March 27-29, 2018

Water Policy Summit

National Water Center, Tuscaloosa, AL

COMMUNITY RESILIENCY: SUMMIT TO SEA

In cooperation with:

Alabama Water Institute
College of Continuing Studies
Environmental Institute
Water Policy and Law Institute
National Water Center

WATER POLICY SUMMIT

March 27-29, 2018

National Water Center | The University of Alabama | Tuscaloosa, AL

COMMUNITY RESILIENCY: SUMMIT TO SEA

National Water Center
Tuesday, March 27, 2018

5:00 – 6:30 pm	Reception at the National Water Center

Bryant Conference Center
Wednesday, March 28, 2018

7:00 – 8:00 am	Registration and Breakfast
8:00 – 8:15 am	Welcome **Patricia Sobecky, PhD** Associate Provost for Academic Affairs and Director Alabama Water Institute, The University of Alabama
8:15 – 9:15 am	Designing for Resilience: Moving Beyond Uncertainty **John Matthews, PhD** Executive Director, Co-Founder, Alliance for Global Water Adaptation
9:15 – 10:15 am	National Water Center Update **Ed Clark** Director, National Water Center & Deputy Director Office of Water Predictions, NOAA
10:15 – 10:30 am	Break
10:30 – 12:00 pm	State Wide Surface Water & Ground Water Assessment **Berry H. (Nick) Tew, Jr., PhD** State Geologist and Director, Geological Survey of Alabama **Brian Atkins, PE** Division Chief, Alabama Office of Water Resources, ADECA **Pat O'Neil, PhD** Deputy Director, Geological Survey of Alabama
12:00 – 1:00 pm	Lunch
1:00 – 1:30 pm	Designated Exhibitor Time
1:30 – 3:00 pm	Coastal Resiliency **CDR Nathan Hancock**, Moderator Executive Officer, Office of Water Prediction, NOAA **COL Thomas D. Asbery** Commander and District Engineer, New York, District, USACE **Bret Webb, PhD, PE, DCE** Professor of Coastal Engineering, University of South Alabama **Walter Meyer, ASLA, LEED-AP** Principal, Local Office Landscape and Urban Design

3:00 – 3:15 pm	Break
3:15 – 4:45 pm	Law & Policy **Thomas L. Casey, III, Esq**, Moderator Environmental & Natural Resources Law, Partner, Balch & Bingham, LLP **Laura Myers, PhD** Senior Research Scientist and Director, Center for Advanced Public Safety **Beth Stewart** Executive Director, Cahaba River Society **Robert Bendick** Director, Gulf of Mexico Program, The Nature Conservancy
4:45 – 6:30 pm	Poster Reception

Bryant Conference Center
Thursday, March 29, 2018

7:00 – 8:00 am	Breakfast
8:00 – 8:15 am	Welcome **Sagy Cohen, PhD** Associate Professor, Geography, The University of Alabama
8:15 am – 9:15 am	Pleased to Meet you: Can Water Law and Resilience be on a First Name Basis? **Mark Davis, JD, MLT** Director, Institute on Water Resources Law and Policy, Director, ByWater Institute, and Senior Research Fellow, Tulane University
9:15 – 10:00 am	Coastal Resiliency: Recent Experiences and a Perspective from Texas **Kenneth Wisian, PhD** Major General (ret), Executive Director, CDBG-DR, The University of Texas
10:00 – 10:45 am	Civil Infrastructure Planning **Andrew Ernest, PhD, PE, BCEE, DWRE** Professor & Chair, Civil Engineering, University of Texas Rio Grande Valley
10:45 – 11:00 am	Break
11:00 – 12:30 pm	Post Disaster Resiliency **Sam Contorno**, Moderator Physical Scientist, NOAA **Jim Stefkovich** Meteorologist, Stefkovich Consulting Solutions, LLC **Casi Callaway** Executive Director and Baykeeper, Mobile Baykeeper **Lisa Auermuller** Assistant Manager, Jacques Cousteau Reserve, Rutgers University
12:30 pm	Closing and box lunch pick up **Andrew Ernest, PhD, PE, BCEE, DWRE** Professor & Chair, Civil Engineering, University of Texas Rio Grande Valley

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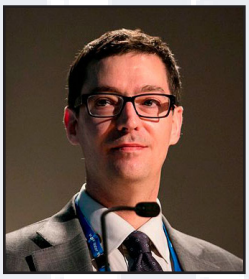
SPEAKER BIOS

Patricia Sobecky

Dr. Sobecky is a professor of biological sciences who also serves as an associate provost and the director of the UA Water Institute. She is a Pennsylvania native who earned a bachelor's degree in biology from the University of Pittsburgh at Johnstown and a PhD in microbiology from the University of Georgia. Her postdoctoral fellowship was with Dr. Donald Helinski at the University of California, San Diego. Dr. Sobecky has authored more than 60 scientific publications, been awarded more than $8 million in extramural research funding, served as chief scientist for oceanographic research cruises in the Gulf of Mexico, and she is an editor for the international journal *FEMS Microbiology Ecology*. She is funded by The Gulf of Mexico Research Initiative to assess impact, recovery, and restoration efforts following the 2010 Deepwater Horizon oil spill in the northern Gulf of Mexico. As the director of the Alabama Water Institute she works with the National Water Center, a federal facility on campus, as well as other universities, national laboratories, state agencies, and private industries.



John Matthews

Mr. Matthews is the Executive Director and co-founder of the Alliance for Global Water Adaptation (AGWA), a global network of more than 1100 water professionals chaired by the World Bank and the Stockholm International Water Institute (SIWI). Since 2003, he has integrated technical and policy approaches for climate resilience over five continents and more than 20 countries. He's been published in *Nature Climate Change, Science,* the *PLoS* journals, and the *Global Water Forum* among many others. He has co-authored recent and forthcoming books that explore decision-making frameworks for adapting water infrastructure and ecosystems, deploying finance instruments like bond criteria to mainstream adaptation, developing climate-sensitive approaches to environmental flows, and resilient nature-based solutions. His work has been featured in numerous media outlets, including the *New York Times,* NPR, and at the White House. Under John's leadership has played a central role in elevating the role of water as a strategic theme within global policy frameworks such as the UN Framework Convention on Climate Change (UNFCCC), and he has advised regional and global development banks, governments, scientific and engineering organizations, conservation groups, and civil society more broadly on climate adaptation measures. Resilience criteria for the bonds market developed by AGWA have been applied to more than 1.5 billion USD in the past two years. His personal research has explored how climate change alters North America's Great Basin, how engineering and ecological perspectives on resilience can be reconciled, and long-distance dragonfly migration. John serves on the advisory board of many research groups and is a Senior Water Fellow at Colorado State University and Water Resources Courtesy Faculty at Oregon State University. He's the producer for the ClimateReady podcast. John studied ethnomusicology at the University of Chicago and worked in the publishing industry for 12 years before obtaining a PhD in ecology, evolution, and behavior from the University of Texas. He started and led the global freshwater adaptation programs for WWF and Conservation International from 2007 through 2014. John enjoys trail running, timber framing, fingerstyle guitar, and the consolation of history.

Ed Clark

Mr. Clark is Director of the Geo-intelligence Division of the National Water Center. For the past five years Ed has served in National Weather Service Headquarters as the National Flash Flood Service Leader in the Office of Analyze Forecast Support. Ed co-chairs the Federal Advisory Committee on Water Information, Subcommittee on Spatial Water Data, which is charged with leading the Open Water Data Initiative by the Federal Geographic Data Committee. Prior to his tenure at NWS headquarters, Ed had over seven years of experience as an operational hydrologic forecaster, working as a Senior Hydrologist at the Colorado Basin River Forecast Center in Salt Lake City.

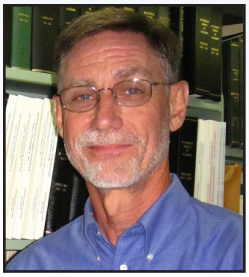
Berry H. "Nick" Tew, Jr.

Dr. Tew is Alabama's State Geologist and Oil and Gas Supervisor. In these capacities, he directs the Geological Survey of Alabama and the staff of the State Oil and Gas Board of Alabama. He is also a Research Professor in the Department of Geological Sciences at the University of Alabama and serves as the Director of the Center for Sedimentary Basin Studies. Nick holds Bachelors, Masters, and Ph.D. degrees in Geology and has been with GSA and OGB for over 30 years, serving in his present capacity since 2002. Dr. Tew has extensive knowledge of Alabama's surface and subsurface geology and the state's rich endowment of geologically related natural resources. He

is an expert in Gulf Coastal Plain stratigraphy, petroleum geology, and public policy applications of the geosciences, as well as the regulation of oil and natural gas operations. He has been is a frequent speaker on these and other topics, nationally and internationally. Nick is Chairman of the Alabama Water Agencies Working Group (AWAWG), a group of state agencies directed by Governor Robert Bentley to recommend an action plan and timeline for implementing a statewide water management plan. He is also Past-President of the American Geosciences Institute and has previously served as President of the Association of American State Geologists, Vice-Chairman of the Interstate Oil and Gas Compact Commission, and Chairman of the U.S. Department of the Interior Outer Continental Shelf Policy Committee. Nick is a Fellow in the Geological Society of America

Brian Atkins

Since March 2007, Mr. Atkins has served in his current position as Division Chief of the Alabama Office of Water Resources (OWR), a division of the Alabama Department of Economic and Community Affairs (ADECA). The role of the Office of Water Resources is to plan, coordinate, develop, and manage Alabama's water resources in a manner that is in the best interest of the State of Alabama. This includes recommending policies and legislation, conducting technical studies, implanting and participating in programs and projects and actively representing Alabama's intra and interstate water resource interests. The Office of Water Resources administers programs for river basin management, river assessment, water supply assistance, water conservation, flood mapping and the National Flood Insurance Program. Prior to going to work for ADECA, Brian worked for the U.S. Geological Survey (USGS) Alabama Water Science Center in Montgomery, Alabama, where he was chief of the office's Hydro logic Investigations and Analysis Section and project chief of the USGS National Water-Quality Assessment Program's (NAWOA) study of the Mobile River Basin. Brian holds a Bachelor of Science in civil engineering from the University of Alabama and is a registered professional engineer.



Pat O'Neil

Mr. O'Neil is the Deputy Director of the Geological Survey of Alabama. In his current position as Deputy Director he represent the State Geologist and GSA as requested in meetings, on committees, and other capacities as directed; oversee GSA publications development including technical reports, publications, maps, and other materials; continue conducting hydrological and biological research to evaluate the state's natural resources; and assist GSA managers with program development, funding, training, and employee evaluation and performance. From January 2003 to November 2009 he served as Director of the Water Investigations Program supervising professional staff. The four program areas were Biological Resources, Hydrogeology, Geochemical Laboratory, and Water Information conducting a wide variety of water resources-related research in Alabama. The Water Investigations Program was split in November 2009 to the Ecosystems Investigation Program and the Groundwater Assessment Program. The Ecosystems Investigation Program has a staff of biologists, engineers, scientific aides, and student aides working in three program areas (aquatic biological surveys, water quality monitoring and assessment, and interdisciplinary watershed research). His responsibilities during both of these Directorships was to oversee personnel, program and budget development, and coordination of programs with other State and Federal agencies to ensure that agency goals are accomplished. He reviewed the performance of principal investigators and group directors to ensure compliance with goals and mission of the program; reviewed contract reports and other technical and administrative documents to ensure completeness and technical accuracy; worked with the State Geologist in formulating, implementing, and administering departmental programs, research, and policies; and served as principal investigator for agency projects to include the collection of field samples, data analysis, preparation of reports and publications, and communication of project results.

CDR Nathan Hancock

Commander Hancock is the Executive Officer of the National Water Center under the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service. He received his commission in May 1997 as a Second Lieutenant, U.S. Army, Engineer. After seven years as a combat engineer, Captain Hancock received an interservice transfer to Lieutenant, NOAA Corps in July 2004. Since joining the NOAA Corps, Commander Hancock has been assigned aboard NOAA Ships McArthur II, Pisces, Ka'imimoana, and twice aboard Gordon Gunter. On those ships, Commander Hancock conducted hydrographic surveys, marine sanctuary assessments, Deep Ocean ROV sampling, deployment of buoys supporting ocean and atmospheric research and tsunami warning, fisheries stock assessments, and marine mammal surveys

COL Thomas D. Asbery
COL Tom Asbery is a professional Army Corps of Engineers Officer with more than 23 years of service in uniform. He currently serves as the New York District Commander in charge of over 600 DoD Civilians responsible for military construction and civil works missions, with oversight of repairing, restoring, and increasing coastal resilience throughout New York, New Jersey, and Thule AB, Greenland. He has more than 7 years of U.S. Army Corps of Engineers experience having served in the Pacific, Europe, Asia, Middle East, and presently the North East. He holds a BS in Landscape Architecture from West Virginia University, a Masters of Architecture from Virginia Polytechnic Institute of Technology, and a Masters of Strategic Military Studies from the U.S. Army War College.

Bret Webb
Dr. Webb is a Professor of Coastal Engineering in the University of South Alabama's Department of Civil, Coastal, and Environmental Engineering. Dr. Webb's research focus is on coastal resilience to natural hazards with an emphasis on natural and nature-based features that reduce infrastructure vulnerability. Dr. Webb is a registered Professional Engineer in Alabama and Florida and is recognized by the Academy of Coast, Ocean, Port, and Navigation Engineers as a Board Certified Coastal Engineer.

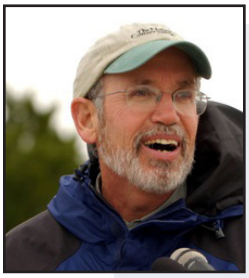
Walter Meyer
Mr. Meyer is an urban designer who uses ecosystem services to create resilient hydrology and energy systems, especially in vulnerable coastal communities. In 2006 he co-founded Local Office Landscape and Urban Design (LOLA). He holds degrees in Landscape Architecture and Urban Design from the University of Florida and Harvard University, and he is a Lecturer at the Parsons School of Design in New York, NY. In 2013 he was recognized by the White House as a "Champion of Change" for his work using alternate energy as a means of immediate relief and an engine for long-term economic recovery after Superstorm Sandy. He served as an adviser to the President's team until 2016. Meyer's ecology-driven design work starts with modeling vulnerabilities – both atmospheric, such as storm surge, and anthropogenic, such as economic crisis – and exploring infrastructural solutions that offer multiple benefits. Once implemented, these projects provide performance metrics that can inform cost-benefit models and policy change.

Thomas Casey
Mr. Casey is a partner at Balch & Bingham LLP in Birmingham, Alabama. His practice focuses on environmental regulation and litigation, including water quality and water quantity matters. He routinely represents utilities and other members of the regulated community in administrative matters, enforcement actions, and citizen suits.

Laura Myers
Dr. Myers, Ph.D. (Criminology), is Director and Senior Research Scientist for the Center for Advanced Public Safety (CAPS) at The University of Alabama in Tuscaloosa. Her research areas include disaster management and planning, severe weather warning improvement, risk communication, and emergency management. She has received over $600,000 in Department of Homeland Security grants to develop and implement a regional emergency planning model emphasizing partnership planning between the National Weather Service and their weather enterprise partners, including emergency management, broadcast meteorology, and end-users of their products. Dr. Myers has conducted multiple studies and service assessments about the behavior of the public and the weather enterprise regarding the warning process after the 2011 tornadoes in Alabama and Mississippi, the 2012 Derecho multi-state wind event, the 2013 Moore and El Reno OK tornadoes, and the 2014 Snowmageddon events in Atlanta, Birmingham, and Tuscaloosa. Current studies underway include a study on the public's response to severe weather events in Dixie Alley and how events and responses differ in Dixie Alley; a social science research curriculum to train weather professionals on how to collaborate on social science research for operational applications in the weather enterprise; and an ongoing evaluation of warning modalities, including NOAA Weather Radio, mobile apps, alert notification systems, WEA alerts, sirens, and other tools to determine how these modalities function in actual events and how they can be refined for better use in actual events.

Beth Stewart
Ms. Stewart, Executive Director of the Cahaba River Society (CRS) since 1995, leads the Society's work promoting water-smart growth and green infrastructure. Raised in Birmingham, Beth has a Master's Degree in Landscape Architecture with a focus in urban

and environmental planning from UC Berkeley. She worked in local government planning and development review for 15 years in Birmingham, New Orleans, Kentucky and the San Francisco Bay Area. She was the founding Executive Director of the Kentucky Waterways Alliance and is a board member for the national organization River Network, Inc., co-leading work on water equity, diversity and inclusion. She has been named a River Hero by the Alabama Rivers Alliance and a National River Hero by River Network and Tom's of Maine.



Robert Bendick
Mr. Bendick has been the Director of the Nature Conservancy's Gulf of Mexico Program since 2013. Prior to this position he has served as TNC's national Director of U.S. Government Relations, Southern Regional Director, and Florida State Director. Before coming to the Conservancy 22 years ago he managed natural resource and conservation programs in state government.

Sagy Cohen
Dr. Cohen is an Assistant Professor of Geography at the University of Alabama (UA). He received his PhD in 2010 from the University of Newcastle, Australia working on soil-landscape evolution modeling. During his post-doc appointment at the University of Colorado he began working on global-scale riverine modeling. His current research efforts focus on modeling and analysis of water, sediment and nutrient fluxes in global river, and remote sensing applications in hydrology (in collaboration with the Dartmouth Flood Observatory and the National Water Center).

Mark Davis
Mr. Davis joined Tulane Law School in 2007 as a senior research fellow and founding director of the Tulane Institute on Water Resources Law and Policy. In 2017 he also became the director of Tulane's ByWater Institute which is focused the interdisciplinary aspects of water stewardship and community resilience. He lectures widely on water resource management, is directly involved in helping Louisiana overhaul its long-term water planning and has testified frequently before Congress on the need for a focused and effective commitment to the viability of coastal Louisiana and other vital natural treasures. Davis spent 14 years as executive director of the Coalition to Restore Coastal Louisiana, where he helped shape programs and policies at the state and federal level to improve the stewardship of the wetlands and waters of coastal Louisiana. He has practiced law in Indianapolis, the District of Columbia and Chicago and has taught at the Indiana University (Indianapolis) School of Business and the IIT-Chicago Kent School of Law in Chicago.

Kenneth Wisian
Major General (retired) Ken Wisian, Ph.D. is Executive Director of the University of Texas Disaster Recovery Block Grant research program. Dr. Wisian is former Senior Deputy Director for Coastal Protection and Disaster Recovery, of the Texas General Land Office. General Wisian has participated in and led operations for multiple national disaster response, recovery, and border security efforts as both a military and state government executive. Dr. Wisian holds a Ph.D. in geophysics from SMU, an M.S. in Strategic Studies from the US Army War College, an M.S. in Geology from Centenary, and a B.A. in Physics from the University of Texas at Austin. He is also a graduate of the Air Force Test Pilot School, with more than 70 hours of medium and high-risk test flights. He served in the Air Force and Air National Guard for 33 years and has more than 3,800 flying hours in all types of aircraft including B-52s, C-130s, and Special Mission aircraft. General Wisian also commanded an MQ-1 Predator Wing. His medals include the Bronze Star and Air Medal. General Wisian has combat time in Iraq, Afghanistan and the Balkans.

Andrew Ernest
Dr. Ernest is the Department Chair, The University of Texas Rio Grande Valley. He has accumulated over 20 years of professional experience in Environmental and Water Resource Engineering, and has been awarded over $20 million in grants and contracts throughout his career. Ernest has more than 100 publications in his name, including more than 40 masters' theses he has supervised. His research focuses at the nexus of environmental informatics and water resource capacity development. Ernest bases his research efforts around his interest in investigating the role of innovation, entrepreneurship and engineering service in stimulating effort-based economies as a mechanism for promoting capacity development and sustainability.

Sam Contorno

Mr. Contorno has been a member of the National Weather Service's (NWS's) Office of Water Prediction (OWP)/National Water Center (NWC) since Jan. 2011, where he served as a focal point on NWC facility design and requirements issues and is currently the University and Collaborative Research Liaison. Prior to moving to OWP/NWC, Sam was with the NWS/Office of Science and Technology since it was established in 2001. He was the manager of the Collaborative, Science, Technology, and Applied Research Program, served as NWS Grants and Collaborative Research focal point, and assisted with science and technology infusion planning in the NWS and NOAA budget process. Sam held a similar position from 1995-2001 with the NWS/Office of Meteorology where his duties also included assisting in the development of NWS-wide training budgets and activities. Prior to joining the NWS, Sam worked on the NOAA/Office of Oceanic and Atmospheric Research (OAR) Program Development and Coordination staff (1992-1995). He served as a liaison for several of the Environmental Research Laboratories and participated in activities such as the initial stages of the NOAA/DoD/NASA Polar Satellite Convergence negotiations and strategic planning initiatives. Sam completed his Bachelor degree in meteorology at the University of Michigan in 1988 and received a Master of Science degree in the same subject from the University of Oklahoma (OU) in 1992. Sam's advisor at OU was Dr. Fred Carr, and he concentrated his efforts on developing algorithms to determine precipitation type in winter storms. Sam was born and raised in Birmingham, Alabama.

Jim Stefkovich

Mr. Stefkovich was with the National Weather Service for 35 years in various roles. The New Jersey native started work at the weather service headquarters in Maryland before he even graduated from Pennsylvania State University. His career has taken him to seven states and included stints in weather service offices including Chicago, Atlanta and Fort Worth, Texas. Stefkovich, led the Birmingham National Weather Service office for the last 11 years as the Meteorologist in Charge. He retired at the end of 2016.

Casi Callaway

Casi (pronounced kc or Casey) Callaway grew up in Mobile, Alabama, graduated from Emory University and moved to DC where she organized and lobbied on environmental legislation at the local, state and federal level. She came home in 1998 to work locally to protect her favorite watershed. Under Casi's leadership, Mobile Baykeeper has grown into the Mobile Bay area's largest environmental advocacy organization and one of the largest local organizations along the Gulf Coast with over 4,500 members. She and the Baykeeper team are responsible for organizing, researching and educating the community on issues that affect public health, environment and quality of life. She is a Board Member of Waterkeeper Alliance, Chair of the Waterkeeper Council and liaison to the international organization's Board of Trustees. She is a graduate of the Leadership Mobile class of 2012, Dean of Leadership Mobile in 2017 and is Finance Committee Chair for Mobile United. Casi is actively involved in environmental groups at the local, state, regional and national levels. She lives in the Mobile Bay area with her husband and wonderful 10-year-old son. Casi received the Liberty Bell Award from the Mobile Bar Association, was named a "Remarkable Woman" by Lifetime Television, Coastal Hero by Coastal Living magazine, "Woman Shaping the State" of Alabama by al.com, Gulf Guardian by the EPA, and River Hero by the national River Network. Casi served on the Gulf of Mexico Program's Citizen Advisory Committee and as a Commissioner to Alabama's Coastal Recovery Commission.

Lisa Auermuller

Ms. Auermuller is Assistant Manager at the JC NERR and has been working at the Reserve since 2002. Her work focuses on the intersection of social science and natural science, meeting the information needs of coastal decision makers. Her work as a boundary spanning professional has been highlighted through coastal resilience technical assistance to New Jersey's municipalities. Lisa works in partnership with many local, state and federal partners.

POSTER PRESENTATIONS

1 Climate Variability in Southeast US Coastal Streams

Primary Author: Ana Sokolenko
Secondary Authors: Sara Tiberi, Bridget Donahue, Cole Griffith, Kelly Duerr and Glenn Tootle
University of Alabama

Precipitation gages and unimpaired (no anthropogenic influences) streamflow gages were identified in coastal regions of the Southeast United States. The influence of climatic drivers such as the Pacific Decadal Oscillation (PDO), Atlantic Multidecadal Oscillation (AMO) and the El Nino-Southern Oscillation (ENSO) on these streamflow gages were evaluated. While both the ENSO and AMO signals have been previously identified in these regions, the coupling of the high frequency ENSO with the low frequency AMO resulted in below normal annual streamflow when a La Nina occurs during an AMO Warm phase. The AMO has been in a warm phase since ~1995 and, given the occurrence of multiple La Nina's since ~2000, historic 10-year low flows were observed in several streams. Incorporating climate variability in water resources can provide water managers and planners useful information in evaluating water availability and the associated risk in estimating annual and seasonal water allocations. The United States Environmental Protection Agency (EPA) Gulf of Mexico (GoM) program sponsors the current research.

2 Quantifying Contributions of Major Drivers of Hydrologic Change in Southeastern U.S.

Primary Author: Ashutosh Pandey
Secondary Authors: Sanjiv Kumar, and GSEI 2070 class

The southeastern U.S. is a hotspot of climate variability and land use change. In recent decades, the Southeastern Plains had the highest rate of land use change of any ecoregion nationally; and it has shown a cooling temperature during most of the 20th century. Meanwhile, there is pressure to increase agricultural production in the Southeast due to long-term drought in the west, particularly in California. Hence, we argue that hydrologic landscape has been significantly altered in the region because of both natural and human factors. Quantifying contributions of major drivers of hydrologic change can be helpful for water policy making. The goal of this study is to quantify long-term (1950 to present) changes in hydrologic fluxes and storages due to (1) climate variability and change, (2) land use change, and (3) land management. We are employing data from state-of-art climate modeling experiments: Land Use Model Intercomparison Projects (LUMIP) to quantify contributions land use change and land management. We will also conduct additional climate modeling experiments to decipher the role of climate variability and change. We have also analyzed trends in long-term streamflow observations in the southeastern United States. We will present scope of the study, methodology and preliminary results.

3 Examining Potential Impacts of External Drivers on Environmental Instream Flows on the Cahaba River

Primary Author: Ashutosh Pandey
Secondary Author: Sarah Praskievicz
University of Alabama

Water is the key to the lives of all living creatures. Human beings need to ensure there will be safe and abundant water resources in the future. The important issue of water is not only about the water quality, but also about the water quantity. As the most effective indicator of water quantity, instream flow is critical for us to understand the water quantity. It includes the variations of water flows, and the variations represent the "high" or "low" period of the rivers. The low flow of rivers is important to preserve the harmony of the environment physically, biologically, and socially. Jowett pointed out that the minimum flows in rivers and streams provides a protection at a certain extent for the aquatic environment (1997). In addition to the creatures that are living within the water, human beings also need water. However, with the external drivers, such as climate change, population growth, and land use change, the "low" period of the water flows in the Cahaba River can be even lower in the feature. Hence, this is what my research is going to address and why it is critical. My research will examine the effects of human activities and climate changes on instream flows in the Cahaba River, Alabama, and suggest what kind of action we might be able to do for preventing negative consequences. The result of this research is expected to see, with the external factors, the instream flow of the Cahaba River is at risk, and we should start to make actions for preventing the trend.

4 Non-Darcian Flow and Non-Fickian Transport in Discrete Fracture Networks

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Fractured reservoirs typically exhibit erratic internal structures, resulting in non-Darcian flow and non-Fickian transport. The quantitative linkage between gradient and flux through discrete fracture networks (DFNs), however, remains obscure, motivating this study. We will report our recent effort in building Monte Carlo realizations of DFNs with a systematic change of major porous media properties, and quantifying the resultant non-Darcian flux.

5 Streamflow Reconstruction Potential using Tree Rings in SE US Coastal Watersheds

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Unimpaired (no anthropogenic influences) United States Geological Survey (USGS) streamflow gages were identified in SE US Coastal watersheds. Using the USGS National Water Information System (NWIS) database, monthly streamflow rate of flow (volume over time – cubic meters per second) was accessed and converted to a seasonal (March through October) volume of flow (cubic meters). Tree ring proxies were obtained from various sources including the National Oceanic and Atmospheric Administration (NOAA) International Tree Ring Databank (ITRB). Traditional streamflow reconstruction techniques (i.e., Stepwise Linear Regression, Principal Component Regression - PCR) were applied to the datasets to evaluate the potential for skillful reconstructions of streamflow. The ability to provide water managers and planners reconstructed streamflow extends the period of record beyond historic (observed) data. Thus, past pluvial (wet) and drought periods may exist that have not been identified in the observed (shorter) period of record. These data can assist in water allocation planning and management and the associated risk. The United States Environmental Protection Agency (EPA) Gulf of Mexico (GoM) program sponsors the current research.

6 Resiliency of Freshwater Mussel Communities and Services

Primary Author: Brian C. van Ee
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Under current climate predictions freshwater resources face an uncertain future. Freshwater assets are particularly difficult to manage as numerous people and stakeholders rely on a finite supply. As plans are constructed to meet the demands of society, we also need to balance the needs of ecological communities. Though managing for ecological interests on top of societal interests adds significant complexity, maintenance of ecological communities preserves the services these communities provide. In-depth ecological understanding of a community is essential for optimizing management strategies. Measurement of even basic physiological processes can greatly enhance management. By assessing physiological processes (feeding, respiration, excretion) across a range of temperatures by freshwater mussels, we begin to understand how these processes are influenced by temperature. This allows for estimation of thermal tolerances, by understanding shifts between anabolism and catabolism. Data of this kind is essential when managing base flow requirements and water release strategies. Further, as these processes are also drivers of ecosystem services, it allows for more accurate estimation of the services these communities provide.

(7) Water Management Tool for Alabama

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Alabama is considered one of the wettest regions in the US with annual rainfall exceeding 1400 mm. However, due to large summer ET rates, summer flows can still drop to critical levels and droughts frequently plague the region. There is no comprehensive water management plan in place in the state; however, efforts have been underway to develop one. It is the challenge for water management in the SE to avoid policies that restrict the normally available water while trying to protect it in times that water is scarce. Intermittent withdrawal restrictions will be necessary but that only reinforces the need for real-time tools. Towards that end, an integrated model has been developed that estimates the stress that is placed on the resources due to water withdrawals. The model consists of a hydrologic module based on the Sacramento soil moisture algorithm together with a module that includes withdrawals from eight standard water use sectors. The Water Supply Stress Index (WaSSI) is computed as the ratio of the water consumed to the supply as computed by the hydrologic model. The water use sector that is most dynamic in Alabama is irrigation. The WaSSI model is linked with a real time crop model that estimates irrigation demand. The Decision Support System for Agrotechnology Transfer (DSSAT) is executed on a 4 km grid and provides irrigation demands to the WASSI model. It can be used to best allocate resources within the economic sectors of the state.

(8) Long-Term Monitoring Web Portal

Primary Author: Clint Smith
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An online long-term monitoring web portal was developed to store, analyze, and display both historic and future data pertaining to environmental site monitoring. Increased attention is being given to long-term monitoring of sites because often times the best available solution is natural attenuation, which may take decades. Long-term monitoring practices require numerous monitoring points, strict monitoring schedules, and individual monitoring thresholds that if exceeded trigger remedial action. It is important that all data pertaining to a site is housed in a single location that allows the data to be easily retrieved. There are many different kinds of data that relate to long term monitoring of environmental sites such as documentation, geographic information, and attribute data. The online portal developed in this project houses historic and new data and is able to query that data by location, time interval, constituent, and concentration range. The portal is able to handle data from various modeling programs as well as PDFs, spreadsheets, and images. This allows data related to a sampling location or an area to be viewed on a map, in tabular form, or on charts and graphs. For example, a selected property parcel would show environmental covenants on the property and can also display sampling locations and laboratory results. The online portal provides access to information and design decisions that may have been made years before the current custodian of the site was involved in the project.

(9) Floodplain dynamics of Sipsey River, Alabama

Primary Author: Deepa Gurung
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Floodplain inundation and extent are key to understand biogeochemical processes such as vegetation production and decomposition along the floodplain. While increased soil moisture can cause an increase in vegetation growth over large areas, very high flood frequency with prolonged inundation might reduce the growth vigor by increasing the plant mortality. This study uses hydraulic modeling to examine the relationship between the floods of various recurrence interval and inundation extent along the floodplain of Sipsey River. The results of this study will help to correlate the productivity in terms of NDVI at different temporal and spatial change in the inundation extent.

The Sipsey River is a tributary of the Tombigbee River, draining an area of 2044 km2 and has extensive bottomland hardwood wetlands, occupying an area of around 50000 acres with a number of secondary channels and oxbow lakes. It is considered one of the last free flowing swamp in Alabama and makes a highly suitable assemblage of floral and faunal biodiversity.

Inundation extent will be determined using the Cellular Automaton Evolutionary Slope and River (CAESAR) model. CAESAR has been found accurate in quantifying the magnitude of inundation required across the significantly disturbed floodplains of such a naturally swampy surface. This study helps to collect the baseline inundation dynamics of the region which could be brought into environmental flow assessments as well as be used for developmental projects on water resource management and floodplain restoration.

(10) Riparian Vegetation Response to Streamflow Alteration Due to Dam Construction in a Range of Rivers Across the United States

Primary Author: Dinuke Munasinghe
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Hydrologic variability plays a major role in structuring the riparian vegetation within river ecosystems. This study evaluates the spatial and temporal response of riparian vegetation to altered flow regimes below 16 river dams across the contiguous United States using a combination of a holistic Environmental Flow Assessment approach and satellite remote sensing.

River flows were characterized using thirty-three (33) different Indicators of Hydrologic Alteration (IHA) using the Range of Variability Approach (RVA). The alterations of riverflows were determined for post-dam scenarios comparing between the pre-dam and post-dam IHAs. Of the 16 locations assessed, 2 showed low levels, 11 moderate and 3 high levels of alteration.

Change detection of riparian vegetation revealed an increase at majority of the sites (10 of the 16) **immediately after** the construction of the dam. Also, in a majority of the locations a decrease (10 of the 16) in vegetation was observed at the **1 year post-dam completion** mark. Analyses show that vegetation change effects due to flow regime alterations below smaller dams occurred at shorter time spans (1-year post-completion) than larger dams (5-year post completion). It is inferred that categorizing dams based on capacity was successful in understanding effects on the vegetation extents better. In addition to the in-stream flow paradigm, regional climate and geomorphology are also identified as driving factors of riparian vegetation regulation. The need for a multi-factor model that drives annual changes in riparian zones is recognized to make better-informed decisions on sustainable dam operations.

(11) Optimization of Flood Inundation Map Generation from Point Observation Data

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Floods pose a pertinent risk to human life and property throughout the world; simultaneously, increasing availability of flood observation data holds great potential for efficient real-time flood inundation mapping. In this research project, the researchers are developing computational tools for rapid mapping of flood inundation extent and water depth from point data. The tool is coded in Python 2.7 using the PCRaster geospatial modules and functions. The tool is to be validated using satellite imagery data from missions such as NASA's Landsat, as well as uncertainty calculation methods. We have selected Columbia, South Carolina, as the site of the initial case study, after the significant flooding that the city experienced as a result of Hurricane Joaquin in September and October of 2015. A sensitivity analysis will be performed to reveal the optimal range of parameterization and help in understanding the input data requirements. After initial testing using United States Geological Survey (USGS) High Water Mark point observations, the tool will be expanded to accept point observation data from social sensing techniques and public platforms such as the widely popular Twitter service. The accuracy and availability of these inputs are to be assessed for their applicability, as the input of data must become a largely automated process. In addition, the underlying interpolation algorithms will be tested to optimize processing time as new data inputs are continuously calculated. Ultimately, the researchers aim to develop a web-interface that will generate and visualize flood maps from point observation data in real-time.

(12) Hydrological Impacts on Tuscaloosa County Car Crashes

Primary Author: Jeffrey Edmondson
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Tuscaloosa County car crash data is thoroughly reported to the Tuscaloosa County police department. There are over 60,000 incidents reported from 2009 to 2016. Weather data from the North American Regional Reanalysis was used to determine a level of resolution similar to that of the detailed crash data. This study aims to examine the car crash data presented by separating the crashes based on clear sky or non-clear sky

conditions. Once the data was sorted appropriately, a Wilcoxon Mann-Whitney Rank Sum Test was performed to identify any trendlines or consistencies in the data that correlated the clear sky or non-clear sky to crash occurrences. A second Wilcoxon Mann-Whitney Rank Sum Test was performed on the data under the specifications of "rear-end collisions" and "intersection related". In order to perform the Wilcoxon Mann-Whitney Test the data used must be random and the variables being tested must be independent of each other (which they are). The goal of this study was to examine the existing Tuscaloosa County crash data for correlations between car crashes and hydrological events (Evans 1987, Soyoung et. al. 2010).

(13) Enhancing U.S. Military Operations through Hydrology and Hydraulics

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The U.S. Military possesses unique hydrologic and hydraulic (H&H) capabilities that can enhance resiliency both domestically and abroad. This poster will discuss how the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) makes use of H&H to enhance their operational resiliency abroad, including a discussion of how U.S. military operations benefit from enhanced H&H capabilities in remote and data sparse environments. Improvements in numerical weather prediction, the increasing abundance of computation power, and greater precision of remotely sensed observations make actionable real-time information characterizing the physical environment more feasible. Water managers and first responders can utilize such information and technologies to foster resilience in local communities and to build capacity within partner nations.

(14) Estimating Losses (Evapotranspiration) in Southeast US Coastal Streams

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Unimpaired (no anthropogenic influences) streamflow gages and precipitation gages were identified in coastal regions of the Southeast United States. While precipitation was measured in units of length (centimeters), streamflow was measured in average flow rate (cubic-meters per second) over some period of time (year). Streamflow was first converted to annual volume (cubic-meters) by simply multiplying the average flow rate times the length of record. By knowing the watershed area (square kilometers) contributing to the streamflow gage, we can then divide that area into the volume to determine the average runoff for the watershed in terms of length (centimeters). Thus, in evaluating a basic water balance model of a watershed [Inflow – Outflow = Delta Storage], Precipitation (P) and Groundwater-In are the major influxes while Runoff (Q), Groundwater-Out and Evapotranspiration (ET) are the main outfluxes. We assume net change in watershed storage over a year is negligible, thus Delta Storage is zero. We also assume Groundwater-In is nearly equal to Groundwater-Out for a large watershed. Thus, the water balance equation reduces to ET = P – Q.

Using the observed P and Q data, we then estimated ET-Observed for seven SE US Coastal Watersheds. We then obtained ET-Modeled data from the NLDAS Noah Land Surface Model at grid points spatially located near the watershed P gage and Q gage locations. We then compared ET-Observed to ET-Modeled for the seven watersheds. The United States Environmental Protection Agency (EPA) Gulf of Mexico (GoM) program sponsors the current research.

(15) Comparison of Traditional Bankfull Discharge Estimation Methodologies Using a Comprehensive Observational Dataset

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Bankfull discharge (Q_{bf}) is the flow of water that reaches the top of the channel's banks. It is most commonly used for stream restoration and flood modeling. There is significant variability in measuring techniques. Field measurements to determine Q_{bf} are time consuming and specific to each river reach. Increasing efforts to develop large scale (continental, global) and hyper-resolution hydrological modeling and flood forecasting systems, warrant a robust and universally consistent Q_{bf} estimation approach. There are currently three empirical/statistical methods of estimating Q_{bf}:

(1) Hydraulic Geometry - $Q_{bf} = ax^b$ where a and b are constants determined from observational data, and x is another related variable, most commonly the drainage area for the river or average discharge. The constants can be calibrated by physiographic region (Bieger et al., 2015), or by hydrodynamic landscape region (Blackburn-Lynch et al. 2017).
(2) Frequency analysis based on daily mean discharge - Q_{bf} is defined as the flow associated with e.g. 1.5 return interval for a gaged station. This return interval can be calibrated by region to increase accuracy (Leopold et al, 1994)
(3) Frequency analysis based on maximum 30 day mean discharge - Q_{bf} is approximated as the maximum value of 30 day mean discharge for a river (Yamazaki et al. 2011).

In this study, the accuracy of these methods will be assessed by calculating and comparing them to observed Q_{bf} at 1105 river gaging sites located in the continental United States (from Blackburn-Lynch et al. (2017) and Moody et al. (2003)).

(16) Alabama Dam Management

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In order to assess the state of dam management in Alabama, data from the National Inventory of Dams published by the United States Army Corps of Engineers was compiled and evaluated on a number of criteria. The three described in this report are as follows: storage accumulation over time, primary function by party, and normal versus maximum storage. These topics were chosen based on their perceived relevance to a number of issues surrounding the state's management of its 2271 dams. These areas highlight the risk emanating from lack of inspection and information, lack of legislation or a regulating authority, and increased extreme weather events. This report only scratches the surface, but it does yield an accurate depiction of the issues and risks faced by the state. The ultimate goal is for legislation establishing a dam safety program and regulating body for better risk management.

(17) Towards an Operational Probabilistic Drought Forecasting over the CONUS

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Despite the significant improvements in drought modeling over the last decade, accurate provisions of drought condition in a timely manner is still a major challenge. This study aims at operational drought monitoring and probabilistic forecasting over the Contiguous United States. The framework integrates statistical and dynamical modeling and issues drought forecasts at the lead times of 1, 2, and 3 months. The Variable Infiltration Capacity (VIC) hydrologic model is used across the CONUS and the associated uncertainties are quantified through Particle Filtering (PF) data assimilation by integrating observed satellite soil moisture with model estimates. The ensemble simulation characterizes the uncertainty in land initial condition and then a multivariate statistical model is used to generate probabilistic drought prediction. This framework is an enhancement of the NOAA's seasonal drought outlook by offering drought probabilities instead of qualitative ordinal categories. Additionally, it provides the user with the probability maps associated in a particular drought category. The past drought event in the Great Plains and California were assessed and the results showed that forecasting of these costly droughts were possible at least one month in advance.

(18) Widespread Surface Discharge of Raw Wastewater from Homes in Rural Alabama

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The US Census included water and wastewater questions through 1990. However, these questions did not differentiate clearly between legal onsite wastewater treatment and the discharge of raw wastewater to the

ground through so-called "straight pipes" (EPA, 1999; US Census, 2015). Although straight pipes are illegal, many reports from the southern US and Appalachia indicate that the practice is still common in poor rural areas (e.g., EPA Region 4, 2002; du Albuquerque, 2011).

Onsite inspections conducted by our team in three Alabama counties revealed high, but greatly varying, rates of straight pipe use in Bibb, Hale and Wilcox counties. In Bibb County, 15% of households without a sewer connection had a visible straight pipe. In Hale County, 6.6% of such homes had a visible straight pipe. In Wilcox County, a Black Belt county with widespread rural poverty and impermeable clay soil, 60% of unsewered homes had a visible straight pipe.

The literature also reveals troubling evidence of possible health impacts from onsite wastewater. The most recent survey of soil-transmitted helminths (worms) among children in Alabama was in Wilcox County and showed that 33% of children were positive for one or more helminths (Badham, 1993). Additionally, hookworm was recently discovered among adults in Lowndes County (McKenna et al., 2017).

Technical, regulatory, financial and sociodemographic challenges have allowed this situation to persist. This poster will address the history and current state of onsite wastewater treatment in the Black Belt counties of Alabama, evidence of environmental and health effects, and potential solutions.

(19) Groundwater flow Simulation in Highly Fractured/Vuggy Karst Aquifers

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Water flow and storage in non-homogeneous aquifers is decisively influenced by the presence of the preferential flow paths in the soil called fractures and conduits [1]. These preferential flow paths are very critical in the aquifer characterization [2] and consequently in water resource management [3] and contaminant transport [4]. The large-scale fracture and karst zones are complex features that require to be treated properly. Considering their size being orders of magnitude larger than the pore size, the Darcy's law may not be valid in them. One deals with a multi-scale, multi-physics problem. In this study, the main challenges in the investigation of fractured/vuggy karst aquifers is addressed. The semi-analytical effective models of flow in multiscale fractured aquifer is presented, where two-scale homogenization technique is applied to obtain the averaged models of flow [5], [6]. The effective models of flow in an aquifer containing a set of randomly distributed large-scale karst cavities and elongated large-scale karst conduits is demonstrated [7], [8]. The complete set of Stokes and/or Navier-Stokes equations is coupled with the Darcy's law. The first asymptote of the effective model is responsible for the linear proportionality of velocity and the pressure gradient. The second asymptote represents the inertial effects. The averaged effective semi-analytic model of flow in non-homogeneous aquifer provides with the quantitative evaluation of the extents of uncertainties entering in the hydrological models as a consequence of neglecting the scales of heterogeneities in the aquifer.

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(20) The Effects of Tropical Cyclones on Intensity of Precipitation in North Carolina Coast

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Tropical cyclones contribute to intense precipitation in coastal regions that affect the region leading to intense flood. They can be linked to climate change and the rising sea water surface temperatures when looking at how a tropical cyclone forms. North Carolina is located on a coast and is therefore subject to the effects of tropical cyclones. With data from 1980-2007 for daily precipitation both with and without being affected by tropical cyclones, the intensity can be determined to see how the tropical cyclones are affecting the precipitation in the North Carolina region. After exploring several different cases looking at the frequency of the storms, the accumulated frequency, and the difference in precipitation caused by a storm, it was found that intensity is increasing over the years due to an increase in precipitation overall and increase in frequency of precipitation whether or not a tropical cyclone is present. However, the intensity is increasing at a much faster rate when tropical cyclones are considered.

(21) Quantification of Functional Marker Genes for Denitrifying Microbial Populations in the Chandeleur Islands Impacted by the 2010 Gulf of Mexico Oil Spill

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Estuarine, coastal, and barrier island ecosystems provide communities protection by reducing storm surges, dissipating wave energy, and economically through services such as fisheries, tourism, water catchment and water quality. As these ecosystems are deteriorating and threatened in this century, the services provided to humans are being valued monetarily to communicate their importance; i.e., property values on a Georgia barrier island increased with an additional meter of beach width, an acre of Louisiana wetland reducing wastewater treatment costs for a company by as much as $34,000. Events such as the 2010 Gulf of Mexico oil spill, the largest marine spill in history, act as catalysts to accelerate the deterioration and further the loss of these vital ecosystem services. The 2010 BP spill impacted the Chandeleur Islands, a chain of low-elevation barrier islands in Louisiana waters located forty miles south of Gulfport, MS. The island chain vegetation; i.e., *Avicennia germinans* (black mangrove) and native *Spartina alterniflora* (saltmarsh cordgrass) was heavily damaged as a result of the oil spill. As oil was deposited differentially (i.e., none to heavy), it was important to investigate the microbiology of oil-impacted areas as marsh vegetation is directly linked to microbe-driven ecosystem services such as denitrification, a nitrogen (N) cycle pathway. The objectives of this study were to characterize: i) the biodiversity of the microorganisms; ii) quantify denitrifying microbial populations using functional marker genes; and iii) measure rates of denitrification during a one-year period. Five eco-functional marker genes selected to represent denitrification were investigated; (1) *nirS* for nitrite reductase; (3) *norB* for nitric oxide reductase; and (4) *nosZ* for nitrous oxide reductase. Three different marsh sites were selected for study based upon estimated amounts of prior oiling/oil coverage. The highest rates of denitrification were in September while the lowest rates were observed in February. The highest *nirS* abundance was detected for two of the three sites (Site 1 and 2) in September while Site 3 exhibited the highest abundance in November. Similarly, the highest abundances observed for *norB* and *nosZ* varied by site and by month. During the course of sampling over seven months in 2016 and 2017, weathered oil was detected in some of the marsh sediment cores and was chemically typed to Macondo oil. Ecosystem services such as denitrification, carried out only by microbes, act to remove nitrogenous wastes exported from freshwater systems to marine systems. Studies such as this one are designed to characterize the barrier island microbial biodiversity and N cycle processes so as to better understand the long-term effects disturbances such as the 2010 oil spill pose to an ecosystem service that contributes to maintaining marine water quality. This is especially important in light of the fact that weathered oil continues to be observed seven years post spill.

(22) Response of Fluvial Suspended Sediment Fluxes to Future Climate Change on a Global Scale

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Fluvial sediment dynamics is not only one of the primary drivers of landscape development and channel morphodynamics, but also has important implications for 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. Predicting the responses of riverine fluxes to future climate is, therefore, vital for the management of fluvial systems. In this study, we conducted 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 future climate are simulated using precipitation and temperature projections generated from multiple Global Climate Models (GCMs), each driven by four Representative Concentration Pathways (RCPs). We investigate climate-induced spatial and temporal trends and variability in global suspended sediment load and river discharge dynamics in the 21st century. The trends in future global riverine fluxes produced according to different climate model predictions are also compared under each RCP scenario.

(23) Discharge of Raw Sewage from Unsewered Households in Central Alabama

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Approximately 20% of US households (60% of rural households) are not connected to a sewer system, being responsible for treating their wastewater onsite, chiefly using a conventional septic system that requires 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.

Site inspections in three counties indicate that straight pipes, although technically illegal, are common in rural Alabama. A comprehensive 2005 survey conducted 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. To put this into context, a one-time sewage spill of 5000 gallons will typically make the news and the local newspaper. Our data indicate that over 100 times this volume of raw sewage is being discharged untreated each day in just three counties.

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. Following a storm that broke an extended drought, E. coli FIB increased from 100 to over 50,000 per 100ml from upstream to downstream of Newbern. We also detected the presence of higher proportions of microbially produced protein like compounds, which indicates the contamination of the stream with wastewater. These results indicate that wastewater discharge from straight pipes accumulates on the ground during dry periods and washes into nearby streams during precipitation, leading to up to 1000x increase in fecal bacteria concentration.

(24) Predicting Disturbance-driven Impacts on Ecosystem Servicesin Coastal Wetlands

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Natural and human-induced disturbances pose significant threats to the health and long-term productivity of Alabama coastal wetlands. As wetlands are a vital state resource, decisions on management, restoration, and remediation require actionable data if socio-economic demands are to be balanced with efforts to sustain these habitats. In 2010, the BP oil spill was a large and severe disturbance that threatened coastal Gulf ecosystem services. The largest marine oil spill to date served to highlight fundamental gaps in our knowledge of oil-induced disturbances and the resiliency and restoration of coastal Alabama wetland functions. To address these gaps, a year-long mesocosm study was conducted to investigate oil-induced effects on (i) plant-microbial interactions, (ii) microbial and plant biodiversity, and, (iii) the contributions of microbial genetic biodiversity to ecosystems services. In this study, *Avicennia germinans* (black mangrove), a C3 plant that grows from the tropics to warm temperate latitudes, were grown with or without mono- and polyculture mixtures of *Spartina alterniflora*, a C4 plant. At an interval of 3-months, oil was introduced as a pulse disturbance to achieve a concentration of 4000 ppm. Molecular based analyses of microbial community biodiversity, genetic diversity, and functional metabolic genes were compared to controls (i.e., no oil disturbance). To assess the oil-induced effects on the nitrogen (N) cycle, measurements of denitrification and N fixation processes were conducted. Our results showed that community diversity and phylogenetic diversity significantly changed and that the oil disturbance contributed to the creation of niches for distinct microbial types. The abundance of N-fixing microbial types increased as the abundance of denitrifying microbial types decreased as a result of the oil disturbance. As denitrification is an ecosystem service that directly contributes to removing nitrate ($NO3^-$) loading to coastal zones, impairment of this process is detrimental to the long-term health and productivity of the Gulf of Mexico. Our results are designed to investigate controlling factors and yield insights to aid decision-makers in their ongoing management efforts to restore wetlands along the Alabama coast and elsewhere.

(25) Understand the Decline Dynamics of World Saline Lakes: A Case Study of the Great Salt Lake

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A novel viewpoint of a temporal trend method with extremely changing points is proposed to analyze and characterize the so-called declines of world's saline lakes. A temporal trend can be statistically tested by an attribute regressed against time; if it is statistically significant, an increasing or declining trend exists. The extremely changing points can be determined by using the mean of an attribute plus or minus two times of its standard deviation (SD) for extremely high values and extremely low values respectively. Applying it to the Great Salt Lake's (GSL) relationship between surface levels and precipitation/temperature in the last century, we concluded that climate changes especially local warming and extreme weather including both precipitation and temperature drive the dynamics (declines and increases) of the GSL surface levels. Further studies considering climate, meteorology, and human activities including consumptive water use are needed to reveal the full story of the dynamics of the Great Salt Lake and other world's saline lakes.

(26) Buy One, Get One Free: Integrating Ecology and Hydrogeology to Conserve Alabama Burrowing Crayfish Populations and Groundwater Resources

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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.

(27) A Laboratory-based Study on Intercalation of Perfluoroalkyl Substances in Clay-rich Sediments

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Perflouroalkyl Substances (PFAS) are a class of emerging contaminants that potentially pose serious threats to human health and groundwater, surface water, and drinking water supplies. This study aimed to elucidate the primary physicochemical factors controlling the fate and transport of perfluorinated compounds, specifically perfluorooctanoic acid (PFOA) and perfluorooctanesufonic acid (PFOS). The physicochemical processes of adsorption, diffusion and intercalation, in particular, were investigated for the retention of PFAS in clay-rich sediments. Sediments were collected in a suburban area of Tuscaloosa, AL from a clay-rich stratum. A series of batch reactor experiments were conducted to determine the physicochemical processes as a function of compound chemistry, sediment geochemistry, sorbent crystalline structure, and clay fraction in sediments. PFAS concentrations and sediment characterization were conducted using high performance liquid chromatography (HPLC) and X-ray diffraction (XRD) analytical techniques, respectively. The results from this research allow for the development of improved risk assessments, predictions of fate and transport, and remediation strategies for the emerging perfluorinated contaminants in groundwater and sediment.

(28) Comparing Paleo, Observed and Future Streamflow in Coastal SE US

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Water planning and management decisions are generally based on observed (historic) records. For streamflow, these records typically have a very short period of record (e.g., 50 to 100 years). Thus, water system allocation and subsequent risk are based on a limited record of data. The ability to use dendrochronological (tree ring) proxies to extend the observed streamflow record back into the paleo period (300 to 1000 years) provides water managers and planners with a better understanding of the long-term natural variability of the watershed. However, many argue our current system is not stationary in that due to anthropogenic influences, past variability may not be as useful due to a changing climate. Thus, there is a need to evaluate future streamflow forecasts based on multiple climate model assessments to capture the non-stationarity of our current system as well as future uncertainty. The current research compares both paleo reconstructed (tree-ring based) streamflow, with observed streamflow and future estimates of streamflow. These comparisons provide water managers and planner's useful information is determining water allocation risk. The United States Environmental Protection Agency (EPA) Gulf of Mexico (GoM) program sponsors the current research.

(29) Climate Change Impacts on Saltwater Intrusion Processes in Small Islands

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Saltwater moving from the sea can naturally intrude into fresh groundwater aquifer forming a wedge, and this wedge can contaminate large volume of freshwater resources. Saltwater wedge typically divides coastal groundwater flow regime into two distinct zones- freshwater zone and saltwater zone. In island aquifers the freshwater zone forms a lens which is located above the saltwater-freshwater interface and other is saltwater zone under the interface. In this experimental research we studied an island aquifer where saltwater enters to the coastal aquifer from surrounding denser ocean water and creates two saltwater wedges containing one freshwater lens floating over it. We studied the impacts of climate change induced recharge change on these small island aquifers. In the past, researchers have developed both experimental (physical) and numerical (mathematical) models to study saltwater intrusion processes. As per our knowledge so far no one has carefully investigated the impacts of changes in recharge patterns on the shape of freshwater lens and the associated storage in island aquifers. We used an experimental approach to track the behavior of a transient shrinking and expanding freshwater lens due to changes in infiltration stresses. Also, the laboratory results were simulated using SEAWAT. Our results show that there was a good match between two experimental and numerical data sets. We also observed that during the initial period the infiltration stress caused the highest change in freshwater volume and the rate of change slowed down with the passage of time.

(30) Groundwater, Surface Water and Precipitation: Using Statistical Analysis of Different Time Series to Make Predictions for Future Water Supply

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The hydrological cycle is a highly complex system with many variables that vary with both space and time. To better understand the correlation between the different inputs, surface water, groundwater and precipitation, time series data are collected from the USGS and NOAA at and around Lake Tuscaloosa. Theses data are analyzed using different statistical methods. First, basic statistics are plotted over time to see basic trends in the water supply and the correlation and lag between each series. Then tailing behavior is determined by plotting probability distribution functions (PDFs) on logarithmic scales to investigate extreme events. Next, a Hurst exponent is determined with is a quantitative measure of the memory, or autocorrelation, of a time series . Finally the data are fitted to three different probability distributions to compare the effectiveness of each in capturing the tailing behavior of the water data. The three distributions to be test are the Gumbel distribution, the Levy stable distribution and the tempered stable distribution. For each distribution the ideal fit parameters will be determined and plotted against the actual data. From there the distributions will be compared and the most effective fit determined. By improving the ability of fitting distributions to accurately model the data series will improve the ability to make prediction for future water supplies.

(31) Group of Burrowing Bivalves Stimulates the Removal and Recycling of Excess Nutrients in Lowland Stream Ecosystems: Implications for System Resiliency

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The introduction of excess nutrients from point- and nonpoint-sources has degraded freshwater ecosystems across the globe, and is detrimental to sensitive aquatic plants and animals. In a healthy ecosystem, these plants and animals contribute to system resiliency by regulating energy and nutrient flow through food web dynamics and biogeochemical cycling. Alabama contains some of the highest aquatic biodiversity in the world, and a large component of this high biodiversity is Alabama's freshwater mussels. Freshwater mussels are long-lived, filter-feeding organisms that thrive in dense, speciose aggregations in benthic ecosystems. It is no coincidence that Alabama's undeveloped watersheds host the highest aquatic biodiversity, and that in most of these watersheds there are thriving populations of freshwater mussels. Mussels are known to significantly influence benthic biogeochemical processes due to their unique functional traits. We examined the indirect influence of freshwater mussel functional traits (movement, burrowing, excretion, biodeposition) on nitrogen removal processes in a lowland river in the southeastern US. We hypothesized that mussels indirectly stimulate nitrogen removal in the benthos through the interaction of their functional traits with the biotic and abiotic characteristics of the surrounding sediment. To test our hypothesis, we employed a combination of *ex situ* chamber incubation experiments and an *in situ* density and community composition manipulation experiment. This multi-fold approach allowed us to model the biogeochemical influence of mussel functional traits on the individual- and community-scale, respectively. Our research adds to the growing knowledge of the functional role these important yet globally imperiled organisms play in freshwater ecosystems.

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