving ETo forecasts derived from numerical weather prediction models (NWPs). In this study, we compare several basic and advanced post-processing methods for calibrating single and multi-model ensembles of ETo forecasts over the continental U.S. using short-term reforecasts from the THORPEX Interactive Grand Global Ensemble system (TIGGE). These methods include: simple bias correction regression (BC), non-Gaussian regression (NGR), Bayesian Model Average (BMA) and Ensemble Dressing (ED). ETo estimated using FAO 56 Penman-Monteith equation with quality-controlled U.S. Regional Climate Reference Network measurements are adopted as baseline. The results show that the NGR produces the best performed probabilistic forecasts and is more computationally efficient than the BMA and ED methods. The simple bias correction method provides similar or better bias and accuracy but less skill and reliability compared to the more sophisticated methods. The post-processed ETo forecasts based on the multi-model ensemble of European Centre for Medium-Range Weather Forecasts (ECMWF) and United Kingdom Meteorological Office (UKMO) reforecasts provides better performance than the single model reforecasts or the multi-model ensemble when the Global Forecast System (GFS) reforecasts is included. The study highlights important characteristics of individual methods and recommends users to select post-processing methods and reforecasts based on the region, computing capability, and type of forecasts to be generated.

Spatiotemporal Analysis of Pollutant Inputs and Biologic Responses in Perdido Bay
Alexander Metz & Matthew Waters – Auburn University & Joseph Smoak – University of South Florida
(Abstract No. 107)

Coastal bays and estuaries provide a variety of ecosystem services that are of immense value, yet these ecosystems are currently experiencing diverse environmental stressors resulting in global degradation. In Alabama, coastal ecosystems have become increasingly threatened as eutrophication becomes more prevalent along the coastline due to changes in water inputs and surrounding land use. While monitoring programs and forecasting models are being applied to coastal management, a further source of data that is less utilized are the sediments and sediment records of bay environments. This study examines Perdido Bay and one of its sub-estuaries, Wolf Bay, to recreate historical conditions using paleolimnological techniques. Records indicate Perdido Bay may have been a clear-water, seagrass dominated ecosystem in pre-industrial times, much unlike the algal dominated system of today. Paleolimnology provides tools for measuring the terrestrial and marine inputs to the ecosystem throughout time as well as primary productivity responses to these inputs. Multivariate statistics were then used to determine the primary drivers of ecosystem state change in the study area. Geostatistical and spatial analysis using GIS technologies were then coupled with this study to determine sedimentation locations of the determined drivers and infer their origin in relation to land use throughout the area. If properly applied, knowledge of the primary drivers and their origins can be a helpful tool for improving watershed management strategies and water quality along the Alabama coast.

Innovative financing options for Green Infrastructure to support Water Quality Improvement. **Kevin Middlebrooks,** Jacobs
(Abstract No. 55)

The City of Atlanta is the first municipality in the country to be awarded a publicly-offered Environmental Impact Bond (EIB) for green infrastructure projects. This creative financing opportunity won by the Department of Watershed Management (DWM) will support implementation of green infrastructure projects funded at an estimated cost of $12.9 million. The projects are located in the Proctor Creek watershed within Atlanta's westside. Proctor Creek is recognized as one of EPAs 19 designated Urban Waters Partnerships for focused revitalization efforts to improve water quality and promote their economic, environmental and social benefits.

CH2M Rohadfox Joint Venture was selected to support the City with the planning, assessment, engineering, and permitting of the green infrastructure projects intended to improve wastewater and stormwater management and reduce the strain on the combined sewer system. Leading-edge green infrastructure technologies including bioretention basins, stormwater planters, permeable pavement systems, stream restoration, and constructed wetlands are being designed to capture over 10 million gallons of stormwater. CH2M Rohadafox's holistic approach to evaluate and design these elements involves incorporating the natural environment into engineered systems that capture and absorb stormwater into soil and vegetation to provide environmental, economic and health benefits to local communities by creating more green space in urban settings and address critical flooding and water quality issues. Through this engagement, CH2M Rohadafox was requested to complete design for the projects within eight months to meet the schedule requirements of the EIB. The projects are scheduled to complete design in late 2018 with construction beginning in 2019. This presentation will review the proposed Green Infrastructure projects as well as background on the EIB including volumetric performance metrics that will be used to evaluate success of the projects.

*CH2M is now Jacobs.

Making Watersheds Great Again, **Christian Miller** Mobile Bay National Estuary Program (Abstract No. 57)

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. This planning process, guided by the MBNEP's Project Implementation Committee and watershed stakeholders, charts a conceptual course for improving and protecting the things people most value about living along the Alabama coast. In addition to meeting requirements for watershed planning specified by EPA's Nine Key Elements, these plans also encompass issues related to environmental health and resiliency, culture and heritage, public access, and critical coastal habitats identified by the MBNEP's Science Advisory Committee as most threatened by anthropogenic stressors. To date, with funding secured through the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund, WMPs have been completed for Dog River, Fowl River, Weeks Bay, and Bon Secour River (including Skunk Bayou and Oyster Bay). WMPs are also under development for Bayou La Batre, West Fowl River, and Wolf Bay. Additionally, RESTORE funding has been secured to complete WMPs for Alabama's remaining intertidal watersheds. Key projects identified by the WMPs will feed into the upcoming Coastal Alabama Restoration Plan. This effort is focused on improving the quality of the water entering Mobile Bay, as well as the Gulf of Mexico, and increasing the amount of nursery habitat necessary for sustaining healthy fisheries. This plan will include an inventory of restoration and conservation opportunities guiding future funding requests. 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 Gulf waters; abundant fish and shellfish; protection of heritage; environmental health and resilience; and water that is fishable, drinkable, and swimmable.

Survivability of Mussels During the 14-Week Drawdown of Point A Reservoir, Andalusia, AL. **Jonathan Miller,** Randall Bassham, Meet Patel & Paul Stewart Troy University (Abstract No. 56)

Point A Reservoir near Andalusia, AL has undergone a planned 14-week drawdown for dam maintenance during the fall of 2017. One federally threatened, *Fusconaia escambia*, and two state listed mussel species, *Toxolasma* sp. and *Utterbackiana hartfieldorum*, were known to occur in the reservoir. All listed species were collected and relocated during the initial phases of the drawdown in September 2017, except for a defined study area known to contain the federally listed species. Our study sought to determine the amount of time mussels could survive the drawdown and determine the role of environmental conditions on the survival of mussels. Eight quarter meter quadrats each, from three zones differing in depths, were excavated from the study area weekly and sieved to include juveniles. Soil temperature and moisture were measured for each quadrat, and live and fresh dead mussels obtained from quadrats were identified to species and measured. A total of 254 live mussels were found over the duration of the study, with live *F. escambia* found up to week 13 and live *Toxolasma* sp. and *Elliptio pullata* found through week 14. One live juvenile *U. hartfieldorum* was also found on week 10 of the drawdown. Size did not have a noticeable impact on survival, but specific environmental conditions such as the presence of vegetation played a major role in survival of mussels under the drawdown conditions. This study showed that individuals of multiple mussel species native to the area are capable of surviving 14 weeks of emersion, although specific refugia greatly enhance their success.

Locust Fork Nutrient TMDL. **James Mooney** – ADEM
(Abstract No. 58)

The goal of this presentation is to provide insight into the Department's efforts in developing the Locust Fork Nutrient TMDL. The Locust Fork is a major tributary to the Black Warrior River and is considered a valuable natural resource within the state of Alabama providing numerous benefits to its residents. Furthermore, the Locust Fork watershed also supports a tremendously diverse population of aquatic flora and fauna. The Alabama Department of Environmental Management (ADEM) has identified on the 2016 303(d) List of Impaired Waterbodies five segments of the Locust Fork as being impaired for nutrients. Nutrients are considered to be essential elements in the water column in regards to supporting aquatic life. However, when nutrients are present in concentrations that are considered elevated in comparison to natural conditions, there can be adverse effects such as excessive aquatic plant growth, which in turn can lead to eutrophic conditions in the waterbody. The nutrient impairment in the Locust Fork was addressed by the development of a Total Maximum Daily Load (TMDL), which establishes pollutant loads that are necessary to attain the applicable water quality standards and are considered protective of the designated uses of the Locust Fork. The final TMDL was approved by the USEPA on January 22nd, 2018. This presentation will illustrate the steps taken by the Department during the development of the TMDL, illustrating how a series of dynamic linked water quality models (LSPC, EFDC, and WASP) were utilized in order to accurately predict the necessary nutrient reductions in the Locust Fork watershed in order to meet an established numeric chlorophyll-*a* target in the Locust Fork embayment.

EPA's New Watershed Data Tool. **Amy Newbold** – US EPA Gulf of Mexico Program (Abstract No. 60)

The public has become increasingly concerned with water quality issues and relies on EPA and their state governments to tell them if their water is safe. EPA is developing a public web application that tells the story and condition of water quality in the United States on several scales. The application provides an interactive, easy to use interface that will educate users on water quality issues and allow them to explore at the national, state, county and watershed scales. A working prototype has been developed over the past several months, which includes data from OW, other program offices at EPA and outside organizations. In this session, EPA will walk participates through the current prototype and solicit feedback on the kinds of data and information that would be the most useful to include in the tool.

The Success of the Duck River Watershed Management Plan. **Steve Newton**, TTL, Inc. (Abstract No. 61)

The City of Cullman Utilities Board in north Alabama provides potable water for the Cullman region, which includes the City of Cullman, Cullman County, other surrounding municipalities and water authorities. Currently, the Board's water treatment plant gets its raw water from Lake Catoma. To fulfill part of its mission to provide the Cullman region with an additional surface water source for emergency and long-term supply, the Board has constructed a dam on the Duck River located approximately 7 miles east of the City of Cullman. This new, 640-acre water supply reservoir will be used in conjunction with Lake Catoma to optimize its water supply and provide a sustainable source of water for many years to come. During the 2007 Exceptional D4 Drought, the pool elevation in Lake Catoma dropped over 26 feet below full pool, leaving the community with a very limited supply of water. A large sector of Cullman's industrial base involves the poultry industry, which is a significant user of potable water and was impacted, along with other industries and residents, by the 2007 drought. The new Duck River Reservoir is located in a rural setting where over 65% of the land is used for agricultural purposes (cultivated crops, cattle, poultry, etc.). The watershed has only one, small NPDES permittee so the focus of the WMP was on the identification and management of nonpoint source pollutants that could affect water quality in the reservoir. Baseline water quality monitoring to generally assess the overall health of the Duck River Watershed was completed in 1997 and 1998. These results suggested that a potential exists for accelerated eutrophication within the future Duck River Reservoir. This concern established the need for the development and implementation of an effective WMP which addresses the best management practices and other strategies to mitigate nonpoint source pollution, specifically total phosphorus. The original Duck River WMP was prepared and implemented in 1999 then updated by the Board in 2014. The Duck River WMP includes several BMPs to address nonpoint source pollution within the watershed which include, but are not limited to, establishment and maintenance of a riparian buffer zone around the reservoir, restricted use of land owned by the Board around the reservoir, public education outreach, encouraging compliance with ADEM's AFO/CAFO rules and other management strategies. To monitor the effectiveness of the WMP, extensive water quality monitoring and biological integrity assessments have been completed by the Board. The Duck River Reservoir reached its full pool elevation in the spring of 2016. Water quality monitoring of the reservoir began in 2017 to document the effectiveness of the Duck River WMP.

This presentation will provide an overview of the Duck River WMP and will show how actual water quality data documents the effectiveness of the WMP.

Alabama's Erosion and Sediment Control Handbook: Is it Perfect? No, but Getting Better.
Perry Oakes & Earl Norton**,** AL Soil and Water Conservation Committee.
(Abstract No. 62)

The Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management (The Handbook) has recently been revised to incorporate research results from the Auburn University Erosion and Sediment Control Test Facility. While not a regulatory document, the Handbook is referenced as the acceptable technical document in the ADEM NPDES stormwater regulations. Significant changes to the Handbook include: the proper use of a geotextile underlayment for Check Dams and Inlet Protection; the use of geotextile to "choke" check dams; the proper use of a silt fence as a Check Dam, the proper placement of sand bags when used for a Check Dam; the proper staking and pinning of wattles used for check dams and inlet protection; reduction in the Type of silt fences; silt fence post spacing; and alternative silt fence installation procedures. These changes, along with other information, will be discussed. Information on how to access and obtain the handbook will be provided.

Understanding the drivers of stream restoration setbacks and failures. **Frances O'Donnell**, Jessica Calhoun, C. Preston Waid, Elizabeth Prior & Eve Brantley, Auburn University (Abstract No. 64)

Stream degradation is a growing problem in the U.S. with more than a third of rivers listed as impaired or polluted. Stream restoration and rehabilitation projects, which seek to improve stream health and function, are often often implemented with specific goals for improving water quality or macroinvertebrate and fish populations. Due to setbacks, such as erosion and mass wasting of stream banks, projects may fail to meet these goals without costly repairs. There are a number of factors that can contribute to project setbacks, and the scarcity and lack of synthesis of post-restoration monitoring data make it difficult to determine their relative importance. We conducted post-restoration monitoring of Moore's Creek in Lanett, AL, a project that was initiated to improve water quality. We measured streamflow in the reach and turbidity and dissolved oxygen content above and below the restored reach and above and below each in-stream structure. We found that after an initial post-construction stabilization period, turbidity was consistently low across a range of stream flow levels. However, the site received large, intense rainfall events from the storm systems associated with Hurricanes Harvey and Irma and experienced substantial erosion of two stream bank sections. As a result, turbidity was elevated at moderate to high flows, but was still below pre-restoration levels. There are several factors that may have been responsible for the erosion: (1) due to delays in funding and planning, vegetation was planted at a later date than originally targeted, meaning it may not have had adequate growth time to stabilize the bank; (2) the species planted may not have had high enough growth rates or strong enough roots to stabilize the bank even with an earlier planting; and (3) the flows associated with a heavy tropical storm season may have made a fully successful stream restoration project nearly impossible in the given year. We are conducting a hydrologic and hydraulic modeling analysis to provide more insight on the relative importance of these factors, but having data from only one site presents a challenge as there is only one scenario to analyze. We are currently developing a comprehensive geodatabase of stream restoration and rehabilitation projects throughout Alabama to synthesize available data and identify sites for additional data collection that would be most informative. Currently, information collected includes date of installation, reason(s) for implementation, funding source, designer and contractor, maintenance plans, stakeholder involvement, in-stream structures installed, vegetation planted, project setbacks or failures, and availability of monitoring data, though we are seeking input from conference attendees on other factors to consider. Our goals are to understand the mechanisms behind setbacks and failures and identify practices that maximize the probability of project success.

Using Spatial Data to Predict Faunal Distributions for Alabama Barrier Island Restoration Assessment on Dauphin Island, Alabama. **Kristie Ouellette Coffman**, Kelly Joyner, M. Clint Lloyd ALCFWRU & Elise Irwin USGS, Auburn University – ALCFWRU
(Abstract No. 65)

Dauphin Island is a strategically significant barrier island along the northern Gulf of Mexico, serving as the only barrier island providing protection to much of the state of Alabama's coastal natural resources. The island has sustained impacts from both storms and the recent Deepwater Horizon oil spill, warranting evaluation of restoration options. This work builds on a long-term Structured Decision Making (SDM) project with the objective of identifying the most beneficial and effective restoration activities for Dauphin Island to ensure the long-term sustainability and resiliency of Dauphin Island, its habitats, the living coastal and marine resources it supports, as well as estuarine conditions in the Mississippi Sound and the extensive coastal wetlands to the north. Working with decision makers (Alabama Department of Conservation and Natural Resources), residential and local stakeholders, as well as experts from the US Army Corp of Engineers, US Geologic Survey, and other state and federal agencies, restoration objectives have been identified. Objectives primarily relate to maximizing the conservation value for coastal marine resources, particularly for the species of greatest conservation need that inhabit the island. Team members have engaged faunal experts to develop the list of focal species, their habitat preferences and habitat use patterns for habitats on the island, including relative habitat use data for each species. Non-metric dimensional scaling analysis was used to identify groups of species and ultimately assist in identifying species that represent habitat guilds. Data were used to parameterize a Bayesian Belief Network (BBN) designed to incorporate ecological, economic, and social aspects into decisions regarding restoration alternatives for Dauphin Island. We are implementing novel methods by integrating software, such as GeoNetica and Geographic Information Systems (GIS), with the BBN to predict the impacts of restoration decisions on species conservation values. The output from the software integration allows for visualization of the impacts on individual focal species and on species in habitat guilds. Visual, quantitative data predicting the consequences of restoration decisions will aid in communicating the potential positive and negative impacts to residents, state and federal officials, and other stakeholders.

Karst Features and Aquifer Systems in Alabama. **Gheorghe Ponta** Geological Survey of Alabama
(Abstract No. 121)

The Groundwater Assessment Program (GAP) at the Geological Survey of Alabama investigates the availability, and quality of the state's groundwater resources, including the karst aquifers. Alabama is in the humid region of the United States, with numerous karst features, such as caves (>4,000), sinkholes (>6,000), and springs (>160) occurring in carbonate (limestone and dolomite) rocks, which underlie about 20 to 25 percent of the state. In the Interior Low Plateaus (Western and central part), Appalachian Plateaus (Jackson County), and Valley and Ridge Physiographic Provinces, which are in the northern half of the state, carbonate rocks underlie many areas and groundwater is contained mainly in karstified aquifers with high secondary porosities.

The southern half of the state is situated in the Coastal Plain physiographic province, where 7.5 percent of the aquifers are located in carbonates rocks. All wells installed in carbonate rocks and karst springs obtain water from solution cavities in these strata or the regolith above them. These solution cavities are not uniformly distributed, making prediction of their occurrence extremely difficult. In order to understand the geologic framework of karst aquifer systems in Alabama, a series of hydrogeological cross-sections were constructed depicting stratigraphy and aquifers in the area. The selection of cross-section lines and wells were based on their geographic location, with preference being given to wells having a greater total depth, with supporting geophysical and sampling logs. These cross-sections are used to identify geologic structure, aquifers (depth and elevation) and their production intervals, and determine where deeper aquifers might be located.

The economic future and quality of life for Alabamians, as well as sustainable ecosystem functions and services, are dependent upon the availability and protection of the state’s water resources. Therefore, future water source development will require significant scientific research, substantial logistical planning, and infrastructure development to find and manage adequate sources.

Determination of environmental phosphorus loss risks for Alabama Soils. **Rishi Prasad**
Crop, Soil and Environmental Sciences, Auburn University
(Abstract No. 66)

Animal manure has long been recognized as an important source of macro- (nitrogen, phosphorus, potassium) and micro- nutrients (boron, zinc, sulfur) for plant growth. However, frequent applications of manure often result in phosphorus (P) buildup in soils and pose risk to the environment via runoff or leaching to water systems. Although P index and soil test phosphorus (P) levels are used for environmental assessment of P loss risk, these tools do not provide any information on prediction of safe life span of application sites i.e. how long P can be applied safely before the site becomes a source of P to the environment. The objective of this study was to determine the capacity of the Alabama soils under different management practices, soil types, climatic zones, and land use types, to hold P before becoming an environmental risk. Soil samples representing diverse management types were collected at several locations throughout Alabama and relationship between routine soil test extractants (e.g. Mehlich1, Mehlich3) and critical P threshold values were determined. The information was then used to calculate the phosphorus storage capacity of Alabama soils. The phosphorus storage capacity of soils was compared against the site's soil test P and P-index values to determine the discrepancy in P loss risk assessment. Preliminary results will be presented.

Characterizing the hydrology and water quality function of headwater slope wetlands.
Rasika Ramesh & Latif Kalin, Auburn University
(Abstract No. 2)

Rapidly increasing population growth and land use conversion to urban and agriculture in Alabama's coastal plain have altered many coastal wetlands. Headwater wetlands are particularly vulnerable because of their linear nature; they are easily filled or by altering water conveyance through ditching or tiling or filling. Since headwater areas are widespread throughout the region they play a disproportionately high influence on watershed flow and nutrient fluxes. Alterations to their functionality can have significant impacts downstream and in coastal waters. We examined flow and dissolved inorganic nitrogen (DIN) trends in four headwater slope wetlands in Baldwin County, AL across a range of watershed alterations. This wetland type exists as groundwater-fed wetlands above and alongside 1st order streams and occurs in high densities in the coastal plain region. Watershed sizes ranged from 0.5 – 1.8 km2 and % imperviousness varied from 1.5 to 41.6%. Each wetland showed different hydrology and DIN trends. High levels of urban cover caused wetland hydrology to be flashy with increasing RB indices (flashiness index) corresponding to level of urbanization in the watershed. The wetland in the least altered watershed showed stable and persistent flows with the highest baseflow contribution (>70%) compared to other wetlands. Overall, observed DIN concentrations were low in the wetlands except for the wetland in a dominantly agricultural watershed. Despite watershed alterations, wetlands still showed DIN load reductions ranging from 9% to 50%. Findings from this study give preliminary understanding of the diversity of headwater slope wetland function in the region which will be critical towards their protection and restoration in the face of ever increasing development in Baldwin County.

Land use effects on water-related dynamic soil properties of Southeastern Coastal Plain Kandiudults. **Joey Shaw**, Thorsten Knappenberger, & Eve Brantley, Auburn University (Abstract No. 69)

Soil resources of the Southeastern U.S. Coastal Plain have been significantly utilized for food, fiber and timber production over the past two centuries. These land use systems affect dynamic soil properties (DSPs), or near-surface properties that are altered by management on human time scales. Remnants of Longleaf Pine (*Pinus palustris* Miller) – Wiregrass (*Aristida stricta* Michx.) ecosystems provide reference states in portions of this region; allowing evaluation of management and land use effects on water-related DSPs. Under long-term managed and reference land use systems in Alabama and Georgia Coastal Plain Kandiudults, DSPs have been evaluated in our program using space for time experimental designs. Reference sites have higher soil organic carbon, water stable aggregates (0-15 cm), infiltration rate, and saturated hydraulic conductivity (15 cm), and lower bulk density (0-30 cm) compared with cultivated sites. Changes in these properties affect soil functions related to regulating, provisioning, and filtering water, which impact ecosystem services related to water quantity and quality.

Partnering to Reestablish Habitat for a Keystone Species: Pensacola East Bay Oyster Habitat Restoration. **David Stejskal** & Matt Davenport, Jacobs
(Abstract No. 70)

Jacobs, formerly CH2M, was selected by The Nature Conservancy (TNC) to assist with the planning, permitting, and preliminary engineering design of a 6.5-mile-long oyster habitat restoration and living shoreline project in eastern Pensacola Bay (Florida). TNC identified this area for restoration due to years of decline in oyster production and coastal seagrass beds, which once flourished in this area. Causes for the decrease include sedimentation, water quality changes, and other factors.
TNC was granted funding from the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund to complete the first phase of the project, which includes pre-restoration monitoring, planning, design, and engineering support to secure required permits and develop bid documents. Specifically, this work includes:

- Data Collection and Analysis: Collecting wind, wave, tidal, current, and geomorphic data on the physical conditions at the project site. Local survey data collection included deploying Acoustic Doppler Current Profilers (ADCPs) in coordination with a sub-contractor to measure waves and currents at key locations.
- Environmental Surveys and Permitting: Completing protected species and cultural resource surveys to support permitting with the U.S. Army Corps of Engineers and the Florida Department of Environmental Protection.
- Hydrodynamic Analysis, Wave, Sediment Transport, and Shoreline Change Modeling: Using MIKE21 software to simulate tidal level variation, tidal currents, wave height, period and direction to support the evaluation of construction materials and the preliminary design.
- Preliminary Engineering Design: Developing preliminary engineering drawings, which are suitable for permitting and developing construction cost estimates.

Detailed Design and Bid Document Preparation: Adding detail sufficient for developing construction bid documents, including drawings and specifications, to the design concepts developed during the preliminary work.
TNC is currently working with NFWF to secure funding for the installation of the project. Pending securing funding, construction is projected to commence in 2019.

Digital Coast: Resources for Coastal Decision Making. **Brenna Sweetman,** NOAA's Office for Coastal NOAA's Office for Coastal Management
(Abstract No. 71)

Coastal communities are among the most densely populated, biologically rich and economically viable in the nation. However, the increasing severity and frequency of extreme events places coastal areas at increasing risk. The National Oceanic and Atmospheric Administration's Office for Coastal Management (OCM) helps communities better plan and prepare for coastal issues by connecting people with the necessary information, tools and technology for informed decision making. The most visible part of OCM's effort is the Digital Coast, a website providing an integrated suite of data, tools, instructor-led trainings and case studies to help communities better understand and address coastal management issues. Top resources of the Digital Coast include data and visualization tools such as the Sea Level Rise Viewer and the Coastal Flood Exposure Mapper as well as regional trainings on topics such as green infrastructure and planning and facilitating collaborative meetings. As part of the NOAA Water Initiative, OCM is currently developing a new tool that will expand on existing tools' capabilities to help coastal communities examine the impacts of coastal flooding on stormwater management planning, practices and projects. This new tool, designed as a self-guided resource for stormwater managers, will help users determine flooding thresholds and identify strategies to address impacts of coastal flooding on stormwater infrastructure. This presentation will highlight top resources offered through the Digital Coast and provide an overview of the new tool being developed by OCM for the NOAA Water Initiative.

Ditching nitrogen: Are roadside ditches biogeochemical hotspots? **Corianne Tatariw[1],** Olivia Mason[2]**,** Behzad Mortazavi[1] – [1]The University of Alabama/ Dauphin Island Sea Lab, [2]Florida State University
(Abstract No. 72)

Human activity has more than doubled the amount of reactive nitrogen (N) in the environment with negative environmental impacts on coastal ecosystems, such as eutrophication. In Alabama, urban growth and agricultural intensification have increased nutrient loads to the Mobile Bay, an estuary of high commercial, cultural, and ecological significance to the state. One potential pathway of anthropogenic N delivery is through roadside ditches, which direct stormwater runoff to streams, rivers, and wetlands surrounding the Bay. Although these manmade drainage networks have historically been perceived as conduits for runoff-associated pollutants, they are subjected to recurring, concomitant supplies of water and nutrients following precipitation events which make them potential hotspots for microbially-mediated biogeochemical processes. The objective of this study was to evaluate the N-removal potential of roadside ditches across three land use types surrounding Mobile Bay. Denitrification and anaerobic ammonium oxidation (anammox) are microbially-mediated process by which reactive N (as nitrate, NO3-) is reduced to dinitrogen (N2) gas, removing N from the environment. These processes are controlled both by microbial community composition (i.e. the biomass of functionally capable taxa within the microbial community) and environmental conditions (i.e. the availability of NO3-, organic carbon (OC), and anoxic conditions). Intermittently wet ecosystems, such as wetlands and riparian zones (i.e. terrestrial-aquatic transition areas) have been identified as hotspots for N-removal due to inputs of fresh nutrients and favorable redox conditions associated with periodic wetting. We predicted that precipitation-driven intermittent wetting and resulting nutrient delivery will cause ditches to be hotspots for N-removal in the landscape. Land use-driven changes in substrate composition and hydrologic regimen, as well as inputs of particulate-associated terrestrial microbes shape microbial community structure and functional capacity in streams. We predicted that ditch N-removal capacity will be greater in agricultural and urban ditches compared to forested ditches due to higher inputs of NO3- and labile organic carbon OC. In summer 2018, soil samples were collected from 96 roadside ditches in predominantly forested/wetland (Fowl River), urban (Dog River) and agricultural (Weeks Bay) watersheds. Denitrification, anammox, and dissimilatory nitrate reduction to ammonium (DNRA) capacities were measured on soil slurries to determine the N removal (denitrification and anammox) and recycling (DNRA) potential of roadside ditch soils. Initial findings show a trend of greater N-removal by denitrification and anammox in urban and agricultural ditches, and that N-removal dominates over DNRA in all land use types. Additional analyses will relate ditch N-cycling rates to environmental characteristics including microbial community diversity, soil physicochemistry and vegetation.

Biological Filtration Performance for Water Treatment: Evaluating the Effects of Extended EBCT, Temperature and DOM Character. **Leigh Terry**, The University of Alabama
(Abstract No. 74)

Microbial activity in biofilters is key for dissolved organic matter (DOM) removal efficacy and is influenced by filter operation, empty bed contact time (EBCT), and water quality parameters, including influent DOM, the DOM origin and temperature. Extending the EBCT of a biologically active filter (biofilter) can significantly improve the performance for removing DOM. For systems with excess plant capacity, like many small systems, this can be done without additional capital investment. Understanding when this approach is advantageous requires an understanding of the biomass distribution in the biofilter, its relationship to biofilter performance, as well as the DOM character. One measure of DOM character is the specific ultraviolet absorbance (SUVA). SUVA is an indicator of DOM aromaticity and can be associated with the DOM origin; microbial or terrestrial. Adenosine triphosphate (ATP), the primary energy carrier in all living cells and quantification, has been used as an indicator of biomass activity in biofilters. Research has shown that at short EBCTs and cold influent water temperatures, DOM removal and microbial activity in biofilters decrease. The goal of this work was to comprehensively study how DOM behaves in a biofilter and the development and distribution of biomass within the biofilter. The overall objectives of the research were to evaluate the effects EBCT, temperature, SUVA and influent DOM have on biomass stratification throughout the filter and biofilter performance. Bench scale filters were set up to assess biofilter performance at different EBCTs and the impact of varying DOM. Microbial, terrestrial and wastewater effluent sources were selected. Barker Reservoir (SUVA = 3.0 L mg-1 m-1) served as the terrestrially influenced source, Wonderland Lake (SUVA = 1.6 L mg-1 m-1) served as the microbially influenced source, and Boulder Wastewater Treatment Plant effluent (SUVA = 2.1 L mg-1 m-1) served as the wastewater effluent source. The biofilters had taps at depths that represent 5, 15 and 30 minute EBCTs. The filters were packed with biologically active anthracite collected from a local utility's biological filter. The biofilters were online for 12 months. Each source water was evaluated at temperatures of 7, 22 and 28 °C. Biomass activity and filter performance were monitored at each EBCT for each water sources. The results of this study showed DOM removal increased with longer EBCTs, higher temperature, and higher biomass activity. Activity is highest at the top of the filter and tapers off throughout filter. Total influent DOM concentration did not affect DOM removal. SUVA, in the range of 1.6 - 3 L mg-1 m-1, did not impact the biodegradable portion of the DOM.

Using Paleohydroclimate Studies of Mobile Basin Rivers to Inform Alabama Water Policy.
Matthew Therrell, Glenn Tootle, Sahar Tabatabaei, & Emily Elliott, University of Alabama, Bearden Bennett, Geological Survey of Alabama
(Abstract No. 75)

Increasing community resilience to the hazards posed by hydroclimate variability (e.g. drought) requires understanding the full range of long-term natural variability as well as the frequency and magnitude of extreme hydrologic events in relevant river systems. The Mobile River Basin drains over 70% of Alabama's land area and is the fourth largest in the nation in terms of streamflow. However, unlike many of the larger river systems in the U.S., no reconstructions of past streamflow using paleoclimate records (such as tree rings) have previously been developed for this system. In this presentation we report on the development of streamflow reconstructions for the Alabama and Tombigbee Rivers, which show that the observed record of streamflow does not adequately represent the risk of severe drought (low streamflow) shown in these longer records. Given the current lack of a comprehensive water policy in Alabama was well as the ongoing litigation over interstate water resources, it is imperative that the paleo record be thoroughly studied and the results used to inform water policy and statewide water management plans in Alabama.

Policy implications and increasing community resilience in coastal watersheds of Alabama by risk assessment of past, present and future trends in hydrologic and hydroclimatic extremes. **Glenn Tootle**, The University of Alabama
(Abstract No. 76)

In addition to suffering the effects of a host of manmade degradations including significantly altered hydrology, siltation and polluted runoff, many coastal watersheds that flow into the Gulf of Mexico (GoM) have endured extreme drought in recent decades (e.g. Seager et al., 2009; Pederson et al., 2012). Recent work presented in Tootle et al. (2018) reveals the SE has experienced multi-decadal decreases in annual streamflow. This research also showed the potential association between declining streamflows and large-scale ocean-atmosphere patterns (Enfield et al., 2001; Mo et al., 2009; Tootle et al., 2005). However, the study is limited by the length of the instrumental (historic) record in unimpaired gauges (Falcone et al. 2010), and inclusion of a longer term, paleo reconstructions of streamflow and extreme events is needed to further clarify the climatic signal within the record. Through funding from the EPA Gulf of Mexico Regional Partnership Programs, researchers in this session will present initial data from a multi-year project to better understand past, present and future streamflow in Alabama. The objectives of the overall project will be to (1) reconstruct multi-century records of streamflow, drought and flood occurrence for watersheds in Alabama that lead to the GoM (Alabama, Apalachicola, Choctawhatchee-Escambia, and Mobile-Tombigbee Rivers), (2) model future streamflow and extreme events in these watersheds, (3) develop risk assessment guides for stakeholders and policy makers, addressing projections for streamflow over the coming century. This project seeks to disseminate risk assessment and mitigation strategies directly to local, state and national stakeholders, working with these groups to develop emergency preparedness plans and informed policy associated with changing streamflow and extreme events. This improved understanding will directly benefit the development of water policy in Alabama and the greater SE region, by informing a variety of socially and economically relevant areas related to waterwithdrawals, streamflow forecasts, drought and flood mitigation. This concluding presentation will serve as a panel discussion to address current progress toward the project goals, including past, present and future reconstructions of streamflow in the watersheds that lead to coastal Alabama and the Gulf of Mexico, as well as the potential policy implications associated with these findings. This final panel discussion is meant to engage the audience on the current findings of this research and to address areas where the research could be improved to better address stakeholder concerns for future research direction for the project.

Water use in the Tennessee valley for 2015. **Amanda Turk** & Gary Springston – Tennessee Valley Authority (TVA)
(Abstract No. 78)

INTRODUCTION: The quality of life in the Tennessee Valley Region depends on ample water for homes, businesses, farms, meeting places, and recreational activities. Dependable water is fundamental to the economic growth of the region as is dependable, low-cost electricity. It is anticipated that water supply and water-quality issues, coupled with emerging water-use conflict over a fixed supply, will continue to increase across the southeast.

APPROACH: The Tennessee Valley Authority implemented their current reservoir operating policy in 2004. One of the objectives of the operating policy is to meet the off-stream water needs of the Valley until at least 2030. TVA inventories water use every five years to project water demand in the Valley and to examine trends in water use. These results are used to determine how well the assumptions behind the operating policy are holding up. The data are also used for a variety of purposes including the siting and permitting of new power plants and to aid TVA in its efforts to promote economic development in the Valley. Water use estimates focus on four categories of off-stream water use: thermoelectric power, industrial, public supply, and irrigation. Each record in the database is labeled as a withdrawal or return transaction. Each water use transaction is assigned to a Water Use Tabulation Area (WUTA) and Reservoir Catchment Area (RCA).

RESULTS AND DISCUSSION: This presentation describes 2015 water use for industry, public supply, irrigation, and power generation. It also presents the projection for 2040 water demand. Trends in water use and their implications will also be discussed. This presentation will have information on both the water use in the entire Tennessee River Basin and a focus on the water use in the Alabama portion of the Tennessee River Basin.

Preventing sediment resuspension with cellular confinement systems. **Jose Vasconcelos**
Auburn University
(Abstract No. 79)

Sediment basins attempt to mitigate environmental impacts from sediment discharges by creating quiescent conditions. However, settled particles are susceptible resuspension if new flows are admitted, increasing velocities, shear forces, and turbulence near the basin bottom. A very simple idea, which has never been attempted in the context of sediment and erosion control, is to create a method by which particles can settle at the bottom of basins and be shielded from background flows and turbulent eddies. This condition can be attained by means of sediment confinement, which is similar to the concept of cellular confinement systems (CCS). This study presents results from an investigation of the benefits of confinement cells as a lining strategy for the bottom of sediment basins. Characteristics of effluents in an experimental apparatus representing the bottom of sediment basins were studied for varying geometries of confinement cells and flow conditions. As anticipated, a significant decrease in effluent turbidity was reported with the use of cellular confinement cells, with smaller cell widths as a key parameter to reduce outflow turbidity. Future studies are targeted at testing this concept in a larger scale apparatus.

Reconstructing environmental conditions of southern Alabama utilizing the sediment record of Ditch Pond: evidence of climate change, fire, and eutrophication. **Matthew Waters**, Rachel Kuntz, Alexandra Tsalikis, & Kaye Jernigan, Auburn University
(Abstract No. 81)

The relationship of land-use change with water quality typically is established through monitoring efforts and forecasting models. These effective tools are used to set management parameters and future environmental targets for aquatic resources. However, these decisions are constructed from data that represent a short timescale of a water body's history negating important periods of environmental change that could be useful to management practices. One way to reconstruct historic land use and water quality change is to use the sediment record as a long term data set of environmental change. Here, we report on the sediment record of Ditch Pond, Alabama, a small, natural lake located in the Conecuh National Forest. A 1.8m sediment core spanning the last 5,000 years of environmental history was analyzed for organic matter, nutrients (C, N, P), heavy metals, algal production, cyanobacteria production, forest inputs, and fire. Results show that the modern environmental impacts to the lake are driven by prescribed fire management causing changes in nutrient inputs into the lake system. Prior to the human impact period (1850 AD), several periods of wildfires occurred in the forest indicating historic periods of drought in the area. Algae and cyanobacteria measurements indicate a modern period of increased production but also periods of historic algal and cyanobacteria abundance related to changes in the watershed. These data provide one of the longest records of environmental history for the state of Alabama and identify potential drivers of concern for future water quality and management decisions.

Comprehensive Flood Information at Your Fingertips. **Jeff Zanotti,** Wood Environment and Infrastructure Solutions, Inc.
(Abstract No. 83)

The Alabama Office of Water Resources (OWR) has taken a proactive step in communicating flood risk and regulatory flood map changes to communities and stakeholders in Alabama. Alabamaflood.com is the one stop website for regulatory floodplains, published preliminary floodplains, Changes Since Last Firm (CSLF) and structure based flood damage information. The website was primarily developed to provide up to date floodplain information to stakeholders during the post-preliminary processing period between preliminary map issuance and the effective date. It has been further developed to display risk map products such as CSLF as well as results of Level 2 HAZUS at the structure level. The website provides the status of each Risk MAP watershed project in the State and allows users to zoom in at a county or specific address level to access data. OWR has successfully used the website to communicate Special Flood Hazard Area (SFHA) changes along the coast in Alabama to community officials prior to the official preliminary map issuance. This was accomplished via a password protected process that provided a "no surprises" environment as the maps moved through the flood risk review and the PDCC process. Further functionality includes the ability to download effective and preliminary panels with future enhancements such as effective HEC-RAS model download and on-demand Base Flood Elevation (BFE) information in development. The website is extremely popular within the state and is becoming very popular among the floodplain management community. The goal of this presentation is to demonstrate OWR's commitment to communicating flood risk to community officials and project stakeholders in an easy to use website format.

Poster Presentations
(alphabetical order by author's last name)

P25 *Infusing NASA Remotely-Sensed Data into a Dynamic SPARROW Water Quality Modeling and Decision Support System*. **Mohammad Al-Hamdan**, Universities Space Research Association at NASA/MSFC, Richard Smith, Anne Hoos, Gregory Schwarz, & Richard Alexander, United States Geological Survey, William Crosson Universities Space Research Association at NASA/MSFC
(Abstract No. 84)

The USGS Spatially Referenced Regression on Watershed Attributes (SPARROW) surface water quality modeling system has been widely used for long term, steady state water quality analysis. However, users have increasingly requested a dynamic version of SPARROW that can provide seasonal estimates of nutrients and suspended sediment. The goal of this NASA-funded project is to develop a dynamic decision support system to enhance the southeast SPARROW model and finer-scale dynamic models for selected coastal watersheds through the use of remotely-sensed data and other NASA Land Information System (LIS) products. The spatial and temporal scale of satellite remote sensing products and LIS modeling data make these sources ideal for the purposes of development and operation of the dynamic SPARROW model. Remote sensing products including MODIS vegetation indices, SMAP surface soil moisture, and OMI atmospheric chemistry along with LIS–derived evapotranspiration (ET) and soil temperature and moisture products will be included in model development and operation. MODIS data will also be used to map annual land cover/land use and in conjunction with Landsat and Sentinel to identify disturbed areas that might be sources of sediment and increased phosphorus loading. These data and others constitute the independent variables in a regression analysis whose dependent variables are the water quality constituents total nitrogen, total phosphorus, and suspended sediment. Remotely-sensed variables such as vegetation indices and ET can be proxies for nutrient uptake by vegetation; MODIS Leaf Area Index can indicate sources of phosphorus from vegetation; soil moisture and temperature are known to control rates of denitrification; and bare soil areas serve as sources of enhanced nutrient and sediment production. The enhanced SPARROW dynamic models will provide improved tools for end users to manage water quality in near real time and for the formulation of future scenarios to inform strategic planning. Time- varying SPARROW outputs will aid water managers in decision making regarding resource allocation in protecting aquatic habitats, planning for harmful algal blooms, and restoration of degraded habitats, stream segments, or lakes.

P01 *Modeling the Risk of Wastewater Surface Discharge in Rural Alabama.* **Aaron Blackwell** & Parnab Das, University of Alabama; Kevin White, University of South Alabama; Robert Jones, Alabama Department of Public Health (retired); Joseph Weber, Sagy Cohen, & Mark Elliott, The University of Alabama
(Abstract No. 102)

Approximately 20% of US households (60% of rural households) are not connected to a sewer system, leaving them to rely on conventional septic systems that require subsurface discharge. However, there are many anecdotal reports 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. Stakeholders report that straight pipes are especially common in the impermeable clay soils and shallow chalk of central Alabama. A 2005 survey in Bibb County found that 15% of unsewered homes had a straight pipe (White and Jones, 2006). Surveys of Wilcox County indicate that >60% of unsewered homes had straight pipes and in our Hale County sample, 6% of households had straight pipes (Elliott, 2017). These discharges are estimated to result in over 500,000 gallons of raw sewage discharged to the ground every day. Estimating the number and location of straight pipes and the volume discharged will enable legislators and stakeholders to prioritize wastewater projects and justify spending based on clearly defined benefits. 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 are too expensive and time-consuming to conduct for the entire region. The prevalence of straight pipes varied across counties and communities. Our preliminary analysis indicates that these differences are likely based on two main factors: soil characteristics and rural poverty. We are developing a GIS model that will map the likely number of straight pipes in rural areas of Alabama. The model will be built using our existing site inspection data alongside secondary data including USDA soil surveys, digital elevation models, and property information from county tax assessors. Ours is the first model to estimate the presence of straight pipes in the United States. References: Elliott, M. (2017) Surface discharge of raw wastewater among unsewered homes in central Alabama. Webinar presented for EPA Office of Decentralized Wastewater. March 28, 2017. https://www.epa.gov/septic/webcasts-about-onsite-wastewater- treatment#alabama Accessed Sept. 4, 2017. White, K. and Jones, R. (2006). A Survey of Onsite Wastewater Systems in Bibb County, Alabama. Report for the Alabama Association of Conservation Districts. Montgomery, AL.

P03 *Investigating the use of Polypropylene covers in preventing algae and cyanobacteria growth*. **Justin Box**, John Otto, William Kent & Brendan Higgins, Auburn University
(Abstract No. 119)

During the summer months, there is a concern for algae and cyanobacteria production within water treatment facilities. Algae growth within settling basins can lead to toxins produced by certain cyanobacteria as well as off-flavors due to geosmin and MIB production. While water treatment plants have a variety of options for managing algae populations, we are investigating the use of Xton Inc. polypropylene covers in preventing algae and toxic *Microcystis aeruginosa* (UTEX 2667) production within small-scale settling basins. A mesocosm study was performed at North Columbus Water Resource Facility, which use a combination of EarthTec and Xton Inc. covers to prevent algae growth. EarthTec is a proprietary chemical mixture containing copper sulfate which is advertised to limit algae growth and lower the levels of dissolved organic matter in water. This experiment consists of triplicate mesocosms for controls (no treatment), EarthTec treated water, a single layer cover, and a double layer cover. Each week, mesocosms are sampled and partially flushed with fresh water from Lake Oliver (the treatment plant's supply). This fresh water is treated with alum and calcium carbonate in the same concentrations used by the water treatment plant, creating a small, parallel version of their settling basins. Chlorophyll a readings suggest that the Xton covers are more effective than EarthTec in preventing algae from growing. The next step of the study is to inoculate the individual mesocosms with M. aeruginosa (UTEX 2667) to determine the effectiveness against toxic cyanobacteria growth. We will use qPCR to quantify the population of total cyanobacteria, *Microcystis* sp, and the specific microcystin toxin-producing gene. If proven to be effective, these covers could be the next step for water treatment facilities to prevent algae populations and cyanobacteria production.

P05 *Using Functional Marker Genes to Characterize Denitrifying Microbial Populations in Oil-Impacted Barrier Islands.* **Patrice Crawford**, Peter Whitehurst, Nikaela Flournoy, Corianne Tatariw, Behzad Mortazavi, & Patricia Sobecky, The University of Alabama
(Abstract No. 103)

Disturbances to estuarine, coastal, and barrier islands can drastically alter their ecosystem services. Erosion and loss of sediment accretion, excess nutrient loading, invasive species, and oil spills are examples, which can affect the physical and biological structure and function of these vital systems. In addition to providing protection by reducing storm surges and dissipating wave energy, barrier islands support coastal economies while contributing to improved water quality which also support fisheries and tourism. In this century, these ecosystems are further threatened with chronic stresses (i.e. rising sea levels, climate change, invasive species, new and re-emerging pathogens) and pulse disturbances (i.e. oil spills, flooding, super storms). The Chandeleur Islands, a chain of low-elevation barrier islands in Louisiana waters located forty miles south of Gulfport, MS, is an important coastal defense and ecological habitat. Subjected to gradients of oiling during the 2010 Deepwater Horizon oil spill and to the ongoing northern expansion of black mangrove (*Avicennia germinans*), this study assessed the denitrifying microbial populations using nitrogen (N) cycle biomarker genes. We hypothesized that oiling events could further increase the vulnerability of this barrier island chain thereby reducing its resiliency to future stresses. The primary objective of this study was to assess denitrification capacity in saltmarsh cordgrass and black mangrove marsh study sites on the Chandeleur Islands. We applied quantitative polymerase chain reaction (qPCR) to key functional genes in the microbial denitrification pathway. We measured gene products that catalyze the first, second, and third enzymatic steps in the denitrification pathway from (nitrite to dinitrogen; NO2- to N2). Three eco-functional marker genes were investigated; (1) nirS, encoding the nitrite reductase gene; (2) norB, encoding the nitric oxide reductase gene; and (3) nosZ, encoding the nitrous oxide reductase. Quantification of denitrification biomarker gene abundances indicated lower values for nosZ and norB but varied for nirS in environmental DNA (eDNA) extracted from samples collected from *Avicennia* mangrove-associated sediments than for eDNA from samples collected from *Spartina* cordgrass-associated sediments. Our findings suggest influences of marsh plant types on denitrifying microbial population abundances. As denitrification in coastal and estuarine habitats are responsible for as much as 50% removal of nitrogen released to the ocean, such changes in microbial N-cycling populations could reduce the microbial transformation of N furthering contributing to decreased water quality through eutrophication by added nitrogen loading from coastal systems.

P26 *Virtual Eco Tour of the Mobile-Tensaw Delta.* **Michael Dorie**, Wild Native Tours (Abstract No. 17)

A visual tour of the Mobile-Tensaw Delta.

The Mobile-Tensaw Delta is the second largest delta in the United States and considered one of the most biologically diverse ecosystems in North America. Designated a National Natural Landmark in 1974, the Delta encompasses a variety of vital habitats that are home to diverse wildlife including 126 species of fish, 46 mammals, 69 reptiles, 30 amphibians and at least 300 species of bird, including more than 110 which nest in the region. This vast network of over 250 separate waterways, encompasses approximately 260,000 acres, nestled on the border of Mobile and Baldwin Counties to the North of Mobile Bay. Join us on a visual tour of this magnificent natural resource.

Presentation includes:

- Experienced, knowledgeable guide(s) to present in a fun and informative manner.
- Digital slideshow introducing the treasures of the vast Mobile-Tensaw Delta.
- Identification of waterways, habitat variations, diverse wildlife, and plant life.
- Participant interaction with opportunities for Q & A.

P06 *The role of a fluvial flood wave in the coastal region of Alabama.* **Steven L. Dykstra** & Brian Dzwonkowski, University of South Alabama/Dauphin Island Sea Lab (Abstract No. 104)

Fresh water discharge is modulated by natural (e.g. levees, channels) and human structures (e.g. dams, diversions), changing the timing and magnitude of flow, important factors for flood management, navigation, and ecological processes. Discharge is reliably measured inland of tides, estuaries, and deltas where long backwater regions that can significantly impact the downstream dynamics of the estuarine and coastal systems. Limited understanding of coastal backwaters and their basins generate uncertainties in the timing and magnitude of discharge making a coastal response to discharge difficult to quantify. Of particular interest are the dynamics of fluvial flood waves (i.e. large discharge events). These events propagate to the coast while being modulated by their basin (e.g. shape, friction) and are measured as celerity, not local velocity. The goal of this study was to identify how a fluvial flood wave propagates through a backwater environment, common to nearly all estuaries, and the effects of propagation on estuarine circulation and river plume dynamics. Long-term discharge, velocity, water level, and salinity records in the tidal reach of coastal Alabama were used to study fluvial flood wave propagation from the dams on the Tombigbee and Alabama Rivers, 238km inland, to the Gulf of Mexico. Typically, as discharge levels in a river system increase, the fluvial flood wave celerity and the associated velocity increase. Surprisingly, the results of this study showed the fluvial flood wave was significantly faster when water was in the channel as compared to flooding stages. At observed water levels that would be expected to overtop system levees, momentum balance estimates derived from Saint-Venant equations indicate a sharp increase in the frictional term with rising water levels, likely a result of the interaction with the forest plains. Once flooded, the water level rose several more meters maintaining the same slope as the floodplain. The water level slopes without forested plains increased. This highlights the importance of the flood basin in controlling the water level slope and dominate bed slope instead of the channel. Additionally, due to the backwater environment, the velocity signal lead that of the water level creating an unsteady flow. In streams, this lag is commonly on the order of hours, but was measured days apart and phased nearly as a standing wave in the main stem of the river system. With flooding and decreased backwater influence, the wave became more progressive. At the head of the bay subtidal velocities peaked and salinity reached a minimum on average two days before the subtidal water level. The high friction of the delta during river floods created a shallow water level slope extending close to the head of the bay at which point the slope steepened. This increased the barotropic pressure at the bay head and caused the tides to damp, two- layer estuarine flow to break down, and the bay to be flushed.

P17 *Using NASA Earth observations to monitor salinity changes in the Mobile Bay/Mississippi Sound system and application to manatee movement*. Maury Estes, University of Alabama in Huntsville, Mercedes Bartkovich, Alabama Department of Conservation and Natural Resources, **Leah Parker**, University of Alabama in Huntsville; Paul Lemieux, National Centers for Environmental Information; & Ruth Carmichael, University of South Alabama
(Abstract No. 117)

The Mobile Bay/Mississippi Sound system, located in the north central Gulf of Mexico, is a major freshwater-dominated habitat. Endemic species depend on the health of this habitat and many are affected by variation in salinity levels. The West Indian manatee (*Trichechus manatus*), in particular, exhibits movement patterns that may be influenced by salinity in this system. Before NASA's launch of the Aquarius satellite, the ability to directly measure ocean salinity levels remotely was nonexistent. Aquarius provided salinity data for pelagic marine regions, but its spatial resolution limited its use in coastal areas. By using NASA's Aqua moderate resolution imaging radio spectrometer (MODIS) remote sensing reflectance band ratios and in situ salinity data, a model was developed to better predict salinity in nearshore areas of the Mobile Bay/ Mississippi Sound system and determine how animals such as manatees may use this habitat with respect to salinity. Aqua MODIS level-2 ocean color data were retrieved from Goddard Space Flight Center's ocean color website and processed using the SeaWiFS Data Analysis System (SeaDAS 7). In situ salinity data for the estuarine study area were acquired from multiple local research organizations and paired with the MODIS ocean color data in a geographic information system. Numerous MODIS reflectance band ratio models were tested with the best model being the band ratio of 667nm/448nm (r^2 = 0.73). Further analysis employing Aqua MODIS and in situ data were used to monitor salinity changes from June 2007 to May 2017, which demonstrated slight fluctuations within northern Mobile Bay and southern Mississippi Sound. These data were used to align manatee sightings with salinity patterns in the study area during the 2016-2017 season as one application for the estuarine salinity estimates. Peak (1 June to 31 October 2016) and off-peak (1 November 2016 to 31 March 2017) seasonal maps of manatee sightings provided insight into salinity levels that were associated with manatee habitat use in coastal areas of the Mobile Bay/Mississippi Sound.

P07 *Developing and Testing a Computationally Efficient Soil Moisture Prediction Algorithm Methodology.* **Junhao He**, Auburn University; Muhamed Hantush, U. S. Environmental Protection; Sabahattin Isik, & Latif Kalin Auburn University (Abstract No. 32)

The Richards equation (RE) has been widely studied and applied in predicting soil moisture distribution in soils. However, solving the partial differential equation based RE is tedious owing to its high nonlinearity and computational demand. The RE requires dividing the soil into small depth increments and solving the moisture content at each depth. But most of the time, the average moisture content of a soil layer is needed. In this study, a novel approach for depth-averaged solution to the Richards equation (DARE) for one-dimensional vertical unsaturated flow is developed. DARE is a simpler mathematical representation of RE; it is based on ordinary differential equations as opposed to partial differential equations of RE. DARE can simulate average soil moisture contents in different soil layers, considering plant water uptake, soil evaporation and groundwater level fluctuations. To test the accuracy and utility of DARE, simulations were carried out for 12 uniform soil texture class and for 2 non-uniform layered soils. Variable top boundary conditions and two different bottom boundary conditions (variable flux and free-drainage) were studied. Furthermore, the situation of groundwater level fluctuation within the soil columns was simulated for wetland environments. The results were compared with HYDRUS 1-D model and experimental data. DARE gave accurate results with free-drainage bottom boundary condition for all simulations compared to HYDRUS 1-D. With variable flux bottom boundary conditions, DARE gave reasonable accurate results compared to both HYDRUS 1-D and experimental data. In terms of model performance, DARE eliminates numerical crashes and takes less calculation time compared to HYDRUS 1-D. DARE can be used for field and watershed scale soil moisture estimations.

P27 *Development of an Artificial Intelligent System for Irrigation Applications Using Heterogeneous Sensors.* **Andrés Jiménez**, Universidad de los Llanos & Brenda Ortiz, Auburn University
(Abstract No. 85)

Monitoring strategies to improve water management are essential in agricultural systems, especially where water is scarce. The quantity and quality of data associated with irrigation has increased in recent years due to the use of the information and communications technologies. There are many smart sensors that provide useful information to determine or prescribe water requirements to crops, especially sensors monitoring soil, plant and weather parameters. The goal of this project is to build an intelligent system for irrigation management applying the multi-agent paradigm. An agent is an entity made up of software and hardware that can have a reactive or proactive behavior, has learning and reasoning capabilities and can communicate information with other agents. If there is more than one agent in the system, it is considered as a multi-agent system. In the designed system, five types of agents have been defined: moisture sensor agent, canopy temperature sensor agent, weather station agent, coordinator agent and application agent. The use of this data management and analysis approach will allow prescription and application of irrigation. In the proposed intelligent system, there could be at least one type of sensor agent, one coordinator agent and one application agent; with expansion capability to more sensors and application agents. This intelligent system is a tool for farmers and companies to manage irrigation according with the real behavior of the variables of soil, plant and weather in the field. The proposed system will merge heterogeneous data from different technologies and provide a site specific irrigation recommendation. This system is useful as a decision support system to define the application of irrigation, but the underlying goal is to develop a system that allows irrigation water management with minimum human intervention.

P09 *Linking photosynthetic pigments and taxonomy in cyanobacteria blooms: implications for water quality management in the Southeast United States.* **Avery Lamb**, Auburn University; Sarah Leinbach, University of Maryland; Matthew Waters & Alan Wilson, Auburn University
(Abstract No. 86)

Algal and phytoplankton communities are frequently monitored in water quality management. However, current practices to identify primary producers typically follow two extremes: broad-scale chlorophyll-a measurements or detailed identification via microscopy. One technique that could provide rapid and beneficial identification of phytoplankton groups is the measurement of pigments (chlorophylls and carotenoids) using high performance liquid chromatography (HPLC). Coupled with an increase in cyanobacteria communities, a concern over cyanobacteria toxins (cyanotoxins) that can cause negative effects in aquatic ecosystems and human health, is also increasing. Typically, primary producers and cyanotoxins are monitored infrequently, often on a yearly or monthly-basis. Environmental conditions in aquatic ecosystems can change rapidly from alterations in temperature, rainfall, wind and other environmental variables thus confounding the representative nature of infrequent samples. Therefore, there exists a need to evaluate whether a yearly or monthly, single-sampling method is truly representative of the algal community and cyanotoxin presence in a waterbody. Here, we report on a frequent sampling strategy of water samples from four ponds indicative of high cyanobacterial presence at the E.W. Shell Fisheries Center in Auburn, AL where ponds were monitored biweekly for species, photosynthetic pigments, and cyanotoxins. Results demonstrate the need for increased frequency in sampling regimes as well as caution in the strength of inferences drawn from infrequent sampling programs.

P10 *Impacts of Land Cover and Climate Changes on Water Quantity and Quality of the Flint River Watershed in North-Central Alabama*. **Sara Miller**, University of Alabama in Huntsville; Mohammad Al-Hamdan & Muhammad Barik, Universities Space Research Association at NASA/MSFC in Huntsville
(Abstract No. 88)

The Flint River watershed's land cover is dominated by agriculture and forest. Madison County, which is within the Flint River basin, is developing rapidly. Construction of new roads and other impervious surfaces leads to changes in runoff as well as transportation of sediment and nutrients. Climate change scenarios predict higher mean temperatures and redistribution of rainfall, which could also lead to changes in water quantity and quality. The Soil and Water Assessment Tool (SWAT) was used along with ArcSWAT and the Hydrologic and Water Quality System (HAWQS) to create hydrologic models for different land cover change and climate change scenarios. These models were calibrated for the watershed and validated using USGS gauge stations located on the Flint River at Brownsboro. Land cover change was examined using land cover maps from the Landsat-derived National Land Cover Database covering years 1992-2011. Climate change scenarios from the IPCC were used to predict future water quantity and quality changes from projected climate changes. Statistical analyses were used to determine if land cover and climate changes have significant effects on the water quantity and quality in the Flint River.

P11 *Drought Management Plans for Major Cities in Alabama and the Southeastern United States*. **Meredith Moore** & Philip Chaney, Auburn University
(Abstract No. 89)

The severe drought that struck California over the last several years has led to greater awareness of the consequences of water scarcity and the lack of effective drought policy. The Southeastern U.S. is not immune to this threat, as evidenced by the devastating droughts of 2007 and 2016. Without adequate management and effective planning, drought impacts are likely to become longer lasting and more severe. While 47 states have a drought action or response plan in effect, they are unlikely to address the local needs, policies, and implementable actions that mitigate the effects and long-term consequences of drought. Preliminary research suggests that drought management plans are much more common in the Western U.S. than the Southeast. Therefore, this study aims to investigate local drought management plans in the Southeast and to offer insight and recommendations for developing a successful plan for local communities. Characteristics of these local management plans are analyzed for a definition of drought, implementable actions (for example, over-consumption surcharges and litigation prohibiting the washing of cars, lawns, and gardens during the drought period), clear enforcement, conservation measures during non-drought periods, and goals for mitigating the impacts of future droughts. This poster will present preliminary findings for several key cities in the Southeast (e.g. Birmingham, Auburn, Dothan, Tuscaloosa, Columbus, and Atlanta) and the Western U.S. (e.g. Los Angeles, Sacramento, and Tucson). Few studies have critically analyzed drought management plans and conceptualized the overall quality of the mitigation strategies. As a proactive approach to addressing water scarcity issues and the threats of depleted freshwater supplies, these comparative and deductive methods are necessary to optimize present and future water availability of this limited resource.

P12 *Response of Fluvial Suspended Sediment Fluxes and River Discharge to Future Climate Change on a Global Scale*. **Nishani Moragoda** & Sagy Cohen, The University of Alabama
(Abstract No. 90)

Fluvial sediment dynamics play an important role in the functioning and connectivity of the earth's natural systems. It is not only one of the primary drivers of landscape development and channel morphodynamics, but also has important implications for water resources, ecology, geochemical cycling and socio-economic aspects. Although anthropogenic influences are a major cause of changes in river sediment transport processes, it is widely accepted that these processes are also sensitive to climate change. Future climate changes, particularly rises in temperature driven by increased greenhouse gas emissions, are projected to considerably impact 21st century precipitation distribution which will alter fluvial processes, soil erosion and sediment loads worldwide. Predicting the responses of riverine fluxes to future climate is, therefore, vital for the management of fluvial systems. In this study, we conduct a global scale analysis of future suspended sediment and water discharge dynamics in response to the changing climate. We use a spatially and temporally explicit global scale hydrogeomorphic model, WBMsed. Changes in earth's climate system were obtained by forcing the model with downscaled precipitation and temperature projections generated from multiple General Circulation Models (GCMs), each driven by four Representative Concentration Pathways (RCPs). We investigate climate- induced spatial and temporal trends and variability in global suspended sediment loads and river discharge dynamics in the 21st century.

P13 *A Remote Sensing Analysis of Flood susceptibility Response to Morphological Evolution of River Deltas: A Case Study from the Rosetta Promontary of the Nile River Delta*. **Dinuke Munasinghe**, & Sagy Cohen, The University of Alabama
(Abstract No. 91)

Close to half a billion people live in deltaic regions worldwide, including in a number of mega-cities. Deltaic regions act as central locations for agricultural production, livestock farming, fisheries and hydrocarbon extraction. Deltas are also biodiversity hotspots and carry with them a vast cultural heritage. Over the past half century, the frequency of high magnitude floods has increased, causing devastating socio- economic and ecological losses to human settlements and infrastructure in deltaic regions. The overarching goal of the study aims at providing perspectives on the drivers, mechanisms and trends of morphology changes and how these affect flood susceptibility in large deltas, globally. A case study of the Rosetta Promontary of the Nile River Delta is presented herein.

The Rosetta Promontory, created at the terminal by one of the two diverging branches (Rosetta Branch) of the Nile River, Egypt has been suffering from continuous erosion. The dramatic retreatment was observed during the last century, basically due to the construction of Aswan High Dam in 1964, consequently reducing the flow and sediment discharges. The promontory is of particular importance since it is used for transportation, agriculture, and fishing activities. This particular case study aims at investigating the following research questions: (1) Are changes in fluvial sediment flux to the delta are directly linked to decadal changes in delta morphology? (2) Will the degradation of delta significantly increase flooding susceptibility? (3) How will trends of flood susceptibilities vary individually in the delta? (4) How much of a significant net increase in flood susceptibility can be expected through the 21st century?

A multifaceted research approach combining (a) numerical modeling of riverine water and sediment fluxes, (b) remote sensing analysis of delta morphology changes and flooding dynamics, and (c) GIS analysis of socio-economic impacts of flooding on deltaic communities is performed. Numerical modeling is used to obtain fluvial sediment and water fluxes to deltas. River gauging is used to validate the model predictions. Remote sensing techniques are used to map changes in deltaic topographic trends and flood inundation in the last four decades. Older maps from comparable studies/repositories are used, to infer on longer-term changes. These are combined, using GIS techniques, with geospatial land use and population distribution information, to quantify flooding impacts and their spatio-temporal dynamics.

At its conclusion, the study is envisioned to provide scientific advancements and predictive platforms that could assist decision makers at local, national, and international levels to make informed decisions on mitigating flood inundation risks of global deltas.

P14 *Shoreline stability using living shorelines on a southeastern United States reservoir: design, ecological impacts, erosion/wave attenuation, and stakeholder implications*. **Eric Muth**, Pell City High School
(Abstract No. 108)

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 results in eventual failure and additional repair/replacement cost. The erosion that they contribute to decreases biodiversity and exchange of nutrients from upland to the water. On coastal shoreline and marine ecosystems, living shorelines have shown to be an ecological 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 and a permitted example should be tested.

P15 *Evaluating practical approaches for on-farm water testing to meet the FSMA Produce Safety Rule requirements*. **Casey Nowell**, Sergio RuizCórdova, Puneet Srivastava and Yucheng Feng, Auburn University
(Abstract No. 92)

The Produce Safety Rule, a part of the FDA Food Safety Modernization Act (FSMA), will soon require produce farmers to monitor the quality of irrigation water used on the farm for generic E. coli in an effort to prevent microbial contamination of fresh produce grown for human consumption. Generic E. coli concentrations in water are typically enumerated using the Environmental Protection Agency's (EPA) Standard Method (EPA Method 1603) in certified laboratories. This would require shipping water samples from the farm to a laboratory, which presents both an excessive financial burden on produce farmers and the problem of getting the samples analyzed within an acceptable holding time (a maximum of a 6 h transport time and 2 h analysis time). Anticipating these issues, we are seeking the use of alternative methods for meeting the FSMA requirements as long as the alternatives provide the same level of public health protection as provided by the use of the EPA Standard Method. Several E. coli testing methods are available for citizen monitoring programs, including the Coliscan® Easygel method used by the Alabama Water Watch program. The objectives of this study were to compare alternative methods against the EPA Standard Method in determining E. coli levels in surface waters of varying chemical characteristics and to determine the effects of transport time on E. coli concentrations determined by the EPA standard method. We have been collecting water samples monthly from 12 sites around Auburn, AL. Water samples were analyzed using the Coliscan® Easygel, 3MTM Petrifilm, and Coliscan® MF methods in addition to the EPA method 1603. Six of the samples were kept on ice for 24 h to simulate the effects of a 24 h transport time to a laboratory. Preliminary results will be presented, and implication of the results will be discussed.

P02 *Helping Alabama farmers to adopt precision irrigation practices in Alabama*.
Brenda V. Ortiz, **Luca Bondesan, Guilherme Morata**, Hemendra Kumar, Laljeet Sangha, Brittney Goodrich, Jasmeet Lamba & Puneet Srivastava, Auburn University; George Vellidis, University of Georgia
(Abstract No. 93)

Irrigation adoption in Alabama is increasing but this rapid adoption has not always resulted in crop yield benefits or water savings. The challenges farmers in Alabama, Tennessee and other southeastern states face are the lack of irrigation water management training/experience and the low adoption rate of the state-of-the-art technologies and practices that increase irrigation water use efficiency. A NRCS funded project has been initiated with farmers in North and South Alabama to demonstrate practices of sensor-based irrigations scheduling and variable rate irritation. The four demonstration sites are representing different irrigation scenarios which can be used to discuss how better to manage irrigation water. At each site we are comparing the irrigation farmer's practices versus the technology-based practice. Preliminary results from the 2018 growing season will be presented. Four farmers focus groups have been established at each demonstration site to train farmers and consultants and share project findings.

P16 *Evaluation of Atmospheric Active Soil Moisture Residence Time in Climate.*
Ashutosh Pandey & Sanjiv Kumar, Auburn University
(Abstract No. 94)

Plants play a central role in the global water and energy cycles by regulating the partitioning of water and energy fluxes at the land surface in response to the atmospheric demand and soil moisture availability in the root zone. Soil water dynamics in the root zone are dominated by rapid infiltration and subsequent vertical redistribution following rainfall, in contrast, to slow dry down due to water uptake by roots for evapotranspiration during interstorm periods. The sensitivity of ET to soil moisture is a central parameter within the coupled land-atmosphere system. However, there exist large uncertainties in constraining this parameter in climate models due to lack of concomitant observations of evapotranspiration and soil moisture at similar spatial scales. We develop a new processes based metric named as "Atmospheric Active Soil Moisture Residence Time" that measures e-folding decay time of evapotranspiration response using daily soil moisture observations. We compute AASMRT from the recession limb of soil moisture data as an ordinary least square estimate of recession constant for a linear reservoir model. We have computed AASMRT at 1172 soil moisture stations available from North American Soil Moisture database. We have compared AASMRT observation the state-of-the art climate model outputs. We found that Community Land Model version 5.0 (CLM5) show comparable results to the observations; however, there is greater spatial variability (43%) in the observations than climate model outputs. CLM5 also show 20% increase in AASMRT compared to earlier version of the model (CLM4.5, and CLM4). The increased AASMRT can have implications for climate predictability in the fully coupled simulations

P08 *Using NASA Earth Observations to Assess Vegetative Stress of Row Crops in Irrigated and Non-Irrigated Plots in Alabama*. Chris Ploetz, **Maggi Klug**, Olivia Callaway & Emilene Sivagnanam, NASA DEVELOP, The University of Alabama in Huntsville (Abstract No. 118)

Over the past decade, drought in Alabama had a major impact on agriculture causing crop yields to fall well below normal levels. High resolution satellite remote sensing can enhance current drought monitoring practices led by the Alabama Office of the State Climatologist (AOSC). The AOSC monitors drought using a myriad of data types and sources and compiles the information into a weekly drought-monitoring map, the United States Drought Monitor (USDM). This project explored using two vegetation indices, Green Normalized Difference Vegetation Index (GNDVI), Normalized Difference Vegetation Index (NDVI), and one water index, the Normalized Difference Water Index (NDWI), from high-resolution satellites, Landsat 5 TM, Landsat 8 OLI, and Sentinel 2 MSI to increase the level of detail in drought depiction for the USDM. Additionally, the project considered whether farms with center pivot irrigation fared better than farms relying solely on precipitation during the 2011 and 2016 drought using data provided by the Earth System Science Center (ESSC) at University of Alabama in Huntsville. The results were compared to the USDM output and the crop's water stress index, which was provided by the ESSC's Gridded Decision Support System for Agrotechnology Transfer (GriDSSAT) crop model. The project resolved that although higher resolution satellites do provide information on when a crop is under vegetative stress before the USDM depicts drought conditions, the resolution of Landsat 5 and Landsat 8 was not high enough to analyze crops at a field level scale.

P18 *Multi-level modification of the USLE K factor for annual soil erodibility assessment of mixed landscapes*. **Pooja Preetha** & Ashraf Alhamdan, University of Alabama in Huntsville
(Abstract No. 95)

The measurement of soil erodibility factor (K) of the Universal Soil Loss Equation (USLE) in the field and laboratories for dynamic soil loss estimates is laborious, time-consuming and expensive. Thus, realistic predictions of K through amended model functions could be time and cost efficient for annual and seasonal soil loss estimates and soil management practices. The aim of this study was to develop a new functionality for more realistic estimates of annual K factor using multiple linear regressions capturing the factors of the USLE through using GIS and dynamic remotely sensed land cover data from MODIS in the Soil and Water Assessment Tool (SWAT) model. The study was conducted for Fish river watershed in Alabama for the temporal conditions of 2001 to 2011. In this study, SWAT model was first calibrated to reproduce the historical K collected for each hydrologic response unit (HRU) including landuse, management and soil attributes of the sub basins within the study area for the year 2001 ($R2 = 0.956$, $NS = 0.877$). Then, the variables that most significantly affect K were identified by developing a correlation matrix and a forward stepwise multiple linear regression (MLR) for the five variables of topographical factor (slope length and steepness), crop management factor, soil permeability, soil moisture content, and soil bulk density. The study showed that the soil moisture content and soil bulk density, which are commonly not accounted for in the traditional USLE model, had a significant impact on K factor due to their strong influence on the stability of dissolved nutrients for runoff releases and reduced soil health respectively. Model verification results of the study for the years 2006 and 2011 determined that the forward stepwise MLR analysis containing all five variables with the highest R2 (0.903 for 2001; 0.8917 for 2006 and 0.9376 for 2011) was the best model for estimating the K factor. A strong correlation between the estimated K from MLR of the study and measured K indicated that the use of soil moisture content ($R2 = 0.844$, $n = 70$, $p < 0.05$) and soil bulk density ($R2 = 0.771$, $n = 70$, $p < 0.05$) as predictor variables gives an all-inclusive and improved estimation of K in regions with noticeable temporal land cover transformations.

P33 *Low impact development (LID) practices to mitigate thermal pollution in stormwater runoff entering urban streams and sensitive coastal receiving waters.* **Keith Rahn**, Charlene Lebleu, Amy Wright, Mark Dougherty, Rui Wang & Ryan Bowen, Auburn University
(Abstract No. 96)

Mobile Bay is home to Alabama's seafood industry and provides estuary service for many fish, crustaceans and wildlife. Stormwater temperature is an essential but overlooked aspect of the urban stormwater condition. As urbanization and build-out occurs, the thermal regime (surface, air, and water) of the surrounding environment is altered. Heated stormwater runoff flows into receiving waters where it mixes and increases the base temperature of surface water in lakes, streams, bays and estuaries. The amount of heat transferred, and the degree of thermal pollution is of importance for fisheries management and the ecological integrity of receiving waters. Fish and other aquatic life in particular are most sensitive to thermal pollution. (Galli, 1990) Thermal inputs to a stormwater system include influent and effluent temperature, solar radiation, longwave radiation, convection and diffusion from both the atmosphere and subsurface, and infiltration. The main purpose of this research is to develop design models for standard stormwater control measures that can be used to meet specific effluent temperature standards and to maintain the required thermal regime in a receiving stream. This project engages controlled laboratory test to assess low impact development (LID) stormwater control measures to reduce the impact of the thermal characteristics of stormwater runoff. Research will be conducted in the Green Infrastructure Laboratory located in the Center for Advanced Science, Innovation and Commerce (CASIC) Building at Auburn University. The laboratory provides a controlled environment, and is designed for both wet and dry research. Test cells are constructed from pavement materials of the type and thickness typically used in urban areas. Infrared heat lamps are used to heat each cell. A simulated rainfall system with irrigation spray heads were installed in each corner of the testing area. The cells are designed to simulate the appropriate installation method, including fill (impervious) or retention (pervious) subbase and soil below the 10 cm thick slabs. They are also designed to capture the simulated stormwater runoff for impervious materials or allow infiltration for the pervious materials. Unique to this project is using a data logging system and thermistors located in various locations within the cells in conjunction with surface thermal imaging using an infrared camera. Results from this project will be used to establish a baseline measurement of heat removal effectiveness of pervious material when used as a solitary stormwater control measure and when used in combination with other stormwater control measures.

P29 *3-D Modeling of Sediment Volume in a Municipal Reservoir – A Dredging Feasibility Evaluation*. **Kelley Rich**, Kendall Rich & Leslie Noble, Wood Environment and Infrastructure Solutions, Inc.
(Abstract No. 110)

Drinking water availability is a primary focus of municipal water suppliers, particularly those that supply growing communities. Wood Environment & Infrastructure Solutions, Inc. (Wood E&IS) was contracted by the Birmingham Water Works Board (BWWB) to conduct a feasibility study for the Lake Purdy Dredging Project in Jefferson and Shelby counties, Alabama. The purpose is to evaluate the viability of dredging sediment from the lake to increasing storage capacity and improve water quality. This study relies on the application of three-dimensional GIS modeling techniques using modern and historical lake sediment datasets. Lake Purdy is owned by the BWWB and is used as a secondary source of drinking water for Birmingham and surrounding residents. The lake was initially created by the construction of a dam across the Little Cahaba River in 1910. Historic sedimentation surveys indicate notable storage capacity loss due to silting during the first 25 years following Lake Purdy's construction. The currently estimated storage capacity of the Lake Purdy reservoir is 17,500 acre-feet, in contrast to the 19,080 acre-feet of storage capacity estimated in 1935. In order to determine how much the dredging of sediment from the lake would increase the volume of water storage, Wood E&IS used a combination of geophysical data, sediment borings, historical documents and modern GIS techniques to estimate the current amount of sediment present in the lake. First, a geophysical investigation was conducted by GEL physics to characterize the general extent and thickness of sediment beneath Lake Purdy. The results of this geophysical study helped facilitate the layout of vibracore boring locations used to accurately quantify the thickness of the sediments underlying the lake. Next, pre-impoundment stream centerlines and topographic contours were digitized in ArcGIS from a 1906 map of the Little Cahaba River to better estimate current bottom-of-sediment elevations within the former stream channels. Using ArcGIS with 3D Analyst and Spatial Analyst extensions, three- dimensional surface data sets (one from lake bottom elevations and one from bottom- of-sediment elevations) were extrapolated from the sediment boring data and historic stream channel data points using Kriging interpolation. Map Algebra tools in ArcGIS were utilized to make a volumetric calculation, i.e. the mathematical difference between the upper (lake bottom) and lower (bottom-of-sediment) three-dimensional surfaces, to derive an estimated total volume of sediment currently present in the Lake Purdy Reservoir. This estimated total was used to quantify the increase of storage capacity BWWB could expect in Lake Purdy if the dredging project were to be further considered and carried out. This presentation will highlight the methods used to derive the volumetric calculation of sediment present in Lake Purdy using a variety of available data.

P19 *High-resolution Mapping of Flood Inundation through the Diffusion Hydrodynamics Model: A Case Study of Lake Tuscaloosa Dam Failure*. **Junho Song** & Jonghun Kam, The University of Alabama
(Abstract No. 98)

According to the National Inventory of Dams, 67% of the dams in Alabama have been built between 1940s and 1980s. These aging dams are beneficial for our community, including, hydroelectricity, flood control, recreation, and navigation. Among the manifold damages caused by the collapse of dams, flood damage impact causes fatalities and enormous economic losses. To have their benefits in the future, however we need a careful dam safety program in Alabama, including the Emergency Act Plan (EAP). As the first step of the EAP development, we create high-resolution maps of flood inundation during the dam failure of Lake Tuscaloosa as a case study. We use the Diffusion Hydrodynamic Model (DHM) to estimate the inundation spatial extent, the inundation depth, and the flow velocity during the dam failure. We test the sensitivity of the DHM's mapping performance of flood inundation to the grid size of the DEM. The DEMs include 10 meters (33 feet), 30 meters (67 feet), and 90 meters (100 feet). This sensitivity test will inform us the importance of the quality of the DEMs on the DHM performance. In order to reduce the massive computational time, we run the DHM with the 10-meter DEM through the parallel computing technique, Message Passing Interface (MPI), at the Alabama Supercomputer Authority. Ultimately, these high- resolution flood inundation maps will help the City of Tuscaloosa to develop the EAP for Lake Tuscaloosa Dam.

P30 *Developing climate-informed reservoir inflow forecasts using improved machine learning techniques*. **Di Tian** & Mohammad Valipour, Auburn University
(Abstract No. 112)

Accurate reservoir inflow forecasts are critical for hydropower generation, water supply management, flood control, and downstream environmental flow maintenance in a river basin. Hybrid techniques through machine learning (ML) and dynamic seasonal climate forecasts create an opportunity to further improve inflow forecasting by linking plausible hydro-climatic predictors with inflow observations. In this study, seasonal inflow forecasts for 12 reservoirs are developed based on 19 variables, including retrospective seasonal climate forecasts from the North American Multi-Model Ensemble (NMME) system and antecedent climatic and hydrologic observations. One- season ahead reservoir inflow forecasts are produced for each season using three machine learning techniques including Random Forest (RF), Gradient Boosted Regression Tree (GBRT), and Extreme Learning Machine (ELM). The performance of the inflow forecast for each season is assessed using different evaluation metrics via cross validation. Results indicate that ELM performs best, followed by RF and GBRT. These three ML algorithms consistently perform best in winter, but fails to capture the inflow variability in fall due to reservoir operation rather than the hydro-climatological variations. We further evaluate the feature importance of the 19 variables through RF and selected the top three most important predictors for inflow forecasting, which yields an improvement of the average correlation coefficient and Nash-Sutcliff coefficient for all the three techniques by 65% and 90%, respectively.

P31 *Quantifying the Impact of Nonaqueous Phase Liquid Sources on the Mass Transfer of Toluene, Trichloroethene, and Perfluorooctanoic Acid in Groundwater*.
Geoffrey Tick, Joe Boone Abbott, & Rebecca Greenberg, University of Alabama;
Kenneth Carroll, New Mexico State University
(Abstract No. 99)

The presence of NAPL sources complicates the remediation of particular contaminants of concern (COC) due to variability of mass-transfer behavior as a result of compositional and molecular structure variations between the different compounds within the NAPL phase. This study investigates the effects of the contaminant COC composition and the bulk-NAPL component's molecular structure (i.e. carbon chain length, aliphatic and aromatic) on dissolution and partitioning/mass-transfer for resulting aqueous phase concentrations in groundwater. The specific COC tested include toluene (TOL), trichloroethene (TCE), and perfluorooctanoic acid (PFOA). Each COC was tested in a series of binary equilibrium batch experiments using insoluble bulk NAPL including n-hexane (HEX), n-decane (DEC), and n-hexadecane (HEXDEC). Raoult's Law was used to assess the relative ideality of the mass transfer processes for each binary equilibrium dissolution experiment. NAPL-PFOA partitioning coefficients were quantified to determine the retention/exchange dynamics as a function of bulk-NAPL carbon chain length (i.e. molecular structure). The results show that as mole fraction ratios of the COC (i.e. TOL and TCE) within the NAPL source decrease, dissolution nonideality generally increases for such multicomponent NAPL mixtures. The differences between the observed TOL and TCE equilibrium and Raoult's Law-predicted concentrations are likely due to specific intra-NAPL component interactions that occur and thereby affect mass transfer dynamics from the multicomponent NAPL mixture. However, no particular correlation between the observed COC aqueous-phase equilibrium concentrations (via dissolution) and the COC-NAPL mixture's bulk NAPL carbon chain length was determined. For the PFOA mass-transfer experiments, preliminary results indicate that longer-chained NAPL hydrocarbons (DEC or HEXDEC) tend to retain PFOA to a greater extent, leading to potentially longer release times, greater concentration tailing, and lower concentration groundwater plumes. The results of this work suggest that the prediction of aqueous phase concentrations of COC in groundwater due to the presence of NAPL sources (or complex mixtures) is dependent upon both compositional and molecular structural variations. Such impacts should be taken into account when designing and evaluating a particular remediation strategy and/or predicting COC concentrations from a NAPL source zone region.

P20 *The effects of crude oil on northern Gulf of Mexico salt marsh nitrogen cycling*.
Derek Tollette, Corianne Tatariw, & Behzad Mortazavi, The University of Alabama/Dauphin Island Sea Lab
(Abstract No. 120)

Coastal salt marshes provide many ecological services including the interception and removal of nutrients from coastal waters. In particular, the microbially mediated process of denitrification removes nitrogen (N) that contributes to eutrophication in coastal waters. In addition to denitrification, the dissimilatory nitrate reduction to ammonium (DNRA) pathway utilizes reactive N but conserves it in the system in the form of ammonium. The objectives of our study were to determine (i) the extent to which denitrification and DNRA are affected by oil spills in marshes, and (ii) if the contamination history of sites impact these processes in response to the addition of new oil. In spring 2018, we conducted a lab experiment in which sediments were collected from three sites subjected to a range of hydrocarbon contamination based on the Shoreline Cleanup Assessment Technique (SCAT) Program following the 2010 Deepwater Horizon oil spill. Of the three sites, one was described as moderately oiled (Chandeleur Islands, LA) while the other two (Dauphin Island, AL and Dog River, AL) were not impacted by the Deepwater Horizon spill. Sediments from Dauphin Island were collected in January and March, while sediments from Dog River were collected in February and April. Sediments from the Chandeleur Islands were collected in May. The collected sediments were incubated with and without water accommodated fraction (WAF) of oil for 6 days. Following the incubation, we measured denitrification and DNRA rates with the isotope pairing technique on sediment slurries. At sites with no known history of prior contamination, denitrification rates were similar across treatments ($p > 0.05$). In contrast, denitrification rates were lower in 100% WAF than both control and 25% WAF samples in sediments from the Chandeleur Islands ($p < 0.05$). In contrast to a lack of treatment effect on denitrification at previously unoiled sites, there were differences across treatments in DNRA but this response was not uniform across sites or dates. At Dauphin Island in January, DNRA rates were three- fold higher in 100% WAF than in control ($p < 0.05$), while in March, DNRA rates in the 100% WAF exceeded rates in both control and 25% WAF treatments ($p < 0.05$). In contrast to the response at Dauphin island, at Dog River DNRA rates were lower in 100% WAF than in control in April ($p < 0.05$), while rates were similar across treatments during the February sampling period ($p = 0.102$). There was also a treatment effect at the Chandeleur Islands, as DNRA rates were lower in 100% WAF than control treatments ($p < 0.05$). These results suggest that DNRA is affected in response to the addition of new oil regardless of contamination history, while it appears that denitrification rates are affected only at previously contaminated sites by the addition of new oil. Our ongoing sampling and analysis can confirm this pattern and shed light on the impact of oiling on marsh N removal capacity.

P21 *Urban Land Use Effects on Tidal Creek Salinity and Fringing Marshes.* **Emilia Torrellas**, University of North Carolina; Christopher Anderson & Latif Kalin, Auburn University
(Abstract No. 77)

Urbanization of coastal lands has serious implications on aquatic ecosystem integrity. Coastal wetlands are particularly important systems because of the ecological services they provide, such as carbon sequestration, sediment stabilization, water quality improvement, coastline protection from natural hazards, habitat, food and protection provision for diverse animal and plant species. These functions might be impaired as watersheds draining to these wetlands become more urbanized, causing excessive runoff inputs leading to the degradation of aquatic ecosystems. The purpose of this study is to understand how *Juncus roemerianus* salt marshes respond to different salinity regimes caused by increased urban runoff. To accomplish this purpose, an experimental setup replicating a salt marsh environment mimicking salinity and tidal fluctuations was created using salt marsh sod collected from the Alabama coast. Urban runoff inputs in salt marshes cause stresses of salinity which are reflected on plant productivity. Five treatments representing different watershed conditions were established to analyze plant response to salinity stress: control (steady salinity regime), forested (gradual salinity fluctuation), intermediate and two urban watersheds (abrupt salinity fluctuations). *Juncus roemerianus* productivity within the different treatments were monitored through periodic above ground biomass, photosynthetic rate and stomatal density and size assessments. Modeling tools were used as a complement to the study. A watershed model was coupled with a regression equation to predict salinity time series in few selected tidal creeks in Baldwin County. The potential impacts of changing land use/cover in these small coastal watersheds on the salinity regime were predicted and these predictions were associated with the experimental results to have an understanding of the nexus between watershed land use/cover and *Juncus roemerianus* habitat.

P22 *The potential use of guano core records in reconstructing historic precipitation patterns for northern Alabama.* **Alexandra Tsalickis**, Matthew Waters, Josh Campbell & Martin Medina, Auburn University
(Abstract No. 100)

The need to understand long-term precipitation patterns in Alabama is of great concern considering population increases, climate change and other environmental stressors. Current management strategies are typically based on modern records spanning the past ~50 years, forecasting models based on these records, and dendrochronology records spanning the past hundreds of years. One scientific medium capable of tracking moisture regimes over millennial timescales, but has received very little attention is guano deposits in cave systems. Guano deposits have been shown to track moisture and precipitation and are common in multiple caves systems throughout Alabama and the southeastern US. Here, we present a 9,000-year record of moisture and rainfall periods based upon stable isotopes (?13C, ?D) in a guano core collected from Cave Springs Alabama. Moisture was inferred from carbon stable isotopes indicating alterations between C3 and C4 plant abundance indicating changes from cooler to warmer environments, respectively. Deuterium will be measured from chitinous insect parts that have accumulated in the guano and bulk guano and will be used as an evaporation/precipitation measurement. Results demonstrate periods of terrestrial vegetation change indicating periods of changing precipitation throughout the Holocene. This study suggests that future research investigating guano deposits from Alabama caves can provide a unique and long-term record of water changes across the state.

P32 *Comparative assessment of multiple soil moisture estimates over the contiguous United States.* **Mohammad Valipour** & Di Tian, Department of Crop, Soil, and Environmental Sciences, Auburn University
(Abstract No. 113)

Soil moisture information is useful for water resources management, climatic forecasting, flood and slope failure control, drought and water quality monitoring, and geotechnical engineering. Soil moisture controls evapotranspiration, surface runoff, as well as the exchange of heat energy between the land surface and the atmosphere by affecting latent heat and ground heat flux. Climate reanalysis, land surface model simulations, and satellite remote sensing products provide spatially and temporally consistent soil moisture estimates, which are often used as alternatives to in situ observations. In this study, dynamics of three soil moisture estimates from the state- of-art climate reanalysis (MERRA-2), land surface model simulations (NLDAS-2/VIC), and satellite observations (SMAP) are assessed using in situ observation data from the North American Soil Moisture Database under various climates in the Contiguous United States (CONUS) over the common period during 1996 to 2017. The results show that, while all the three products well capture soil moisture dynamics, they represent different performance in various climate regions over the CONUS. On average, reanalysis products have an ability to estimate surface soil moisture and root zone soil moisture better than remote sensing (SMAP) and particularly land surface model (NLDAS-VIC). During extreme events, either drought or flooding, soil moisture estimates show increased variation among the three products. Moreover, the results highlight the sensitivity of soil moisture dynamics with different probable lag times to individual meteorological forcing and hydrological parameter under different climates. This study has implications to understand the uncertainty of the state-of-art soil moisture estimates and provides recommendations to improve soil moisture simulations in the future.

P23 *Historic Nutrient Deposition in Connected Reservoirs along the Apalachicola-Chattahoochee-Flint River System*. **Benjamin Webster** & Matthew Waters, Auburn University
(Abstract No. 114)

Reservoir construction exponentially increased throughout the 1900s due to the array of ecosystem services provided to surrounding communities. Despite their prevalence in the United States, there has been a scarcity of research on reservoirs in comparison to natural lakes. Reservoirs and dams are known to prevent sediment transport. This results in high sedimentation rates with current trends showing increased phosphorus (P) deposition behind dams. However, transport mechanisms documenting the movement of P through large fragmented rivers are unknown. Prior to the Clean Water act, policies did not exist on pollutant concentrations that waste water treatment plants (WWTPs) could release. One system where WWTP inputs have been a growing concern is the Chattahoochee River in Georgia and Alabama. P inputs into the Chattahoochee River were not regulated until the 1990s despite the Clean Water Act regulations. Here, we collected sediment cores in a string of 5 reservoirs downstream of Atlanta, GA to document P transport and deposition through a reservoir string. Our findings accurately depicted the known increase in phosphorus, a majority of which was sequestered within Lake Harding and West Point Lake. In addition, a dramatic decrease in P storage is shown from the establishment of regulations in the 1990s showing the ability of reservoir systems to limit P transport downstream. Strong reproducibility from such dynamic systems coupled with historic nutrient loading data allow us to better understand how urban inputs and specifically changes to wastewater management strategies have impacted reservoir dynamics. We plan to use this information to help further justify and improve future WWTPs management and regulations.

P24 *Using SPARROW to Evaluate Alabama Watersheds to Determine the Potential for Expanded Agricultural Use*. **Jenny Wood**, Cameron Handyside, Maury Estes & James Cruise, University of Alabama in Huntsville; Anne Hoos, United States Geological Survey (Abstract No. 115)

Understanding factors such as nitrogen and phosphorus that affect water quality is important for studying the relationship between enhanced agriculture and environmental conservation. Nitrogen and phosphorous can be found in many common fertilizers and in animal manure. Without proper agricultural management, however, these components can seep into groundwater reservoirs and nearby waterways causing nutrient pollution. This type of nutrient loading can cause heavy algal blooms leading to depletion in oxygen that aquatic life needs for survival. To monitor this phenomenon, the SPAtially Referenced Regression on Watershed attributes model known as SPARROW, developed by the United States Geological Survey was employed. SPARROW is a predictive model that uses nonlinear regression to estimate the mean annual load of both nitrogen and phosphorus. The model is driven using functions of sources and transport. The five significant sources used to account for nitrogen and phosphorus loading are 2002 estimates of atmospheric deposition, fertilizer applied to farmland, livestock manure, wastewater discharge, and urban land. The major transport variables assessed in the model include annual precipitation, soil permeability, and soil thickness. In-stream transport is accounted for through exponential decay functions. Based on the model's variables and output, the University of Alabama in Huntsville plans to use SPARROW to evaluate water quality for each of the 52 HUC-8 watersheds in Alabama. This project will assess projected amounts of nitrogen and phosphorus in each of the watersheds to understand their effect on water quality of stream segments and water bodies. UAH also intends to use this model to understand the impact of increased irrigation on water quality. While irrigation in Alabama is more limited than that of surrounding states, it has the potential to be a significant water consumer. As irrigation continues to grow in the state and an increased water demand results, managing the water supply and understanding the implications on water resources is becoming more of a challenge. Using SPARROW, UAH aims to consider the possible relationship between nutrient pollution and irrigation. If such a relationship exists, this study will use SPARROW to evaluate each watershed in Alabama under increased irrigation scenarios. Based on the findings of this and other studies, UAH plans to prioritize watersheds for expanded irrigation and to identify local environments in Alabama that might be negatively impacted by additional irrigated agriculture.

For further information, please see the conference website:
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