Sustainable Water Resources
Complex Challenges, Integrated Solutions

WATER INSTITUTE
2022 SYMPOSIUM

ABSTRACT BOOK

February 22-23, 2022

University of Florida
Gainesville, FL

UF Water Institute
UNIVERSITY of FLORIDA

conference.ifas.ufl.edu/waterinstitute

DUKE ENERGY®

ABSTRACT COMPILATION

Abstracts are sorted alphabetically by presenting author's last name.
Presenting author names appear in **bold.**

Online Tip: To easily find a name in the abstract compilation, use "Ctrl + F" and type the name.

PAYMENTS FOR FOREST ECOSYSTEM SERVICES: AN INTEGRATED APPROACH TO VALUE FOREST WATER BENEFITS

*Unmesh Koirala, Kotryna Klizentyte, **Damian C. Adams**, and John Lai*
University of Florida, Gainesville, FL, USA

Increased adoption of management practices for maintaining low basal area by non-industrial private forest landowners is a potential tool for improving groundwater resource conditions. However, the economic feasibility of this approach is largely unknown in watersheds connected to the Florida aquifer. This study assessed the forest-level economic tradeoffs associated with a suite of proposed management practices for slash, loblolly and longleaf pine forest enterprises in S. Georgia and N. Florida. We then surveyed non-industrial private forest landowners (n=6000) to determine what level of incentive payments would be required to ensure their participation in voluntary water conservation-based practices, which can affect forest yield and net return. We also surveyed general public (n= 3000) to understand their preferences for supporting those voluntary programs to incentivize forest landowners to improve water benefits. Both surveys used a discrete choice experiment (DCE) model to elicit Willingness to Accept (WTA) compensation for forest landowners to enroll in a voluntary incentive program and Willingness to Pay (WTP) for general public to support those voluntary incentive program. The preliminary results for the WTA survey showed the marginal estimates for WTA compensation increases with decreasing net returns, increasing production cost and higher rotation age. Similarly, the preliminary results for the WTP survey showed the marginal estimates for WTP is higher for positive economic impacts on producers, greater opportunities for outdoor recreation, assurance of better water quality for future generation and better environmental health of the aquatic flora and fauna. Taken together, the WTA and WTP findings will indicate social welfare impacts of adopting water conservation-based management practices in forest and help inform incentive program policy design and assess social value associated with policy interventions.

PRESENTER BIO: Unmesh Koirala is Postdoctoral Research Associate, School of Forest, Fisheries and Geomatics Sciences, University of Florida. Kotryna Klizentyte is a PhD Candidate, School of Forest, Fisheries and Geomatics Sciences, University of Florida. Damian C. Adams is Associate Professor, School of Forest, Fisheries and Geomatics Sciences and UF/IFAS Interim Assistant Dean. John Lai is Assistant Professor, Food and Resource Economics Department, University of Florida.

GATORBYTE – A LOW-COST MOBILE REAL-TIME WATER RESOURCE MONITORING PLATFORM

***Piyush Agade**, Eban Bean*
University of Florida, Gainesville, FL, USA

For many water resource managers (WRMs), real-time, high-frequency and accuracy monitoring systems are inaccessible due to their high acquisition costs. These systems have proprietary software and hardware making them applicable to limited scenarios. Moreover, the data from these systems are from a few fixed locations in the water body of interest. These limitations ultimately lead to lack for high frequency actionable information, preventing WRMs from taking mitigative steps against water pollution events at the source of pollution in timely manner. The goal of the GatorByte platform is to develop a compact, low-cost, high-frequency spatiotemporal datalogger. The platform is open-source, hence WRMs can easily alter the designs and the software to suit their needs. The primary components of the system include- datalogger, cloud-based server/datastore, web-based visualization tool. The datalogger can be configured as a station (fixed location), or a buoy (mobile). In both configurations, the datalogger is built using inexpensive and widely available sensors and peripherals, a 3D-printed enclosure, and a custom Printed Circuit Board (PCB), bringing the cost of the datalogger down to under $1500. The open-source nature of the platform allows WRMs to incorporate a cellular-modem to allow the broadcast the sensor data to interested entities in real-time. Currently, the datalogger includes four low-cost and compact sensors- temperature, pH, dissolved Oxygen, and electroconductivity, a 4G-capable microcontroller, an onboard SD-card storage for backups, and Bluetooth module for on-filed diagnostics. The buoy variant additionally incorporates a GPS module for geolocation, and an accelerometer for sensing velocities. Hence, the GatorByte platform provides a low-cost, compact, and open-source solution for monitoring spatiotemporal variation in water quality. The system can be easily modified to be deployed in other environmental monitoring applications like weather monitoring, or air quality monitoring.

PRESENTER BIO: Piyush Agade is a third-year PhD student at University of Florida's Agricultural and Biological Engineering. He has a Bachelor's in Electronics and Telecom Engineering and a Master's in Computer Science, providing him the right skillset to work on applications of Internet of Things in environmental sphere.

WATERSHED MODIFICATION EFFECTS ON COASTAL ECOSYSTEMS: A SYNTHESIS FROM KEY GULF OF MEXICO ESTUARIES

Scott B. Alford*, Holden E. Harris, Bradley Ennis, David D. Chagaris, Charles W. Martin, Micheal S. Allen*
UF/IFAS Nature Coast Biological Station, University of Florida

Estuaries of the Gulf of Mexico contain valuable wetlands that provide numerous ecosystem services and functions, including supporting diverse ecosystems, providing productive fisheries, and buffering wave energy from storm events. Freshwater from terrestrial runoff combine with coastal marine waters to drive estuarine environmental conditions, subsequently determining ecological processes within coastal systems. However, land-use to meet the needs of a growing human population and climate-induced changes throughout watersheds also alter water availability and quality, affecting estuary-derived natural resources. We summarized five case studies from major watersheds that feed northern Gulf of Mexico estuaries (Galveston Bay, TX; Mississippi River Delta, LA; Big Bend of Florida; South Florida) to examine effects of watershed modification on coastal ecosystems. Studies were selected to provide comprehensive descriptions of watershed modifications on estuaries of the Gulf of Mexico. Based on these examples, we developed a conceptual model describing effect pathways of changes in freshwater inflow on coastal ecosystems. Our synthesis indicated that anthropogenic modification of watersheds affects estuarine food webs by affecting seasonal processes through timing and quantity of fluvial resources, altering species interactions through changes in community structure, and impacting foundation species on which ecosystems services depend (e.g., oysters, seagrasses). These effects will most likely be exacerbated by climate change. Watershed management presents a unique opportunity to mitigate threats to coastal natural resources, but these efforts often require cooperation across multiple levels of government and stakeholders to balance conflicts of inland and coastal interests.

PRESENTER BIO: Scott is a Fisheries and Aquatic Sciences PhD candidate at UF advised by Dr. Charles Martin. His dissertation research focuses on freshwater inflow effects on estuarine community and trophic structure. He is also involved on projects focusing on estuarine habitat assessments, nonnative and expanding species, and oil spills.

REGIONAL TREND ANALYSIS FOR RAINFALL OF SOUTH FLORIDA

Al Ali
South Florida Water Management District, FL, USA

Rainfall represents the most important component driving the hydrology in Central and South Florida. Understanding the impact of climatic conditions on rainfall nonstationarity is important for evaluating the resilience of the water management system. Rainfall is among the set of science-based Water and Climate Resilience Metrics being implemented by the SFWMD to identify trends in District-managed water and climate data. Rainfall regional trend analysis is performed for all district areas using spatiotemporal rainfall data covering fourteen operations and maintenance rainfall basins between 1935-2018. Analysis was performed for three rainfall properties: 1) Rainfall sum over month, season and annuum,2) Rainfall maxima over 1, 3, and 5 days at certain frequencies, and 3) Peak Over Threshold Analysis. Trend analyses were performed using Mann-Kendall Tau test with 95% confidence band around the trend slope. A trend is considered significant if a double-sided Z test rejects the null hypothesis that there is no trend. Results show a significant rainfall trend during the months of July, August and the transitional month of October. Wet season results show upward trend in some western basins and a downward trend in east Everglades Agricultural Area. EAA annual rainfall trend is slightly downward. Trend analysis for the rainfall maxima show significant trend in the EAA, St. Lucie and Upper Kissimmee areas for the daily maxima and in Broward for 5-day maxima. Rainfall Trend results point out the need to investigate the sensitivity to changes in basin boundaries and in the length of Period of Record as well as the need to understand the coverability with the multidecadal variables

PRESENTER BIO: Dr. Al Ali is a Chief Engineer at the South Florida Water management district with more than 30 years of experience in Geostatistics, stochastic modeling of nonstationary processes, and optimization of nonlinear systems under uncertainties. He has extensive development and application experiences in everglades restoration projects.

THE HANGOVER EFFECT: COUPLING SEAGRASS LOSS, MACROALGAL GROWTH, & WATER QUALITY IN CHARLOTTE HARBOR

Chris J. Anastasiou[1], *Nate Morton*[2], *Mark Walton*[1], *Tara Schiro*[1]
[1]Southwest Florida Water Management District, Tampa, FL
[2]NV5 powered by Quantum Spatial, Inc., St. Petersburg, FL

Charlotte Harbor, in southwest Florida, is the second largest open water estuary in Florida with a surface area of approximately 700 square kilometers. From 1988 to 2018, seagrass coverage remained relatively stable between roughly 7,000 and 8,000 hectares. In 2020, seagrass coverage reached its lowest levels in 32 years, since the Southwest Florida Water Management District began mapping seagrass. Between 2018 and 2020, the Harbor lost an unprecedented 1,798 hectares of seagrass. Most notably, the east side of Charlotte Harbor, known as "the east wall," lost half (712 hectares) of its seagrass. Concurrent with seagrass loss was an explosion of drift and attached benthic macroalgae. This relatively sudden shift from seagrass to macroalgae occurred in the wake of a protracted regional red tide event that lasted approximately 15 months from October 2017 to January 2019. While red tide was extreme in many coastal areas along southwest Florida, the east wall was largely spared direct impact. We hypothesize that seagrass loss and macroalgal proliferation along the east wall was not a direct result of red tide, rather it was a function of its aftermath, a phenomenon we term "the hangover effect." During and after the major red tide event, massive amounts of nutrients from dead and decaying organisms were likely released into the water column. Many of these nutrients through the process of denitrification would have become bioavailable in the water column which were then rapidly assimilated by the macroalgae. We utilize seagrass maps, aerial imagery, water quality data, and hydrodynamic modeling to support the idea that "the hangover effect" at least in part led to the greatest loss of seagrass in Charlotte Harbor in over 30 years.

<u>PRESENTER BIO</u>: Dr. Anastasiou is Chief Water Quality Scientist and Seagrass Mapping Program Lead for the Southwest Florida Water Management District with 25 years of experience in estuarine, freshwater, and springs ecology. He has worked on a variety of research and restoration projects from the Mississippi River Delta to the Florida Everglades.

ACCELERATING THE INFUSION OF SCIENCE INTO COASTAL POLICY – A PANEL

Annie Brett[1], Rachel Silverstein[2], Adam Blalock[3] and ***Thomas T. Ankersen[4]***

[1]University of Florida Levin College of Law, Gainesville, FL, USA
[2]Miami Waterkeeper, FL USA
[3]Florida Department of Environmental Protection, FL USA
[4]University of Florida Levin College of Law, Gainesville, FL USA

Driven by rapid developments in sensor design and deployment, robotics, big data acquisition, storage and analytics, artificial intelligence and Earth Systems modeling, the pace of coastal science has accelerated. At the same time, the scale and gravity of the hazards confronting coastal waters, shorelines and communities has also been accelerating. Many of these coastal hazards are systemic - warmer water, rising seas, tropicalization - the result of the changing climate. Others are more localized – legacy pollution, altered hydrologic regimes, ecosystem disturbance. Synergies between these global and local impacts, coupled with multidecadal time horizons, present a profound policymaking challenge. Policy challenges include engineering scaled up coastal hazard mitigation and adaptation measures, changing human behaviors, and planning for a coastal future we can model but cannot easily imagine. These challenges will tax the current policy framework for coastal management. Each panelist will briefly address their own work at the interface of science and policy and discuss role of the coastal science presented during the symposium in informing future policy. Panel and audience will then engage in a moderated, interactive discussion.

PANELISTS BIO:
Professor Brett teaches in the areas of environmental law, ocean and coastal law, and the intersection of law and science. Her scholarship focuses on how scientific data is used in decision-making. Prior to joining UF, Professor Brett worked on international ocean policy for Stanford University and the World Economic Forum.

Dr. Silverstein practices both science and policy in her role as Executive Director of the Miami Waterkeeper. Prior to becoming the Waterkeeper, she was Knauss Sea Grant Fellow and Professional Staff for the U.S. Senate Commerce Committee's Subcommittee on Oceans, Atmosphere, Fisheries and Coast Guard.

Adam Blalock is responsible for restoring and protecting Florida's aquatic ecosystems; managing aquatic research, monitoring and laboratory analysis; governing coastal protection and resiliency. In addition to practicing law in the private sector, Adam served as policy chief for the Agricultural and Natural Resources Subcommittee of the Florida House of Representatives.

MODERATOR BIO: Professor Ankersen directs the UF Law Conservation Clinic and is Florida Sea Grant's legal specialist. He also serves on the leadership team of the Center for Coastal Solutions where he helped to pilot the Coastal Policy Lab, a collaboration between the Colleges of Law and Engineering and Florida Sea Grant.

THE EFFECTS OF COLONIZATION ON WATER DISTRIBUTION IN INDIGENOUS LANDS: CASE STUDIES IN THE NAVAJO NATION AND PALESTINE

***Farah Aryan**, Sharmin F. Siddiqui, David A. Kaplan*
University of Florida, Gainesville, FL, USA

Globally, access to high quality water resources is strongly driven by economics, governance, technology, and water availability, among other factors. In many regions, water distribution politics has been used to oppress and control disenfranchised minority groups, impacting societal health and limiting economic development. This is commonly seen when land is colonized; indigenous communities often suffer from a lack of natural resources, which are taken and redistributed by the colonizer. This work investigates water availability and water quality inequity caused by settler colonization in two regions—Palestine and the Navajo nation. To do so, we applied the dissimilarity index, a metric frequently used to measure inequality in health outcomes, to diagnose differences in access to clean water among neighboring regions with contrasting socioeconomic settings. Preliminary results from Palestine show that over the past 25 years, water use in Israeli settlements was 75% higher than in Palestine, while the mortality rate due to unsafe water sources was 93% higher in Palestine. In the Navajo Nation, it is expected that poor water quality is a major driver of inequitable water access and associated quality-of-life outcomes such as poverty levels, mortality rates, and economic data. Overall, this study explores the disparities in water access, health, and environmental outcomes between colonized and self-governed areas and provides and analytical framework to identify similar water inequities in other areas of the world that have a history of colonization.

PRESENTER BIO: Farah Aryan is currently a graduating environmental engineering major at UF and will be pursuing her masters in biological engineering at UF this upcoming spring. She is interested in environmental justice and hopes to pursue a career that allows her to fight for equal water use for all.

ORGANIC CARBON BURIAL IN MANGROVE-SALT MARSH ECOTONES OF APALACHICOLA BAY: THE ROLE OF REACTIVE IRON

Prakhin Assavapanuvat[1], *Thomas S. Bianchi*[1], *Joshua L. Breithaupt*[2]
[1]Department of Geological Sciences, University of Florida, Gainesville, FL, USA
[2]Florida State University, Coastal & Marine Lab, St. Teresa, FL, USA

Due to global warming, poleward invasion of mangrove communities into salt marsh habitats has been increasing around the world. This range expansion is expected to enhance carbon storage in these "blue carbon" communities because of higher organic carbon (OC) burial rates commonly observed in mangrove (10-88 g C m^{-2} yr^{-1}) compared to salt marshes (4-40 g C m^{-2} yr^{-1}) (e.g., Doughty et al., 2016; Breithaupt et al., 2017; Radabaugh et al.,2018; Dontis et al., 2020; Vaughn et al., 2020; Vaughn et al., 2021). Interestingly, recent studies have observed that significant proportion of OC was bound to reactive iron phases in soils. The stability of reactive iron-associated OC (FeR-OC) depends on sediment redox state which subject to unequal rhizosphere oxidation between mangrove and salt marsh taxa. Hence, mangrove-salt marsh substitution could potentially adjust the magnitude of FeR-OC fraction and OC preservation potential. Here, we investigate carbon burial in sediments of Apalachicola Bay, the northernmost limit of expansion of both black (*A. germinans*) and red (*R. mangle*) mangrove into Floridian *Spartina spp*. and *Juncus spp*. salt marshes. According to the analyses of lignin-derived phenols and citrate-dithionite FeR-OC extraction, we observed that 1) degradation signal of lignin abruptly decreased after former salt marshes were replaced by *A. germinans*, and 2) near-surface sediments under *A. germinans* community contain higher fraction of FeR-OC relative to both sediments from *R. mangle* region and the deeper section of *A. germinans* core where precedent salt marshes were the major OC source. These findings illustrate higher OC burial after mangrove establishment and highlight the importance of climate-driven adjustment of coastal vegetation habitat in regulating feedbacks on global carbon cycle.

<u>PRESENTER BIO</u>: Prakhin Assavapanuvat is a graduate student in Department of Geological Sciences, University of Florida, working in Professor Thomas S. Bianchi's lab. His major research interest is tracing the effect of natural and anthropogenic disturbances on wetland biogeochemical cycles.

YOUTH EDUCATION AND SKILL DEVELOPMENT FOR A GENERATIONAL IMPACT ON WATER QUALITY OF THE INDIAN RIVER LAGOON

*Carol Roberts[1], Vincent Encomio[1], Armando Ubeda[1], **Mandy Baily[1]**, Kimberly Davis[2] and Beth Falls[3]*
[1]University of Florida, Gainesville, FL, USA
[2]Florida A&M University, Tallahassee, FL USA
[3]Ocean Research Conservation Alliance, Fort Pierce, FL USA

A team of University of Florida (UF) and Florida A&M University (FAMU) Extension agents partnered with the Ocean Research Conservation Association (ORCA) to hold a fishing clinic in the Indian River Lagoon. It was the result of a deliberative forum hosted by The Community Voices, Informed Choices (CIVIC) program leaders to address water quality issues in the Indian River Lagoon (IRL). During that forum, participants expressed concern for community members who fish the urban tributaries flowing into the IRL. They wondered if the fish consumed by the community members was toxic and could be negatively impacting their health. To learn more about the issue, CIVIC reached out to researchers with UF, FAMU, and ORCA to convene a town hall meeting with the community. During that meeting, the ORCA researcher shared her work looking at fish toxicity in the region and the challenges she faced in obtaining fish for her research. The community was enthusiastic about the research and wanted to contribute, so the idea of a youth fishing clinic in which the fish caught would be given to ORCA to study and the community could be educated was conceived. Extension agents reached out to their partners and secured over $2,000 worth of fishing equipment and food to be shared during the event. The youth learned knot-tying, casting, baiting, and fishing. Every fish that was caught was donated to ORCA and in exchange, the participants enjoyed a freshly cooked fish sandwich and got to take home their fishing gear and bait. Community partners such as the Florida Fish and Wildlife Conservation Commission, Coastal Conservation Association and St. Lucie County 4-H County Council provided education and volunteers. Thirty-five youth ages 8-14 participated in the event and twelve of the fish they caught were donated to ORCA.

PRESENTER BIO: Ms. Baily is a UF grad student.

DRIVERS OF PROTISTAN DIVERSITY IN THE OLIGOTROPHIC LAKE TOHOPEKALIGA

Maximiliano Barbosa*, Forrest W. Lefler, David E. Berthold, H. Dail Laughinghouse IV*
University of Florida Ft. Lauderdale Research and Education Center, Ft. Lauderdale, FL, USA

Lake Tohopekaliga is an oligotrophic shallow lake within the Upper Kissimmee River Basin in central Florida, which is dominated by aquatic macrophytes such as Hydrilla (*Hydrilla verticillata*) and some locations by water hyacinth (*Eichornia crassipes*). Therefore, mechanical and chemical control of these aquatic weeds is prevalent in the lake. Water samples were taken from pre-determined plots in Lake Tohopekaliga that were either treated by application of aquatic herbicide or via mechanical harvesting. Sampling occurred 1-2 weeks before the mechanical harvest or chemical spray, in addition to monthly or bimonthly sampling. The protistan community was highly diverse with a few dominant classes including Bioeceae, Chlorophyceae, Cryptophyceae, Oligohymenophorea, and Spirotricheae. These classes are comprised of both heterotrophic and photosynthetic protists which indicates a balanced community structure among heterotrophs and autotrophs along space and time. A principal coordinate analysis (PCoA) indicated that diversity of protists was driven by 8 environmental factors. Some of these factors are dependent on seasonality such as photic depth, water temperature, and turbidity. Others, such as concentration of aluminum (Al), sodium (Na), chlorophyll a, conductivity, and phycocyanin, are driven by both biotic and abiotic factors. A redundancy analysis (RDA) showed clustering along dates, which indicates that protistan community structure are largely similar along a temporal scale instead of a spatial scale. This indicates that protistan community structure is driven by seasonality instead of locality and that different treatment methods do not significantly affect potistan community structure.

PRESENTER BIO: Max Barbosa is a third year PhD student with extensive experience in algal biology and ecology. His work encompasses tropical and subtropical lake ecology in with a concentration on environmental drivers of cyanobacterial and protistan diversity.

RESEARCHING THE EFFICACY OF RECLAIMED WATER BMPS FOR NUTRIENT LOAD REDUCTIONS IN RESIDENTIAL AREAS

Dylan J. Barr[1]*, Mary Lusk*[1]*, Kate Rotindo*[2]

[1]University of Florida, Gulf Coast Research and Education Center, Wimauma, FL, USA

[2]St. Lucie County Extension, University of Florida/IFAS, Ft. Pierce, FL, USA

Population growth and other anthropogenic and environmental factors put Florida's freshwater resources under exceptional and persistently increasing demand. Expanding sustainable use practices to reduce the strain on the state's groundwater stores is critical to protect environmental systems, ensure public health, and promote economic development. These practices should also not contribute to the many water quality issues plaguing freshwater and marine ecosystems around the state. This research aims to investigate the water quality impact of using treated municipal wastewater or reclaimed water for residential landscape irrigation. Study sites are located in the Indian River Lagoon watershed in St. Lucie County, Florida. Water samples collected from household sprinkler systems that utilize reclaimed water are used to quantify the concentration of nitrogen and phosphorus. Homeowner irrigation behaviors will be surveyed to aid in assessing possible over-irrigation. Additionally, we seek to quantify the amount of wasteful sprinkler overspray, or the amount of water being applied to impervious surfaces such as driveways, sidewalks, and roads. Combining those points allows us to determine the amount of possible nutrient reductions in the watershed if improper or unnecessary irrigation practices are reduced. The eventual goal of this research is to develop science based BMPs for using reclaimed water in residential irrigation settings and ultimately to reduce nutrient loads being received by the St. Lucie estuary.

PRESENTER BIO: Dylan is a MS student in the Soil and Water Sciences Department under the supervision of Dr. Mary Lusk at the UF/IFAS Gulf Coast Research and Education Center in Wimauma, FL.

THE ROOM WHERE IT HAPPENS": CO-PRODUCING SCENARIOS FOR THE FACETS PROJECT

Wendy-Lin Bartels[1], *Carrie A. Furman*[2], *Kristin Rowles*[3] *and Mark Masters*[4]

[1]University of Florida, Gainesville, FL, USA
[2]University of Georgia, Atlanta, GA, USA
[3]Albany State University, Baltimore City, MA, USA
[4]Albany State University, Albany, GA, USA

The co-production of knowledge between scholars and practitioners presents a promising approach for generating relevant, credible, and useful science. This paper focuses on an analysis of the nuts and bolts of knowledge co-production, i.e., the "incubator stage" of a participatory modeling project located in the SE USA. Our study documents the iterative process of collaboration to create core modeling components in the FACETS project. These modeling inputs and outputs include the management systems that contribute to the farm and regional scale models as well as the future land use scenarios that are intended to guide discussions about tradeoffs. This paper explores who was in "the room" and how modeling components were generated together. Specifically, we examine 1) expectations for the participatory process among project team members and stakeholders 2) perceived contributions to the process and outcomes (focusing on participation and power relations), and 3) trust dynamics (in product, process, and people). Finally, because much of this stage of the FACETS project occurred during COVID, we investigate the impacts of a virtual exchange space on interactions and outcomes.

PRESENTER BIO: Dr. Bartels works at the interface of academia and society, exploring scientist-stakeholder interactions within the arenas of sustainable rural development, natural resource conservation, and climate risk management. She conducts social research on the factors shaping collaborative partnerships. She also facilitates networks and community platforms for knowledge exchange, collective learning, and problem solving.

POTENTIALS OF VARIABLE RATE IRRIGATION FOR VEGETABLE PRODUCTION IN SOUTH FLORIDA

Haimanote K. Bayabil*, Fitsum T. Teshome, and Christian Bartell*
Agricultural and Biological Engineering, Tropical Research and Education Center, University of Florida, Homestead, FL, USA.

Florida's vegetable industry contributes significantly to the state's economy with an estimated annual economic return of $1.34 billion. The state is one of the top producers of sweet corn and green beans in the country. Irrigation is critical for vegetable production in the state due to uneven rainfall distribution. Irrigation management is even more crucial in regions like South Florida that heavily depend on shallow aquifers as freshwater sources for drinking and irrigation This is because soils in South Florida are often shallow, highly permeable, and with low water holding capacity. Precision irrigation management practices have great potential for not only conserving freshwater quantity but also protecting water quality by reducing nutrient loading from excess irrigation. A field study is being conducted to investigate the potentials of variable rate irrigation (VRI) system for green beans and sweet corn production at the Tropical Research and Education Center (TREC). Thirty-two experimental plots (each 9 m long x 5.5 m wide) were established under a linear move VRI system. The experiment involves four irrigation levels (100, 125, 150, and 175% of maximum allowable depletion (MAD)) based on rootzone soil moisture readings. Experimental plots are equipped with soil (moisture, temperature, electrical conductivity) sensors, free drainage lysimeters, above canopy infrared (IRT) sensors, and a weather station. In addition, drone images are collected daily using multispectral and thermal sensors. In this presentation, we will share preliminary study results; and challenges and opportunities of using a VRI system for vegetable production will be discussed.

PRESENTER BIO: Dr. Bayabil is an Assistant Professor of Water Resources. He has a research and extension appointment. His program focuses on developing efficient water management practices that not only conserve water but also protect water quality and ensure optimal plant growth and yield.

MOVING FLORIDA FORWARD ON LOW IMPACT DEVELOPMENT + GREEN STORMWATER INFRASTRUCTURE

Eban Z. Bean[1]*, Lynn Jarrett*[1]*, Jovana Radovanovic*[1]*, M. Jennison Kipp*[1]*, and Lesley Bertolotti*[2]
[1]University of Florida, Gainesville, FL, USA
[2]The Nature Conservancy, Maitland, FL USA

Water, whether in underground aquifers, freshwater springs, lakes and rivers, or estuaries and oceans, is both necessary for our lives and is the lifeblood of Florida's economy. Urban development, increasing demand for limited fresh water, and nutrient loading from residential and agricultural landscapes are driving hydrologic changes that threaten this critical natural resource. We must shift our mindset from "development as usual" to development that works in harmony with our land, soils, and water by encouraging natural drainage, conserving water, and reducing pollutants at their source. Low impact development and green stormwater infrastructure (LID+GSI) mimic natural systems and processes to store, filter and absorb stormwater. They employ engineered designs that help restore our water supply, improve water quality, and reduce flood risks.

The Florida Department of Environmental Protection is funding a project with UF's Program for Resource Efficient Communities and The Nature Conservancy to develop materials that will assist local governments, engineers and other professionals to design LID+GSI urban water management and to break down implementation barriers by educating communities about the economic and social benefits of practices that protect our water resources. The work began with a needs assessment of planners, engineers, and other professionals to identify problems preventing widespread adoption of LID+GSI in Florida and to guide the development of materials so that they are practical and actionable. Products to be generated include:

- A design guidance manual for LID+GSI, focusing on measures appropriate for sensitive groundwater areas
- A photo gallery of Florida's existing LID+GSI sites, highlighting aesthetically pleasing community assets with long-term stormwater benefits
- A local ordinance audit tool municipal governments can use to identify LID+GSI barriers in their local codes.

Session attendees will learn about the many practical benefits this project offers and how it fits with other stormwater initiatives in Florida.

PRESENTER BIO: Dr. Bean is an assistant professor and extension specialist in urban water resources engineering. His work focuses on the design, evaluation, and management of urban landscapes for water resource sustainability, water quantity and quality issues in urban stormwater, and promoting sustainable development to reduce nonpoint source pollution.

EVALUATION OF CLIMATE INDUCED CHANGES TO POREWATER BIOGEOCHEMISTRY IN MANGROVE/SALTMARSH ECOTONE

Anna R. Beard[1], *Tracey B. Schafer*[1], *Samantha K. Chapman*[2], *Nicole Dix*[3], *Todd Z. Osborne*[1]

[1]Whitney Lab, University of Florida, St. Augustine FL

[2]Villanova University, Villanova Pennsylvania

[3]Guana Tolomato Matanzas National Estuarine Research Reserve, Ponte Vedra FL

Coastal wetlands can be found all over the globe and are recognized as some of the most productive ecosystems in the world. Saltmarshes dominant coastal wetlands in temperate zones while mangroves are limited to their poleward boundaries by freeze-inducted mortality at the sub-tropical/temperate transition. With climate change, lack of freezing events in NE Florida have led to a northward expansion of mangroves into the historically saltmarsh dominated ecosystem i.e*., A. germinans* replacing *Spartina alterniflora*. Recent research suggests that warmer temperatures will likely change ecosystem dynamics via changes in dominant vegetation and increased biological activity. To investigate this, an in situ warming experiment using warming chambers (1.6 C° mean temperature increase) was conducted at three coastal wetlands along a latitudinal gradient within salt marsh cordgrass vegetation *Spartina alterniflora* and mangrove *Avicennia germinans* plots over a yearlong study. Seasonal sampling, via pore water well, *A*. *germinans* vs. *S. alterniflora* pore water nutrients were investigated along with warming vs non warming plots. Our findings showed no significant differences in warming vs. non-warming plots, and no significant differences in *A. germinans* vs. *S. alterniflora*. Seasonal differences in porewater total nitrogen, total phosphorus, dissolved organic carbon, salinity and ammonia stand alone in significance regardless of temperature or vegetation type.

PRESENTER BIO: Anna Beard is the Analytical Laboratory Manager for the Estuarine Biogeochemistry Laboratory at Whitney. She received a Bachelor of Science from Stetson University in marine science and has 10 years' experience in marine research. She has been a part of the Estuarine Biogeochemistry lab for 4 years running with a passion for coastal wetland research.

REFERENCE AND POTENTIAL EVAPOTRANSPIRATION, SOLAR RADIATION, AND ALBEDO OVER FLORIDA, USA, 1985-2020

Jason C. Bellino *and John Stamm*
U.S. Geological Survey, Caribbean-Florida Water Science Center, Lutz, FL, USA

Evapotranspiration comprises a considerable portion of the water budget in Florida, sometimes returning 80 to 100 percent of rainfall to the atmosphere as water vapor. As such, estimates of potential evapotranspiration (PET) and reference evapotranspiration (ETo) are required for many resource-management activities such as water-use permitting and regulation, estimating agricultural irrigation demands, scientific evaluations of ecosystem resiliency, and calculation of hydrologic budgets using surface-water and groundwater models. The U.S. Geological Survey Caribbean-Florida Water Science Center has produced daily estimates of PET and ETo at an approximately 2-kilometer spatial grid for Florida for the period 1985-2020. PET and ETo were computed on the basis of solar radiation data from the Geostationary Operational Environmental Satellite (GOES), meteorological data from weather stations and the North American Regional Reanalysis (NARR) model, and shortwave blue-sky albedo data from the Moderate Resolution Imaging Spectroradiometer (MODIS) satellite. Both PET and ETo are highly correlated with seasonal and annual fluctuations of incoming solar radiation. The Florida PET and ETo data products have evolved over time with changes in methodology for interpolating meteorological data and sources of input data. Long-term trends could be evaluated more reliably after the dataset has been reanalyzed with a uniform methodology and input datasets.

PRESENTER BIO: Mr. Bellino is a hydrologist with 15 years of experience including groundwater flow modeling of the Floridan aquifer system, surface-water/groundwater interactions studies, bathymetric mapping, and evapotranspiration studies.

SEAGRASS SPECIES IDENTITY AND HISTORICAL COVER INFLUENCE SEDIMENT ORGANIC CARBON STOCKS

***Alexandra L. Bijak*[1]*, Laura K. Reynolds*[1]*, and Ashley Smyth*[1,2]

[1]Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA

[2]Tropical Research and Education Center, University of Florida, Homestead, FL USA

Biodiversity can promote ecosystem functioning in coastal systems. In general, diverse communities are more productive and recover from disturbance faster than communities with less variation, and diversity can enhance restoration success. We are investigating the role of seagrass species diversity in the ecosystem function of organic carbon storage. While species-specific seagrass morphology and physiology may impact organic matter trapping and sediment microbial activity, the effect of seagrass species diversity on sediment organic carbon storage remains unclear. Since sediment organic carbon stocks represent accumulation over time, seagrass cover and variability in cover over time may predict organic carbon stocks. We examined the effect of contemporary seagrass cover and richness, as well as historical cover and variability in cover over the past 15 years, on surface sediment organic carbon (0-10 cm) in subtropical meadows in Cedar Key, Florida. This region is host to several tropical seagrass species that are underrepresented in carbon stock estimates. We found that meadows where *Thalassia testudinum* (turtlegrass) was present contained higher stocks than meadows where turtlegrass was absent, and stocks increased with turtlegrass biomass. The highest carbon stocks were found in monotypic stands of turtle grass and diverse mixed stands with *Syringodium filiforme* (manateegrass). The lowest carbon stocks were found in monotypic and mixed *Halodule wrightii* (shoalgrasss) meadows and unvegetated sediments. We also found that sediment organic carbon stocks increased with average historical seagrass cover and declined with increasing variability in cover. These findings suggest both meadow history and contemporary species identity are drivers of local-scale variability in sediment organic carbon stocks.

PRESENTER BIO: Alex Bijak is a 3rd year PhD student interested in how biodiversity promotes ecosystem functioning. She has an educational background in conservation biology and population genetics and gained professional experience in nation-scale water quality monitoring through an ORISE fellowship at the U.S. EPA.

WATERSHED TOPOGRAPHY AS A PREDICTOR OF STREAM CHEMISTRY ACROSS NON-GLACIAL SYSTEMS IN GREENLAND

Megan Black[1], *Jonathan B. Martin*[1], *Ellen E. Martin*[1], *Andrea J. Pain*[1,2], *Madison K. Flint*[1]
[1]Department of Geological Sciences, University of Florida, Gainesville, FL, USA
[2]Horn Point Laboratory, University of Maryland Center for Environmental Science, Cambridge, MD, USA

The retreat of continental ice sheets since the Last Glacial Maximum has exposed underlying landscapes to increased biological activity and chemical weathering reactions. The transformation of these landscapes from glacial to non-glacial systems changes stream water chemical composition as weathering reactions alter minerals in the freshly comminuted glacial sediment. In addition, organic carbon and nutrient stream water concentrations change due to shifts in vegetation coverage with ecosystem succession following exposure. Rates of chemical weathering reactions may be affected by factors such as topographic relief, including slope and slope orientations relative to north because of their control on snow accumulation, timing of melting, and water retention in the landscape. This project aims to evaluate whether key landscape topographical variations can be used as predictors of stream chemistry across non-glacial terrains in Greenland using remotely sensed and stream chemistry data. More specifically, relationships between slope and slope orientation versus solute and nutrient concentrations will be explored across nine non-glacial watersheds in southwestern and southern Greenland. These watersheds were previously covered by the Greenland Ice Sheet but were exposed between ~12 and 7 thousand years ago as the ice sheet retreated. Analyses will explore relationships between watershed slope and aspect with concentrations of PO4, NO3, NH4, Si, SO4, Na, Ca, Mg, Sr, and DOC using legacy stream data chemistry collected during three summer field seasons in 2017 and 2018. Determining the role of topography in altering stream chemistry may allow similar analyses across broad region with remote and difficult access, thereby improving evaluations of solute and nutrient delivery to Arctic coastal water.

PRESENTER BIO: Megan Black is a PhD candidate in the Department of Geological Sciences and a WIGF fellow at the University of Florida. Her research focuses on using remote sensing techniques and field data to identify relationships between landscapes and stream chemistry in Greenland.

SPATIO-TEMPORAL FORECASTING OF URBAN HOUSEHOLD-LEVEL WATER DEMAND WITH STATISTICAL MACHINE LEARNING

Isaac Duerr, Hunter R. Merrill, Chuan Wang, Ray Bai, Mackenzie Boyer, Yi Han, Michael D. Dukes,
Nikolay Bliznyuk
University of Florida, Gainesville, FL, USA

Forecasts of water use are crucial to efficiently manage water utilities to meet growing demand in urban areas. Improved household-level forecasts may be useful to water managers in order to accurately identify, and potentially target for management and conservation, low-efficiency homes and relative high-demand customers. Advanced machine learning (ML) techniques are available for feature-based predictions, but many of these methods ignore multiscale spatiotemporal associations that may improve prediction accuracy. We use a large dataset collected by Tampa Bay Water, a regional water wholesaler in southwest Florida, to evaluate an array of spatiotemporal statistical models and ML algorithms using out-of-sample prediction accuracy and uncertainty quantification to find the best tools for forecasting household-level monthly water demand. Time series models appear to provide the best short-term forecasts, indicating that the temporal dynamics of water use are more important for prediction than any exogenous features.

PRESENTER BIO: Dr. Nikolay Bliznyuk is an Associate Professor of Statistics at the University of Florida. His expertise and research interests include modern applied statistics, machine learning and statistical methodology for complex modern data arising in environmental and life sciences.

AGRICULTURAL BEST MANAGEMENT PRACTICES ASSESSMENT TOOL (BMPAT)

Del Bottcher
Soil and Water Engineering Technology, Gainesville, FL, USA

BMPAT is being developed to assist Florida farmers and Florida Department of Agriculture and Consumer Services (FDACS) staff with selecting and implementing the most cost effective BMPs associated with FDACS' BMP assistance programs. The overall objective was to have an effective tool that we allow farm level BMP programs to be quantitatively evaluated for their environmental benefits so that they can be better optimized. The BMPAT allows users to compare offsite water quality impacts associated with their past, current, and various proposed future BMP practices. BMPAT also provides estimated implementation, operational, and maintenance costs for the BMPs, which are used to provide cost effectiveness values for the various selected BMPs in terms of dollars per pound of nutrient (nitrogen and phosphorus) being reduced.

To date, cow/calf and sod operations have been developed in the BMPAT user-friendly Excel based program. Relevant literature and data sources as well as technical advisory groups consisting of farmers, grower association leaders, university experts, and Archbold Biological Station and FDACS staff were used to build and quantify the algorithms and parameter data sets. In addition, the advisory groups helped test and evaluate the utility of the BMPAT for farmers and agency staff. A trial application of the cow/calf BMPAT was run for various pasture conditions for the heavily monitored Buck Island Ranch and was found to be robust in predicting observed nutrient concentrations.

PRESENTER BIO: Dr. Del Bottcher is president of Soil and Water Engineering Technology, Inc. He received his BS in Physics from South Florida University, MS in Agricultural Engineering from the University of Florida, and PhD from Purdue University. He has over 40 years of experience in BMP development, hydrologic and water quality modeling, and analysis of watersheds in Florida. He has managed over seventy related projects.

FLORIDA FARMERS' MULTI-BMPS ADOPTION: A SURVEY ANALYSIS

***Sawssan Boufous**, Tara Wade*
Southwest Florida Research and Education Center/IFAS, University of Florida, Immokalee, FL, USA

Agriculture is a major contributor to surface water and groundwater pollution and freshwater withdrawal. Using agricultural Best Management Practices (BMPs) can reduce the negative impact on the environment (Frydenborg and Frydenborg 2016), which elevated the interest in BMPs adoption. However, the existing adoption literature focuses mainly on factors, farmers' characteristics, and single adoption (i.e. Mpanga and Idowu, 2021; Palmate and Pandey, 2021; Bergtold et al., 2012). To our knowledge, little was done on multi-BMPs adoption. Therefore, we use data collected from online, mail, and face-to-face survey to understand Florida farmers' perceptions of the simultaneous BMPs multi-use costs and benefits. Simulated maximum likelihood procedures are used to identify the factors leading to the multi-BMPs adoption and frequency analysis is used to identify BMP use patterns and commonly used BMP bundles. We identify the BMP use by county using The Spatial Join function from ArcGIS 10.7.1 (ESRI Inc. 2019). We expect that larger farms implement more BMPs bundles than small farms and that there is a complementarity relationship among some of the BMPs.

Orienting the focus on multiple BMPs adoption rather than single adoption opens the possibility to improve BMPs adoption policies, increase farmers' benefits, and reduce farmers' adoption and education costs (Amacher and Feather 1997; Cooper 2003).

<u>PRESENTER BIO</u>: Dr. Sawssan Boufous is a post-doctoral research associate at at the University of Florida, Southwest Florida Research and Education Center in Immokalee, Florida. Dr. Boufous' research focuses on the economic behavior of producers and consumers' regarding sustainability. Dr. Tara Wade is an assistant professor of agricultural economics at the University of Florida, Southwest Florida Research and Education Center in Immokalee, Florida and the Food and Resource Economics Department. Dr. Wade specializes in the adoption of agricultural production practices that have positive ecological outcomes.

DEVELOPMENT OF ADVANCED WATER EXTENSION PROGRAMS FOR MGVS

***Lorna Bravo*[1]**, *Kimberly Moore*[2]
[1]University of Florida IFAS, Broward, FL, USA
[2]University of Florida FLREC, Broward, FL, USA

Educating governments, homeowners, and the public on the tangible benefits of water conservation principles under the UF/IFAS Extension Water Conservation Roadmap is essential for the Urban Horticulture agent. Training and certification of Master Gardener Volunteers (MGV) as change agents is critical when educating homeowners on water conservation. This study evaluated the addition of "water" focused programs to MGV programs. The Broward County Extension urban horticulture agent added three urban water-focused programs to current MGV trainees. The first was the rain barrel program, followed by the Hydro-Kit program and the Water Ambassador program. We used different measures of success for each program. The rain barrel program was successful, with half of the students adopting a rain barrel as a new water management method. The hydro-kit was successful, with students actively engaged with a personal hydro-kit to grow hydroponic lettuce. The water ambassador program tried to tie all elements together and successfully had participants become Florida-Friendly Landscaping™ Certified Professional (FFLCP), and Green Industries Best Management Practice (GI-BMP) certified. Ideally, we would like students to start with a rain barrel, then a hydro-kit followed by a water ambassador. However, only four students followed this sequence, leading to some repetition in each program. In the future, we need to stress the importance of taking these programs in series. There is vast potential to improve water conservation in urban communities by empowering MGV with advanced water knowledge.

<u>PRESENTER BIO</u>: Lorna is currently serving as the new UF/IFAS Extension Broward County Director / Urban Horticulture Agent. Lorna is currently pursuing her Ph.D. at the University of Florida under the department of Environmental Horticulture, where she researches water conservation in the built environment.

MICROBIAL RISK ASSESSMENT VIA QPCR TO DETERMINE THE LEVEL AND SOURCES OF FECAL CONTAMINATION AND HELICOBACTER PYLORI IN NORTHWEST FLORIDA URBAN STREAMS

***Ronell S.H. Bridgemohan*[1]**, *Mathew Deitch*[1] *Dave Bachoon*[2], *and Eban Bean*[3]

[1]Soil and Water Sciences Department, University of Florida IFAS West Florida Research and Education Center, Milton, FL, USA
[2]Department of Biological and Environmental Sciences, Georgia College and State University, Milledgeville, GA, USA
[3]Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL, USA

Fecal contamination of watersheds and urban streams is of increasing concern and has been a critical issue, especially in Northwest Florida. The potential risk to human health posed by waterborne pathogens is one of the greatest threats to the stability and resilience of coastal communities along the Gulf of Mexico. Northwest Florida has a thriving coastal tourism community that also serves many other purposes, such as recreational, commercial, shellfish harvesting, and fisheries. Increasing levels of fecal pollution pose a potential economic constraint and hardship for NW Florida as its economy primarily depends on thriving coastal tourism industry. Poor recreational water quality and high incidences of fecal pollution can be attributed to its inadequate and outdated sewage and drainage systems and poor livestock waste disposal. The constant flooding and runoff issues lead to high levels of fecal pollution, and possibly pathogenic bacteria from human and animal sources, which endangers the residents. Understanding the dynamics of contaminants in streams represents an important first step for identifying their sources and methods to mitigate their delivery from the landscape. The aim of this study was to determine, the level of fecal indicator bacteria concentration (*E. coli*), the point and non-point sources of fecal contamination, and whether they were of human or animal origin. IDEXX Colilert-18 was used to enumerate *Escherichia coli* in the samples and 3 sites exceeded the USEPA limit, 10-mile (461.1 MPN CFU/ 100 ml) Mills site (410.6 MPN CFU/ 100 ml) and Villa Venyce (613.1 MPN CFU/100 ml). DNA was extracted from each sample and qPCR was used for microbiological source tracking (MST) to detect host specific Bacteroides DNA. Microbial Source tracking detected human (HF183) fecal pollution at (44.45%) sites, dogs (Bac Can) (33.33%), and birds (CP1F/R) at (11.11%). This study illustrates that our sites are contaminated with human and animal sources of fecal inputs. Many sites with elevated levels of fecal pollution detected poses a serious health risk.

<u>PRESENTER BIO</u>: Ronell Bridgemohan is a hydrologist, molecular microbial ecologists, microbiologist, and environmental scientist with 11 years' experience in microbial risk assessments and water quality monitoring. He has worked for government agencies, on federal funded projects and internationally on water quality issues. He has studied and worked in USA and the Caribbean.

INFLUENCE OF GROUNDWATER ON STREAMFLOW IN SALMON-BEARING STREAMS

Tyelyn Brigino*, Mark Rains, Kai Rains*
University of South Florida, Tampa, FL, USA

Groundwater discharge plays a critical role in the proper functioning of streams, including the modulation of stream flow, temperature, and nutrient concentrations. In the Kenai Peninsula Lowlands, Alaska, groundwater resources are balanced between salmon-bearing streams and adjacent human users. These groundwater resources are limited and risk further depletion due to both rapid population growth and regional climatic drying trends. If stream flow in this region is primarily comprised of groundwater, a reduction in regional groundwater availability and discharge may be reflected by an accompanying reduction in stream flow. We analyzed the chemical hydrology of precipitation and groundwater across the Kenai Peninsula Lowlands to determine the relative contributions of these sources to stream flow. We used chemical fingerprints to infer the geologic history of different types of groundwater, and their relative contributions to instantaneous and annual stream flow. Contributions to stream flow come from both younger, shallow hillslope groundwater and older, deep-aquifer groundwater. We then used a three-end mass balance mixing model to determine the relative contributions of precipitation, shallow hillslope groundwater, and deep-aquifer groundwater to stream flow. We found that groundwater contributes over half of summer stream flow, more so in the winter. The younger, shallow hillslope groundwater contributes disproportionately to stream flow, though the older, deep-aquifer groundwater also contributes substantially to stream flow. Our results show that groundwater discharge plays an important role in supporting salmon-bearing streams in the Kenai Peninsula Lowlands. Additionally, our results indicate that water-supply wells draw from many of these same groundwater resources, creating a potential resource conflict. Further planned development in the area could result in further reduction of groundwater resources and eventually stream flow. Our results have implications for water resource management and associated ecological functions, and for the salmon-dependent Kenai Peninsula Lowlands economy.

PRESENTER BIO: Tyelyn Brigino earned a BS (Honors) in Chemistry and is currently a MS student in Geology at the University of South Florida.

SETTLING BEHAVIORS OF STORMWATER MICROPLASTICS

Jenna Brooks, *Mauricio Arias, and Cody Stewart*
University of South Florida, Tampa, FL, USA

Microplastic modeling efforts, especially in the freshwater environment, are extremely limited. To better understand transport processes and improve the accuracy of current and future models, more information on microplastic settling behavior is needed. The goal of this study was to provide the first measurements of settling velocities of microplastics obtained from the environment. Plastics ranging from 300 µm to 12 mm were collected from stormwater pond sediments in Tampa, FL. These plastics were processed using a multipart density separation with sodium chloride and sodium iodide. Properties including density, size, surface area, and polymer type were determined for individual particles. Several shape descriptors including circularity, sphericity, and Corey Shape Factor, which have been found to greatly influence settling behavior, were also determined using the ImageJ software. Terminal settling velocity was measured and results were compared to several current drag models.

PRESENTER BIO: Jenna is a third-year civil engineering student at the University of South Florida. She has experience with both stormwater infrastructure and international development projects. Her long-term goal is to obtain a Ph.D. in environmental engineering.

RELATING LAND COVER CHANGE TO FLOOD RUNOFF DISTRIBUTION USING NASA EARTH OBSERVATIONS IN KANSAS

***Trista Brophy*[1,2]**, *Ella Griffith*[2], *Elizabeth Nguyen*[2], *Adelaide Schmidt*[2], *Aida Farough*[3], *and Samuel Smidt*[1]

[1]Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA
[2]DEVELOP National Program, Langley Research Center, Hampton, VA, USA
[3]Department of Geology, Kansas State University, Manhattan, KS, USA

Riley County, Kansas, has observed increased levels of flooding, potentially due to changes in land use/land cover (LULC) and seasonal vegetation variation. To identify areas of concern, the authors worked with stakeholders including the City of Manhattan, Riley County Department of Planning and Development, Riley County Conservation District, the Kansas Forest Service, and the Kansas Department of Health and Environment. The study contrasts two methods of modeling runoff curve numbers (CN) from 2006-2020. (1) The traditional Soil Conservation Service CN calculation method uses a look-up table and tracked LULC to determine runoff changes. These tables allow for CN values specific to various land and crop cover types and account for various farming best practices but lack flexibility in calculations for various seasons or plant health. (2) A dynamic method employs normalized difference vegetation index (NDVI) compiled over the rainy season each year to calculate CN using seasonal vegetation. This method allows for a more precise analysis of runoff variability within and between rainy seasons because it can be updated for regular monitoring with greater temporal detail and it captures higher spatial resolutions by using NDVI as a proxy for LULC. This study further uses inputs from the United States Geologic Survey (USGS) National Land Cover Database (NLCD), the United States Department of Agriculture (USDA) Cropland Data Layer, and Landsat imagery to create more precise LULC raster datasets including both urban cover and crop-specific land use and curve number maps of the area. Results were communicated through an interactive ArcGIS StoryMap to guide the public and decision makers toward informed decisions on resiliency strategies to address future flooding.

PRESENTER BIO: Trista Brophy is a doctoral student of Interdisciplinary Ecology. She has extensive experience with sustainability and resilience planning and coordination with city, county, regional, and federal government agencies. She has also collaborated with NASA on several projects to build capacity for Earth observation use for stormwater management.

UNDERSTANDING NITROGEN DYNAMICS AND ITS FATE IN INORGANIC FORMS IN SANDY SOILS UNDER A COVER CROP SYSTEM IN FLORIDA

***Juma Bukomba*[1]**, *Mary Lusk*[1], *Gabriel Maltais-Landry*[2] *and Yuncong Li*[3]
[1]University of Florida, Gulf Coast Research and Education Center, FL, USA
[2]University of Florida, Gainesville, FL, USA
[3]University of Florida, Tropical Research and Educational Center, FL, USA

Florida continues to experience water quality impairments from excess nutrient pollution, especially from nitrogen (N) and phosphorus. Causes include loss of nutrients due to leaching, soil erosion and stormwater runoff from agricultural and urban areas. The incorporation of cover crops in agricultural cropping systems may be considered as a solution to reduce this problem. The overall objective of this study is to increase the understanding of soil inorganic N cycling in sandy soils with cover crops and to examine how cover crops influence soil N fertility and crop yields. The two-year experiment is being carried out in a vegetable system with four cover crop treatments: sunn hemp (SH), sorghum sudangrass (SS), a 50/50 mixture of sunn hemp and sorghum sudangrass (MX), and a weed fallow that serves as a control (CT). Soil samples are collected at depths of 0-15cm, 15-30cm and 30-60cm and analyzed for KCl extractable NO_3^- and NH_4^+ as well as for net-mineralization and nitrification following cover crop incorporation into the soil. Plant tissue samples are being analyzed for total N and C. Average total N in the plant tissue for SH, SS, MX, and CT was 31, 10, 31 and 18 mg/g respectively. C:N ratio was highest in SS biomass (42) and lowest in SH (13). Preliminary results also indicate that inorganic N (especially NO_3) generally decreased with soil depth across treatments and continuing work is focused on quantifying net mineralization and nitrification after cover crop incorporation, with the goal of assessing N availability and potential leaching among the treatments.

<u>PRESENTER BIO</u>: Mr. Juma Bukomba is a third-semester M. S. student at University of Florida. He has been passionate about reducing nutrient losses from agricultural fields into water bodies for instance his bachelor's project focused on using biocarbon from pineapple residues to reduce nutrient leaching from the soil.

BIOSOLIDS APPLICATIONS AND NUTRIENT EXPORT IN TRIBUTARY WATERSHEDS OF THE UPPER ST. JOHNS RIVER

Andy Canion[1], *Vickie Hoge*[1], *John Hendrickson*[2], *Thomas Jobes*[1], *Dean Dobberfuhl*[1]

[1]St. Johns River Water Management District, Palatka, FL

[2]Fernandina Beach, FL, USA

Biosolids are beneficially used to supplement or replace fertilizer in agricultural production throughout the world. Approximately two-thirds of the biosolids generated in Florida are Class B, the majority of which are applied to pastureland. In 2013, new rules governing Class B biosolids disposal within the Okeechobee, St. Lucie, and Caloosahatchee watersheds led to a migration of applications into the Upper St. Johns River Basin (USJRB), resulting in the USJRB receiving approximately 70–80% of all Class B biosolids in the state. In order to evaluate the potential impact of this shift in applications, the timing and magnitude of Class B biosolids land applications and fluxes of total phosphorus (TP) and total nitrogen (TN) in seven USJRB tributaries were examined using the Weighted Regressions on Time, Discharge, and Season (WRTDS) approach. Increases in TP fluxes were observed during periods of intensified Class B biosolids applications; however, TN fluxes were stable across all tributaries over the period of analysis. The estimated total increase in mean annual TP flux for the seven USJRB tributaries in the present study was estimated to be 36 metric tons. Annual mass losses between 0.4–3.4 % of biosolids TP would be required to produce to observed trends in TP flux in each watershed. Although biosolids applications were within regulatory requirements, applications based on crop N requirements rather than P and the focusing of the majority of the state's Class B biosolids into one basin likely led to the observed increases in TP flux. In addition to new rules implemented by the Florida Department of Environmental Protection (FDEP) to limit excess P application, the St. Johns River Water Management District has begun a multi-year, FDEP-funded project to examine in-field P fate and transport, remediation of legacy P, and modification of wastewater treatment processes to better manage biosolids P.

PRESENTER BIO: Dr. Canion is a supervising environmental scientist with 15 years of experience in water quality analysis, biogeochemistry, and phytoplankton ecology. In his present position, he leads a team whose projects include lake and wetland restoration and water quality improvements.

IRRIGATION SAVINGS FROM SMART IRRIGATION TECHNOLOGIES AND A SMARTPHONE APP ON TURFGRASS

Bernardo Cárdenas*, Michael D. Dukes and Kati W. Migliaccio*

University of Florida, Gainesville, FL, USA

A plot study comparing a variety of irrigation scheduling technologies was conducted in Gainesville, Florida, from 2015 to 2017. The study objectives were to compare the ability of different irrigation scheduling technologies to: (1) bypass scheduled irrigation cycles; (2) decrease water application depth; and (3) compare water savings, if any. Ten irrigation scheduling treatments were investigated, including three soil moisture sensor-based treatments (SMS), three weather or evapotranspiration-based treatments (ET), and two smartphone app-based treatments (APP). Also included were two time-based irrigation schedules: a without sensor feedback (WOS) [the main comparison treatment] and a non-irrigated treatment. Significant differences in turfgrass quality among treatments (including non-irrigated) were not observed during the testing periods, which tended to be wetter than normal. The SMS treatments saved water by bypassing scheduled irrigation cycles, the ET treatments saved water mainly through lower application depths, while the APP treatments saved water through a combination of bypassing and applying lower irrigation depths. Compared to WOS, the SMS, ET, and APP treatments achieved water savings of 51% to 63%, 28% to 66%, and 51% to 63%, respectively, depending on treatment specifics and testing year. Inclusion of additional practices, such as a split irrigation strategy (half in the morning and half in the evening) and seasonal deficit irrigation, were shown to be advantageous in an area where rainfall is frequent and a substantial contributor to plant water needs. The payback period for the evaluated scheduling technologies ranged between 0 and 12 months. Financial and practical considerations should be included when recommending or acquiring one of these irrigation scheduling technologies.

PRESENTER BIO: Mr. Cárdenas is a research associate at UF with more than 18 years of experience in irrigation water conservation. He has contributed to create standards for the Irrigation Association and the EPA WaterSense program and has participated in different multidisciplinary and multi-state projects. He has published consistently in peer-reviewed journals.

ENERGY EFFICIENCY ASSESSMENTS OF WASTEWATER TREATMENT PLANTS IN FLORIDA

Cristian Cardenas-Lailhacar *and S.A. Sherif*
University of Florida, Gainesville, FL, USA

Wastewater treatment plants (WWTPs) play a fundamental role in our society. Water recycling helps the environment and contributes to reducing waterborne diseases. Processes performed in WWTPs vary, but typically include headworks, grit removal, mixing, clarifying, nutrients removal, filtering, disinfection, discharging to local water bodies or open fields, and handling and proper disposal of solid objects. In some plants biogas is generated. Although wastewater treatment is a mature technology, there is significant potential for improvements from an economic and energy efficiency perspectives.

In this presentation, energy consumption, waste management, and productivity data from 15 WWTPs in Florida are presented. The plants range in their processing capacity from 5.5-55 million gallons/day (MGDs) of wastewater treated. For all plants, an energy use baseline has been established to benchmark against expected best practices. Several assessment recommendations (ARs) have been identified. These ARs were all evaluated technically and also to ensure a speedy payback on proposed improvements. Areas of potential improvements included motors, pumps, aerators, blowers, lighting, compressed air systems, occupancy sensors, disinfection systems, boilers, combined heat and power systems, biogas utilization and processing, insulation, heat recovery, photovoltaic systems, power generators, nutrients recovery, and energy management systems. It was observed that the electric energy rate structure has a significant impact on the operational costs of WWTPs. It was also observed that some equipment run a fraction of the annual hours of operation. Plants that further treat their sludge when biogas is being generated onsite can produce biofertilizers of high grade and can sell it for profit. The overall cost savings for all 15 WWTPs studied was as high as $15 million, with an associated reduction in energy consumption of 18% per plant. Adoption of Internet of Things (IoT) linked to a SCADA system can provide promising opportunities for overall process optimization.

PRESENTER BIO: Dr. Cardenas-Lailhacar is an associate research scientist in the Department of Mechanical and Aerospace Engineering at the University of Florida. He has more than 20 years of experience in energy management. He has led over 300 energy audits to manufacturing facilities in the US and Latin America.

DOCUMENTING FLOOD OCCURRENCE AND EXPOSURE

Christine L. Carlson
South Florida Water Management District, West Palm Beach, FL, USA

The South Florida Water Management District (SFWMD) is initiating efforts to compile Districtwide flood damage exposure and flood occurrence data to support model validation and flood damage cost projections for the Flood Protection Level of Service Program (FPLOS) and trend analysis for the flood occurrence Resiliency Metric. Exposure data requires building footprints with first floor elevations and occupancy type, local and highway road information including number of lanes, critical infrastructure, and ground elevations. Flood damage functions require depreciated structure and content replacement costs. Flood occurrence data requires geo-located depth and duration observations. In a utopian data universe, it would not be a challenge to compile such data because the data would be normalized and accessible for use and exportable through a single interface and the tools needed to record flood observations would be standardized and available statewide. However, Florida is not a utopian data universe, and this lack of uniform information will limit what can be modeled and assessed at the regional, state, and national level. The good news is we can build this utopian data infrastructure through collaboration. Some of this collaboration is ongoing in the State Geographic Information Office and the Florida Department of Emergency Management. To build on this and support Resiliency Planning in South Florida, standardized requirements for exposure and flood occurrence data, funding for state and local initiatives to compile these data, and regional or statewide data acquisition and assessment tools are needed. SFWMD has developed a flood occurrence application and a flood damage assessment tool and is proposing consideration of these tools for regional or statewide use.

PRESENTER BIO: Christine Carlson leads a team of geospatial professionals in the development and maintenance of enterprise geospatial data and the deployment of geospatial products and tools. During her 30-year + career, she has worked in a variety of capacities and fields including modeling, restoration evaluation, and remote sensing.

IMPROVING THE PREDICTION OF SEDIMENT PARTICLE SIZE FOR ENGINEERING VEGETATIVE FILTER STRIPS

Stefan Reichenberger [1], Robin Sur [2], Stephan Sittig [3], Sebastian Multsch [3], ***Alvaro Carmona-Cabrero[4]****, JJ López [5] and Rafael Muñoz-Carpena [4]*

[1]Knoell France SAS, Lyon, France
[2]Bayer AG, Monheim, Germany
[3]Knoell Germany GmbH, Mannheim, Germany
[4]University of Florida, Gainesville, FL, USA
[5]Public University of Navarra (UPNA), Pamplona, Spain

Vegetative Filter Strips (VFS), areas of dense vegetation implanted between a disturbed source area (agricultural or urban) and receiving surface water body, are one of the most used mitigation measures to reduce pesticides and other runoff pollutants. One of the means of transport of these substances is by the mobilization of eroded sediments on which the chemicals are adsorbed to, after sediment detachment by the kinetic energy of the rain or irrigation. VFS reduce the overland flow speed and facilitate sedimentation and soil infiltration, effectively reducing the surface pesticide load arriving to water bodies. When modeling the required VFS characteristics to achieve a desired pesticide reduction level, an important controlling factor is the median particle diameter (d50) of the eroded sediment entering the VFS. However, d50 measurements are rare and costly to obtain. Current methods to estimate expected d50 values consider d50 as a fixed property depending on the soil characteristics (texture and organic matter) in the source area, disregarding complex hydrological and sedimentological processes that in fact result on dynamic d50 values at the same location during different runoff events. To incorporate these complex dynamics in the d50 estimation, a new dimension-reduction approach is developed consisting of a compilation of a detailed database of existing d50 data with over 30 potential predictors, artificial intelligence (machine learning, ML) as an interpolator of the dataset, global sensitivity analysis (GSA) using the ML interpolator for high-dimensional variance-decomposition of the dataset and selection of important variables and their interactions, and regression modeling on the reduced subset of important variables. Firstly, the relationship of the predictors and the d50 is explored through two tree ML ensembles (random forest and extreme gradient boosting). To prove the ability of this method to identify interactions among the predictors, a test case is presented in which data generated from a highly non-linear function under different noise assumptions is fitted with tree ensembles and the sensitivity measures are compared to those produced by GSA and the analytical solutions. A generic multiple linear regression (MLR) d50 equation is proposed from a compiled dataset of d50 measures and predictors with high prediction (NSE=0.8). The resulting d50 equation has been implemented in the next version of the vegetative filter strips model VFSMOD and coupled within the tool SWAN for pesticide exposure assessment used in the EU regulatory approval process.

PRESENTER BIO: Alvaro is a 3rd year PhD student at the Agricultural and Biological Engineering Department, UF. He holds a MSc in Hydrology, and his current research focuses on complex system modeling and analysis through computer simulations and machine learning, especially in environmentally driven human migration.

THE EFFECT OF TRAINING METHODOLOGY ON MACHINE LEARNING MODELS FOR ESTIMATING NUTRIENT CONCENTRATIONS

***J. Barrett Carter**, Eban Bean, and Aditya Singh*
Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL, USA

Machine learning (ML) techniques have the potential to drastically improve the study and management of water resources. However, the development of an effective and reliable ML model requires adequate training and evaluation steps, and while the use of machine learning techniques for multivariate regression has increased drastically in recent years, there is no standard procedure for training and evaluating ML models. This places a limitation on the advancement and application of ML techniques in practice. Given that there are multiple steps in the training and evaluation of a ML model, which can include a combination of randomized resampling methods such as K-fold cross validation, bootstrap, and jackknife, a slight modification to the organization of these steps could have significant implications on the final assessment of the model and its comparison to other models. This hypothesis was tested by implementing three training and evaluation architectures to produce ML models for estimating stream nitrate and phosphate concentrations from UV-Visible absorbance spectra collected from 171 stream samples. Model performances resulting from different architectures were then compared statistically and graphically to assess the impacts of training methodology on model performance. The results from this study may be used to guide researchers towards a path of more transparent and standard procedures for the development of ML models, which could ultimately help to improve the reproducibility and reliability of such techniques when used in practice such as in water resource management applications.

PRESENTER BIO: Barrett Carter is a third-year Ph.D. student specializing in estimating water quality parameters using UV-Visible spectroscopy. Barrett earned Bachelor's and Master's degrees in Biological Engineering from the University of Arkansas and has a total of six years of experience working as a research assistant at the undergraduate and graduate levels.

ASSESSING IMPACTS OF DEFORESTATION ON WATER QUALITY IN AGRICULTURAL LANDSCAPE IN INDIANA

***Shourish Chakravarty**[1], Yangyang Wang[2], Mo Zhou[3] and Eva Haviarova[3]*
[1]UF IFAS-SWFREC, Immokalee, FL, USA
[2]The Nature Conservancy, IN USA
[3]Purdue University, IN USA

Indiana is primarily an agricultural state with about half of its land utilized for growing crops, mostly in the northern region. High concentrations of nitrogen, phosphorus, and pesticide residues due to agricultural runoff not only deteriorate the quality of surface and ground water within the state, but also contribute to pollutions as far as in the Gulf of Mexico. Forests in this intensive agricultural landscape, therefore, play a pivotal role in reducing runoff and purifying water, especially in areas with high hydrogeologic and aquifer sensitivity. Total forest cover in Indiana has slightly increased between 2008 to 2018, suggesting net afforestation. However, a closer examination reveals that the patterns of forest cover change have been spatially and temporally heterogenous, particularly between 2014 and 2018. While the largely forested southern region has witnessed a steady climb in the forest area, the northern region where agriculture is concentrated has experienced considerable forest loss owing to cropland expansion, predominantly of corn and soybean. The overarching goal of this proposed study is to assess the impact of forest cover change in Indiana's agricultural landscape from 2008 to 2018 on retention of nutrients from farm runoffs. Our study has two specific aims: 1. To pinpoint times, locations, and magnitudes of deforestation in the intensive agricultural landscape in Indiana from 2008 to 2018, using data from USDA's Cropland Data Layer (CDL); 2. To estimate deforestation impacts on water quality due to agricultural runoffs at the watershed level, with the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model. The InVEST model uses, in addition to the land cover data, other geospatial datasets and user-defined nutrient export and filtration coefficients to estimate pixel-level nutrient export and retention magnitudes. They are then aggregated to 10-digit watershed boundaries, enclosed within Indiana.

<u>PRESENTER BIO</u>: Dr. Chakravarty is a postdoctoral scholar at UF-IFAS' SWFREC in Immokalee, Florida. His interests are in agricultural and natural resource economics and water quality.

INTEGRATED MODELING OF CARBON AND NITROGEN CYCLING IN RIVER CORRIDORS AND WATERSHEDS

***Xingyuan Chen**[1], Kyongho Son[1], Pin Shuai[1], Yilin Fang[1], Peishi Jiang[1], and Jesus Gomez-Velez[2]*

[1]Pacific Northwest National Laboratory, Richland, WA, USA

[2]Vanderbilt University, Nashville, TN, USA

Process-based watershed models that couple subsurface, land-surface, and energy budget processes are highly desired at the watershed and basin scales to answer a wide range of science questions. The river corridors play important roles in watershed carbon and nitrogen cycling and the removal of excess nutrients. At basin scales, the incorporation of hydrologic complexity and molecular information on microbiome structure (i.e., species composition and distribution of enzyme-encoding genes), microbial expression (i.e., RNA transcription and protein translation), and metabolomes (i.e., reactants and products) will greatly improve a river corridor model (RCM) in capturing distinct water quality signatures across variations in land use, hydrogeology, climate, and disturbances. We have developed an RCM that resolves reactions occurring in both the water columns and in the river corridors as impacted by the hydrologic exchange flows (HEFs). Applying this RCM to the Columbia River Basin (CRB), we found that the physical properties influencing HEFs and land use are the primary controls of the spatial variability in river corridor denitrification. Next, we will enhance the mechanistic foundation of the RCM by linking dynamic river flow processes and heterogeneous terrestrial inputs with variable temperatures and reaction kinetics (informed by molecular properties) to investigate water, energy, and solute fluxes across the river-groundwater interface under both baseline and post-fire conditions. Our approach can be generalized beyond CRB and applied to other basins facing environmental disturbances and water challenges of national significance.

PRESENTER BIO: Dr. Chen is a senior Earth scientist at the Pacific Northwest National Laboratory. Her research focuses on understanding and predicting how watershed and river corridor systems respond to various anthropogenic and environmental disturbances, including dam operations, agricultural activities, and extreme climate events (e.g., wildfires, flooding, etc).

RESPONSES OF MICROBIAL COMMUNITIES TO HEAVY METAL CONTAMINATIONS IN LAKE TALQUIN

Jade Cherry[1]*, Makayla Hightower*[2]*, Andy Strickland*[3]*, Johnny Grace*[4]*, Lekan Latinwo*[1] *and Omolola Betiku*[2]

[1]Department of Biology, Florida Agricultural and Mechanical University, Tallahassee, FL USA

[2]College of Agriculture and Food Sciences, Florida Agricultural and Mechanical University, Tallahassee, FL USA

[3]Fish and Wildlife Commission, Quincy, FL USA

[4]Forest Service, Center for Forest Watershed Research, Southern Research Station, Tallahassee, FL USA

Contamination of community water with heavy metals is a major public health issue because the high concentration of these contaminants is detrimental to the aquatic ecosystem, humans, and livestock whose livelihood depends on a continuous supply of quality water. Mercury (Hg) contamination has been the primary pollutant in Lake Talquin, and the 2021 advisory recommendation by the Florida Department of Health limits the number of fish consumed from the lake. To provide a comprehensive assessment of Hg and other heavy contaminants in the lake, we investigated how season and habitat section, and conditions influence heavy metal concentrations and how microbial communities respond to these factors. Our current results showed higher and significant differences in the pH ($P<0.0001$), total Kjeldahl nitrogen (TKN) ($P<0.0001$), and ammonium hydroxide (NHO4) ($P<0.0001$) between the upper and lower sections of the lake. Likewise, concentrations of Al ($P<0.0001$), Mg ($P<0.0001$), and Fe ($P<0.001$) are significantly different. Interestingly, Hg concentration differed significantly in Bluegill and largemouth bass tissues ($P<0.005$). Our study confirms the presence of heavy metal contaminants, particularly Hg, in Lake Talquin. Information about how the contaminants influence the microbiota will be presented.

<u>PRESENTER BIO</u>: Jade Chery is a graduate student in the Department of Biology. She finished her undergraduate degree in Biology from FSU in 2019. She is a currently working on her master’s degree under Drs. Latinwo and Betiku. Jade is planning to pursue a medical degree after graduation.

QUANTIFYING THE EFFECTS OF NATIONAL WATER MODEL PREDICTION ERROR ON NEARSHORE HYDRODYNAMIC FORECASTS IN SOUTHWEST FLORIDA

*David Kaplan, **Nicholas Chin**, Maitane Olabarrieta, Luming Shi*
University of Florida, Gainesville, FL, USA

Observed streamflow data serve many scientific and social purposes, including as a validation of predictive hydrological and ecological models. The majority of stream reaches in the continental United States (CONUS) remain ungauged, however, constraining the development of models and analyses that require streamflow data. In the absence of flow data, the National Water Model (NWM) provides simulated streamflow over the CONUS at ~2.7 million stream reaches. The NWM has been validated with data from ~7000 USGS gauges, but its predictive performance can vary widely based on geographic region and drainage area. Critically, the impact of poor NWM performance depends strongly on the intended use of flow predictions. In this work, we assess NWM predictions in the context of their impact on simulations of a Coupled Ocean Atmospheric Wave Sediment Transport (COAWST) model developed to forecast coastal hazards in southwest Florida, where harmful algae blooms (HABs) have become more frequent and severe in recent years. Medium-range (72-hour) NWM forecasts for stream reaches discharging to Charlotte Harbor were compared to corresponding USGS streamflow gauges, and model skill was assessed using the Nash-Sutcliffe Efficiency (NSE), Percent Bias (PBIAS), and Pearson's correlation coefficient (r) during wet and dry seasons. NSE ranged from 0.11 to 0.61, PBIAS ranged from -53.7 to 55.3, and r ranged from 0.60 to 0.86 for available stations. Streamflow predictions were generally more accurate for high-discharge rivers and during wet seasons. Using observed rather than NWM-simulated streamflows as inputs into the COAWST model of the Charlotte Harbor Estuary, yielded improved model goodness of fit, especially for salinity and flow stratification in the dry season, which can be critical for estuarine biogeochemistry and ecology. These results highlight the importance of developing improved freshwater flow predictions for both gauged and ungauged streams draining to the coast in support of coastal hazard modeling.

PRESENTER BIO: Nicholas Chin is an Environmental Engineering PhD student working in the Watershed Ecology Lab. His interests include using machine learning and mechanistic modeling to study coastal watersheds.

TRIBAL COMMUNITIES AND WATER ISSUES- SPECIAL SESSION

Session organizers: Paloma Carton de Grammont[1], Kati Migliaccio[2], Matthew Whiles[3]
Speakers: ***Steven Chischilly***[4], ***Abhishek RoyChowdhury***[4], ***Stacy Myers***[5], ***Joe Frank***[5], ***Houston R. Cypress***[6], ***Amelia Winger-Bearskin***[7]

[1] University of Florida, Water Institute, Gainesville, FL, USA
[2] University of Florida, Department of Agricultural and Biological Engineering, Gainesville, FL, USA
[3] University of Florida Soil and Water Sciences Department, Gainesville, FL, USA
[4] Navajo Technical University, Crownpoint, NM, USA
[2] Seminole Tribe of Florida, Hollywood, FL, USA
[3] Love the Everglades Movement, Ochopee, FL, USA
[4] University of Florida Digital Worlds Institute, Gainesville, FL, USA

For Native American communities, water is sacred. Water sustains their cultures, ceremonies, livelihoods, and beliefs. Indigenous people have a deep understanding of water's spatial and temporal distribution, its quality, and its use. Although water issues directly (and disproportionately) impact the livelihoods of Native American communities, the voices of Indigenous people are traditionally excluded from forums like this Symposium. This special session aims to bring attention to some of the water challenges facing Native American communities, specifically the Navajo Nation, the Seminole Tribe of Florida, and the Miccosukee Tribe of Indians of Florida, and convey how solutions to these water challenges benefit from Indigenous perspectives and place-based knowledge.
This session contains three separate 30-minute presentations. In the first block Steven Chischilly and Dr. Abhishek RoyChowdhury from the Navajo Technical University will address how water quality on the Navajo Nation has contributed to the spread of Covid-19. The second presentation by Stacy Myers and Joe Frank will talk about Everglades restoration and water resource issues affecting the Big Cypress Reservation, including a policy and historical framework and a focus on environmental justice. Finally, Houston Cypress and Amelia Winger-Bearskin will have a conversation about Water protection from artists' and activists' perspectives.

This session has been sponsored by the IFAS VP Office & IFAS Research Office

Bios:

STEVEN CHISCHILLY: is Associate Professor of Environmental Science and past Chair of the Science Department and at Navajo Technical University. His research focuses on Climate Change and has served on the NIH Advisory Board for Minority Populations, the Native American STEM Advisory Board, and as an AISES advisor.
Abhishek RoyChowdhury is Assistant Professor of Environmental Science at Navajo Technical University. He specializes in the fields of environmental geoscience and sustainable energy production.
Stacy Myers is a Snr. Scientist and Liaison, Heritage and Environment Resources Office, Seminole Tribe of Florida. In this role he is the primary agency contact for all major Water Resource and Environmental Projects with Federal and State Agencies.
Joe Frank is a Representative of the Seminole Tribe of Florida Big Cypress with extensive expertise in South Florida Water issues and overall Tribal concerns with changes to the environment.
Reverend Houston R. Cypress is a Member of Miccosukee Tribe, Two-Spirit person, poet, artist, environmental activist, and ordained minister. He is a founder of Love The Everglades Movement.
Amelia Winger-Bearskin is a Banks Family Preeminence Endowed Chair and Associate Professor of Artificial Intelligence and the Arts at UF's Digital Worlds Institute, inventor of Honor Native Sky, a project for the U.S. Department of Arts and Culture: Honor Native Land Initiative. She is Haudenosaunee (Iroquois) of the Seneca-Cayuga Nation of Oklahoma, Deer Clan.

A COMPARISON OF RELATIONSHIPS WITH NATURE AMONG WATER STAKEHOLDERS IN NORTH FLORIDA

Natalie A. Cooper[1], *Martha C. Monroe*[2]
[1]University of Florida, Gainesville, FL, USA
[2]School of Forest, Fisheries, and Geomatics Sciences, University of Florida, Gainesville, FL, USA

In North Florida, environmental organizations and farmers often disagree about the role of agriculture in Floridan aquifer water quality management. This dissonance intensifies in areas like the Santa Fe and Suwannee River watersheds where the aquifer is unconfined and more vulnerable pollution. Stakeholders may not only disagree about management decisions but also the nature of the problem and which facts are valid. Why? Environmental problems can escalate into conflicts because of differences in values and identities, or in other words, latent variables that aren't easily observed. Identities, or a person's sense(s) of self, develop over the long term, and researchers of environmental conflicts have revealed that identity is a frequent contributor to inter-group conflict. Understanding human-environment relationships – including the values, worldviews, and identities rooted in and intertwined with lived experiences and frequent outdoors exposure – of key stakeholders may provide insight into why perceptions related to water issues and management diverge and converge.

We explored human-environment relationships of rural producers and environmental professionals by examining individuals' connection to nature and development of environmental identity, or the extent to which individuals self-identify with the natural environment. How do conceptions of nature, sustainability, and stewardship; interactions with the outdoors; and ideologies around the environment compare? What do similarities and differences reveal about and/or contribute to communication barriers and conflict around water governance and management?

We conducted semi-structured interviews with farmers (n=10) and environmental professionals (n=11) in the North Florida region from May to August 2021. Interviews were recorded and transcribed, and qualitative analysis involves thematic coding with a combination of deductive codes retrieved from the literature as well as inductive codes that emerge from interviews. Results will be shared at the conference. This research will enhance efforts to effectively communicate to and engage diverse stakeholder groups about water issues and solutions.

PRESENTER BIO: Natalie A. Cooper is a PhD candidate in Forest Resources and Conservation at the School of Forest, Fisheries, and Geomatics Sciences, University of Florida. Her research combines conservation psychology, communication, and sustainable rural livelihoods to understand perspectives in natural resource management, especially among resource users.

REGIONAL, PASSIVE SALINE ENCROACHMENT IN THE SPRINGS OF FLORIDA (1991 – 2020)

Rick Copeland*, Gary Maddox, and Andy Woeber*
AquiferWatch Inc., Tallahassee, FL USA

Due to awareness of degrading groundwater quality in Florida's freshwater springs and beginning in the early 1990s, the state's water management districts, the Florida Department of Environmental Protection, and the U.S. Geological Survey began efforts to coordinate monitoring of Florida's first- and second-magnitude springs. This study investigates how spring discharge and two saline indicator concentrations changed from 1991 through 2020 (30 years) in the Floridan aquifer system (FAS), underlying all of Florida. Data were obtained from 32 major springs and three additional stream discharge gaging stations. During the study period, discharge decreased, while concentrations of sodium as Na^+ and chloride as Cl^- increased. As a group, the FAS springs experienced passive saline encroachment. Not only did encroachment occur along Florida's coasts, but also in the interior of the state. The rate of change for the median concentrations of sodium and chloride increased by an estimated range of seven to eleven percent per decade. Three potential drivers of the observed changes were investigated: declining rainfall and subsequent declines in recharge, groundwater extraction, and sea-level rise. Evidence suggests the major driver is decreasing rainfall and subsequent declines in recharge to the FAS, followed by sea-level rise. The sources of the saline water are from salt water near Florida's coasts and relict sea water from the deeper portions of the FAS. The observed changes are in line with those predicted by the Ghyben-Herzberg principle in coastal, carbonate aquifers.

PRESENTER BIO: Dr. Rick Copeland is the Director of AquiferWatch Inc. He has over 40 years of experience as a hydrogeologist. He established numerous networks to monitor water quality and has administered Florida's statewide groundwater and surface water monitoring networks. He has authored many papers regarding the analyses of water quality.

MEASURING THE IMPACT OF FLORIDA RED TIDE EVENTS ON RECREATIONAL FISHING EFFORT AND EXPENDITURES

Bijeta Bijen Saha, Xiaohui Qiao, and ***Christa D. Court***
University of Florida, Gainesville, FL, USA

The Northern Gulf of Mexico and communities that it supports are vulnerable to harmful algal blooms (HABs) that can adversely affect the biophysical environment and in turn, the commercial and recreational activities that depend on the resources and amenities that it provides. Although the impacts of HABs, including those caused by *Karenia brevis* – commonly known as Red Tide, on the marine environment are well studied, it remains difficult to quantify the ensuing socioeconomic impacts of these events. The identification and quantification of any change or impact in activity that can be attributed to a Red Tide event requires the support of a long-term data set collected using similar spatial and temporal densities over time. In situ observations of *K. brevis* abundance published within the HAB monitoring database from the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) and data on recreational fishing effort and expenditures available within the Marine Recreational Information Program (MRIP) datasets from the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) are used to estimate the impacts of Red Tide events on recreational fishing effort along Florida's western coast. Results indicate a causal relation between Red Tide events and changes in recreational fishing activity and suggest that Red Tide events are associated with a decrease in fishing trips. The estimated change in number of trips is combined with data from the Marine Recreational Fishing Expenditure Survey, published by NOAA fisheries, to estimate the change in direct expenditures as well as the broader regional economic impacts associated with this decline in recreational fishing activity. These results can be used to inform local, state, and federal level decisions related to the prevention and mitigation of recurring Red Tide events in the Gulf of Mexico region.

PRESENTER BIO: Dr. Court is an Assistant Professor of Regional Economics in the Food and Resource Economics Department at the University of Florida and directs the UF/IFAS Economic Impact Analysis Program. Her current research and extension programs are focused on regional economic impacts of natural and human-induced hazard and disaster events.

INNOVATIVE WATER RESOURCES PROJECTS THROUGH ALTERNATIVE DELIVERY METHODS

***Ernie Cox*[1]**, *Tom Wilson[2] and Sara Phelps Ph.D.[3]*
[1]Family Lands Remembered, LLC, Jupiter, FL, USA
[2]Phillips & Jordan, Inc., San Antonio, FL, USA
[3]Wood Group, Gainesville, FL, USA

Florida has significant water resources challenges that need to be addressed soon. Protecting and enhancing our underground aquifers, rivers, and streams are all necessary to meet Florida's need for green infrastructure and spend the billions of dollars being allocated. As Florida's population grows from 21 million people to potentially 35 million people by 2070, sustainable water resources are critical, including water availability for those people, for agriculture, for industry, and for the environment.

Adding to this challenge, certain factors have reached a tipping point – algae blooms, red tide, sea level rise, sewage spills, water shortages, aging infrastructure, etc. - and immediate action is necessary. The present system of government projects, including traditional design, bid, build processes, along with single-use projects, will not meet all of the needs in the time frame that Florida requires. One potential tool is alternative delivery methods, such as public-private partnerships. Coupled with innovative multi-use projects that include a number of public benefits, alternative or collaborative delivery methods can improve stakeholder engagement and public perception of a project while helping Florida meet these challenges in time to make a difference.

This presentation will focus on two case studies of innovative multi-use projects using collaborative alternative delivery methods.

The C-51 Reservoir Project is a collaboration between utilities and local governments throughout South Florida, along with state and regional agencies and the private sector, to capture harmful discharges to tide, store the water and then use it to recharge the aquifer for public water supply and for environmental purposes.

The 4G Ranch Beneficial Reuse Project is a collaboration between Pasco County, state and regional agencies and the private sector to create new wetlands, recharge the aquifer and restore existing depleted wetlands. Both involve alternative delivery methods to design, permit and implement these regionally significant water resource projects.

PRESENTER BIO: Ernie Cox has degrees in Geology, Economics and Law from the University of Florida. His innovative conservation, sustainable development and water resource projects include the Collier County and St. Lucie County Rural Land Stewardship Areas, Hatchineha Ranch, Babcock Ranch, Farmton/Deering Park, C-51 Reservoir and the 4G Ranch Beneficial Reuse Project.

MICROWATERSHED ANALYSIS AND MANAGEMENT: FLORIDA RESIDENTIAL LAKE CASE STUDIES

Stephen Curless[1], *Jay Madigan*[2]
[1]CCI Engineering Services, Columbus. OH USA
[2]Lake Cane Restoration Society, Orlando, FL, USA

There has been much attention in the last few decades to the damage to freshwater sources due to algal-bloom driven eutrophication, much of this focus has been on vectors driven by agricultural, industrial and stormwater drainage into the major watersheds, the everglades and emptying into gulf. However, there are more than 30,000 freshwater lakes in Florida alone that exist within isolated micro-watersheds.

The use of aerial and bathymetric drone technology can provide local communities with the data the required to manage the health of their local lakes. The Lake Cane Restoration Society (LCRS) has taken leadership in demonstrating to local communities how they can improve lake management and share their experiences between different communities in Florida.

Early in 2021, five Florida Lakes (Lake Cane, Lake Horseshoe, Like Minnie, Lake Hiawassee and Lake Chapman) took part in a case study to utilize drone technology to map the local micro-watershed topography to centimeter-level accuracy, map the lake bottom topography using single and dual-band sonar to capture both the hard bottom and softer silt bottom surfaces. The drone also collected temperature, turbidity, dissolved oxygen, and pH levels. Infrared measurements captured NDVI vegetive vigor and identified thermal anomalies for subsurface water migration from local septic systems or hot spring sources. Unlike prior state of the art this effort captured hundreds of data points to model a digital twin of the lakes.

Design deliverables included detailed DEM and contour maps for mapping watershed and identifying best active measures to control and filter runoff from impervious surfaces. Additional analytics were NDVI vigor maps and detailed HD photos for identification of high nutrient pathways from runoff and to support invasive species mapping. GIS was used to map spot measurements taken by the bathymetric drone that will be used to measure trend data with future data collection efforts.

PRESENTER BIO: Stephen Curless, System Analyst for CCI Engineering services, has been the led the data collection and analysis for the Florida Lake Case Study development in partnership with the LCRS. Stephen has over 20 years of experience in data analysis, simulation, imaging, GIS and database engineering.

STAMPING OUT HABS: MATERIALS AND METHODS FOR TRAINING AN AI CLASSIFIER FOR HAB DETECTION

***Robert Currier**, Barbara Kirkpatrick*
Texas A&M University Department of Oceanography/GCOOS-RA

Blooms of the toxic microalga *Karenia brevis* occur seasonally in Florida, Texas and other portions of the Gulf of Mexico. Brevetoxins produced during *Karenia* blooms can cause neurotoxic shellfish poisoning in humans, massive fish kills, and the death of marine mammals and birds. Brevetoxin-containing aerosols are a problem, having a severe impact on beachgoers, triggering coughing, eye and throat irritation in healthy individuals, and more serious respiratory distress in those with asthma or other breathing disorders. The blooms and associated aerosol impacts are patchy in nature, often affecting one beach but having no impact on an adjacent beach. To provide timely information to visitors about which beaches are low-risk, we developed HABscope; a low cost (~$400) microscope system that can be used in the field by citizen scientists with cell phones to enumerate *K*. *brevis* cell concentrations in the water along each beach. The HABscope system operates by capturing short videos of collected water samples and uploading them to a central server for rapid enumeration of *K*. *brevis* cells using calibrated AI recognition software. When deployed by volunteer citizen scientists, the HABscope consistently distinguished low, medium, and high concentrations of cells in the water. A primary impediment to developing classification models for new taxa is the lack of available imagery. We have created a toolkit that allows us to rapidly generate thousands of tagged images for the training and validation datasets. We use the images to build models based on our STAMP methodology. Rather than attempt to classify all detected objects we build single taxa models and iterate over them. This methodology allows us to easily develop new models that are optimized for a given taxa and that provide robust performance in the cloud and on the HABscopes. We currently have models for *Karenia brevis*, *Alexandrium monilatum* and *Pyrodinium bahamense*.

PRESENTER BIO: Robert Currier's affiliation is as a Research Specialist, Department of Oceanography, Texas A&M University. His primary area of expertise is ocean observation data management and visualization. Currier is the developer of HABscope (https://habforecast.gcoos.org), an automated phytoplankton classification tool that uses AI to detect and count Karenia brevis cells.

URBAN RIVERS AS SOCIAL-ECOLOGICAL SYSTEMS: AN EXAMINATION OF HISTORY & ECOLOGY IN THE MIAMI RIVER

Daniela Brigitte Daniele*, Erin F. Abernethy, Elizabeth P. Anderson*

Florida International University, Miami, FL, USA

Rivers have largely influenced human settlement and played significant roles in development of cities worldwide. Increasing urbanization has diminished the quality of lotic resources and altered the way in which humans connect and interact with rivers, converting free flowing rivers into heavily altered systems. The Miami River in South Florida, USA, provides a model case for examining urban rivers as social-ecological systems. We present an environmental history from 1500 to 2020 to examine how connectivity and water quality of the Miami River has changed over time. In its original extent, the Miami River is a five-mile-long river, and it is now a heavily altered system as a consequence of urban development and years of use as a dumping area. Research on urban rivers in general and the Miami River in particular is limited. To date, how urbanization of Miami and surrounding areas may have disrupted social and ecological riverine connectivity has not been studied. Data collected through by Miami Dade County show that the quality of the Miami River generally improved over the past 40 years. Improvement in water quality in the early to mid-2000s was likely linked to policies and restrictions towards dumping and discharging of pollutants, fertilizer runoff, and sewage in the river and the emergence of watchdog organizations. This research applied a mixed methods approach by integrating long-term water quality data, interview, observational, and archive data. This study will add to the growing knowledge of urban rivers as social-ecological systems, with a focus on historical changes and alterations of river connectivity and water quality.

PRESENTER BIO: Daniela was born in Argentina and moved to Miami when she was 7. She is now a master's student in Florida International University after obtaining her BA from the University of Florida. She focuses on urban rivers and has also done with urban soils. She enjoys studying thes Miami River ecosystem.

EVAPOTRANSPIRATION AND WATER DEMAND ANALYSIS FOR COFFEE FARMS IN THE UPPER SANTA MARÍA RIVER

Karoline Castillo[1], ***Conrado De León***[2] *and Richard Ortega*[1]
[1]Universidad de Panama, Centro Regional Universitario de Chiriquí, David, Panama
[2]RAMSAR Regional Center for the Western Hemisphere (CREHO), Clayton, Panama, Panamá

The Santa María River watershed is considered a priority watershed for its high economic and environmental importance in Panama. Coffee cultivation is one of the main productive systems that guarantees food security in the upper basin; however, the production of this crop has faced various challenges in the past years. Although water availability is considered to be enough at the watershed level, the water availability and precipitation patterns at field level present a notable spatial and temporal variability, without a certain understanding on specific water requirements. Irrigation systems are not commonly used in agricultural lands in this region, but its application is considered to potentially optimize agricultural production.

Evapotranspiration is a factor of great importance to understand water deficit and the necessity of an irrigation system. In this research, the evapotranspiration of coffee was analyzed to calculate the water demand in three coffee farms. Reference evapotranspiration (ETo) was estimated and compared using two methods: the Penman-Monteith method and ETo models from satellite images. Then crop evapotranspiration (ETc) was obtained to estimate the water requirements. ETo was obtained by analyzing data from meteorological stations and satellite images of the METRIC EEFLUX model, the comparison the data presented a coefficient of determination (R2) of 0.38. In calculating the irrigation requirements of the coffee plant, InfoStat was used for statistical analysis with data from the ETESA station at a probability of occurrence of 90% of ETo and precipitation, where lower values were found in December and higher in March (0.48 and 0.71 l / s / ha). These results suggest that in order to establish an optimal production of coffee in the dry season, it will be necessary to apply irrigation systems, since effective precipitation is not enough to supply water requirements.

PRESENTER BIO: Mgtr. De Leon is the Principal Investigator in the "Guaranteeing Water Security in the Mountain Forests and Wetlands of the Santa Maria River Basin" a 2.5-year research project on water allocation analysis. He holds a master's degree in Agricultural and Biological Engineering and a Bachelor of Environmental Engineering.

LEAST LIMITING WATER RANGE IN IRRIGATED SANDY SOILS OF NORTHEAST FLORIDA

***Judyson de Matos Oliveira*[1]**, *Fernando R. Bortolozo*[1], *Lincoln Zotarelli*[1], *Cássio Antônio Tormena*[2], *Allan Bacon*[1], *Júlio C. Pachon*[1]

[1]University of Florida, Gainesville, Florida, United States

[2]State University of Maringa, Maringa, Paraná, Brazil

Northeast Florida (NE) is an important vegetable production area with approximately 15,000 ha irrigated by subirrigation. The development of tools to assist growers with irrigation management will reduce water application, nutrient loss and enhance crop production. The optimum soil water content (θ) range for root growth can be estimated using the least limiting water range (LLWR) approach. The LLWR is defined by the limits between field capacity (soil water potential, ψ=-60 hPa), permanent wilting point (ψ=-15.000 hPa), air-filled porosity of 0.10 $cm^3.cm^{-3}$, and penetration resistance (PR=1.5 MPa). This study aimed to estimate the LLWR for subirrigated sandy soils under seepage and drain-tile. Five representative areas were selected from a total of twenty ones with particle-size distribution <250 µm (PSD_{fine}) ranged from 526-937 $g.kg^{-1}$. Sixty-six undisturbed soil samples were taken from 0-0.40 m soil depth in each area in which soil water retention (SWR) and resistance to penetration (SPR) curves were determined. In-situ θ monitoring of side-by-side seepage and drain-tile systems were performed during the 2020 potato season in two areas. The LLWR was estimated using a SWR and SPR models ($\theta=e^{(-3.1663+1.2235*Bd+0.0642*SOM+0.0006*PSDfine)}*\psi^{-0.3550}$;$p<0.0001$;$r^2=0.74$ and $PR=e^{(-4.9575+0.0676*SOM+0.0009*PSDfine)}*\theta^{(-0.311)}*Bd^{(8.9189)}$;$p<0.0001$;$r^2=0.91$, respectively), considering PSD_{fine} of 611 (lower) and 866 (upper) $g.kg^{-1}$, soil bulk density (Bd) range of 1.18-1.45 $g.cm^{-3}$ and SOM of 7.14 $g.kg^{-1}$ at the 0-0.20m soil depth. The LLWR was 0.02-0.12 and 0.02-0.13 $cm^3.cm^{-3}$ for lower and upper PSD_{fine} soils, respectively. The season-average θ±std for seepage was 0.15±0.16 for lower and 0.17±0.18 $cm^3.cm^{-3}$ for upper PSD_{fine}, while for tile-drain LLWR was 0.13±0.15 and 0.12±0.13 $cm^3.cm^{-3}$ for lower and upper PSD_{fine}, respectively. Seepage resulted in θ above the LLWR, while drain-tile led to better drainage control, resulting in θ falling within the LLWR for longer periods regardless of the PSD_{fine}. The LLWR can be used to enhance soil and water management of subirrigated areas of NE.

<u>PRESENTER BIO:</u> M.S. Judyson de Matos Oliveira is an Agronomist Engineer and, Ph.D. student in Agronomy. He has been working with modeling of soil physical-hydrologic processes for irrigation recommendation models improvements in vegetable production areas (US-FL). He has considerable experience with field trials development, data analysis, crop modeling, and laboratory analysis.

SIMULATING NITRATE TRANSPORT TO THE DEVIL'S SPRINGS COMPLEX USING SWAT-MODFLOW AND MODPATH

Rob de Rooij[1]*, Sagarika Rath*[2]*, Nathan Reaver*[2]*, Dogil Lee*[2]*, Wendy Graham*[1] *and David Kaplan*[3]

[1]Water Institute, University of Florida, Gainesville, Florida, USA

[2]Department of Agricultural and Biological Engineering, University of Florida, Gainesville, Florida, USA

[3]Environmental Engineering Sciences Department, University of Florida, Gainesville, Florida, USA

The overall objective of the USDA-NIFA funded Florida Aquifer Collaborative Engagement for Sustainability (FACETS) project is to gain insights into the tradeoffs between the regional agricultural economy and environmental quality. Within the framework of this project, we have developed a SWAT-MODFLOW model for the Santa Fe River Basin, Florida. The SWAT-MODFLOW code is well-suited for our objective as it is able to simulate crop growth, coupled surface-subsurface flow processes in watersheds as well as nitrate loadings. Nitrate transport through the subsurface can be simulated with SWAT-MODFLOW-RT3D. However, SWAT-MODFLOW-RT3D only provides the spatiotemporal variations in nitrate concentrations and does not provide direct information about source areas or travel times. In this study we provide an alternative approach to simulate nitrate transport in the subsurface based on backwards particle-tracking using MODPATH. Using this approach we can extract useful information from SWAT-MODFLOW models in terms of source areas, pathlines and travel times for nitrate emerging from springs. Here, we track particles backwards starting from the discharge zones associated with the Devil's Springs Complex in the Santa Fe River. We use our modeling approach to simulate changes in spring nitrate concentrations, as well as the time required for changes to manifest, for a variety of alternative land use and land management scenarios.

PRESENTER BIO: Dr. De Rooij is a research assistant scientist working at the Water Institute, University of Florida. His main research interests lie in the development and application of numerical models to complex hydrogeological problems.

A RESTORATION AQUACULTURE APPROACH TO WATER QUALITY

Matthew DePaolis
University of Florida/Florida Sea Grant, Gainesville, FL, USA

Coastal water quality issues are becoming commonplace in Florida. Harmful and massive algae blooms are exacerbated by warming waters and increased levels of nutrients entering nearshore waters. Controlling the influx of pollutants into waterways has proven difficult, so it is necessary to reduce nutrient concentrations from eutrophic waters after it has been contaminated. Human engineered solutions to this issue tend to be complicated and expensive. However, nature has long provided a mechanism to remove excess nutrients from water systems through conversion into biomass. Bivalves, macro-algae, and sponges all serve to extract excess nutrients from water that can then either be sequestered within the system or removed altogether. By purposefully farming organisms to bank nutrients, the pollutants can be removed from a system resulting in cleaner water.

While this may seem like a straightforward solution, establishing an aquaculture operation is expensive. Due to the contaminated nature of the water, the end product will be unfit for human consumption. Without the ability to sell the product produced, an aquaculture farm is not able to sustain itself. In order for water quality restoration aquaculture to be viable, it is necessary to create a market for the end product: the removed nutrients from a system. This presentation will review Florida's nutrient credit trading system, other state systems where polluters can buy 'credits' that are traded in a marketplace, as well as other potential solutions that may be better suited for Florida. By requiring polluters to account for their true costs they are not able to offset their expenses on the general population and will help fund the cleaning and protection of Florida waters. Restoration aquaculture-based solutions are able to scale and adapt to the unique challenges of the different of Florida waters, and the creation of a market would ensure long term success.

PRESENTER BIO: Matt is the inaugural Coastal Policy Analyst at the University of Florida Center for Coastal Solutions, housed in the College of Engineering. After receiving a concurrent J.D./Masters' of Marine Biology from the University of Oregon, he returned to Florida, where he has previously conducted research and worked at Mote Marine.

WATER LEVEL TRENDS AT SOUTH FLORIDA COASTAL STRUCTURES AND IMPLICATIONS TO WATER MANAGEMENT

Tibebe Dessalegne
South Florida Water Management District, West Palm Beach, FL, USA

The South Florida Water Management District (District), serving about 9 million people, is responsible for operating the south Florida regional water management system infrastructure that comprises of approximately 2,100 miles of canals and 2,000 miles of levees/berms, more than 600 water control structures and 625 project culverts and over 70 pump stations. The District operates this complex system for flood control, water supply, water quality treatment and ecosystem restoration. The region is characterized by low relief, flat topography, hydrology driven by a delicate balance between rainfall and evapotranspiration, high surface-water and groundwater interaction. At the outskirts of this water management system, the coastal gravity structures play a great role in disposing inland water to tide while preventing salt-water intrusion. The effectiveness of these coastal gravity structures highly depends on the available head across them in comparison to their design heads. As a result of this, sea water level increase will adversely impact the discharge capacity of coastal gravity structures in effectively disposing inland water to tide. Therefore, to understand and summarize long term water level conditions at coastal gravity structures, trend analysis on water level timeseries was conducted.

The trend analysis on water level data at coastal structures and NOAA tidal gages in South Florida is part of resiliency metrics development that was embarked by the District. The trend analysis metric characterizes sea level trend based on observed long-term historical water level data at coastal structures as well as water level data at NOAA tidal stations. This effort also includes quantifying coastal structure water level trend associated with sea level rise, change in rainfall and other factors. The results of this analysis will assist planners and water managers in designing or retrofitting adaptive water management infrastructure as well as operational protocols.

PRESENTER BIO: Dr. Tibebe Dessalegne is a Section Leader within Hydrology and Hydraulics Bureau at the South Florida Water Management District. He holds a professional Engineering license from state of Florida. In addition, he is a registered Professional Hydrologist and is a Diplomate Water Resources Engineer with over 20 years of experience.

THE “BATHYDRONE” FOR UNDERWATER SURVEY AND MAPPING

***Tony Diaz**, Andrew Ortega, Henry Tingle, Jaejeong Shin, Andres Pulido, Peter Ifju*
Mechanical and Aerospace Engineering Dept., University of Florida, Gainesville, FL, USA

A unique drone-based system for underwater mapping (bathymetry) was developed at the University of Florida. The system, called the “Bathydrone”, is comprised of a drone that drags, via a tether, a small vessel on the water surface in a raster pattern. The vessel is equipped with a COTS sonar unit that has down scan, side-scan and chirp capabilities and logs data onboard. Data can then be retrieved, post mission, from the vessel and plotted in a variety of ways. The system provides both isobaths (underwater topo plots) and contours of bottom hardness. Extensive testing of the system was conducted on a 5-acre pond, located at the University of Florida Plant Science and Education Unit in Citra, FL. Prior to performing scans of the pond, ground truth data was acquired with a RTK GPS unit on a pole to precisely measure the location of the bottom at over 200 locations. An assessment of the accuracy and resolution of the system was measured by comparison to the ground truth data. Additionally, underwater geometric features were submerged in the pond to assess the resolution of locating and identifying these features. During testing, our research group found that there are numerous advantages and attributes of the Bathydrone system including; ease of implementation and the ability to initiate surveys from the land without the need for a boat. The system is also inexpensive, light-weight, thus making transport convenient. The Bathydrone can raster at speeds of between 0 and 10 mph, and thus can be used in waters with swift currents. Additionally, there are no propellers or control surfaces underwater, so the vessel does not have a tendency to snag on floating vegetation. We have been able to raster an area of more than 10 acres in one battery charge and in less than 25 minutes.

PRESENTER BIO: Tony Diaz is a Ph.D. student in the Mechanical and Aerospace Engineering Department at the University of Florida. He is a member of the UF Unmanned Aircraft Systems Research Program and has been developing systems for water based survey and mapping and water sampling.

HISTORICAL USE OF IRRIGATION IN RESPONSE TO REGIONAL DROUGHT

Alexandra G. Dixon[1], *Hannah L. Lukasik*[2], *Jennifer R. Dierauer*[2], *Samuel J. Smidt*[1]
[1]Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA
[2]College of Natural Resources, University of Wisconsin-Stevens Point, Stevens Point, WI, USA

Irrigation is well-known for overcoming weather variability (e.g., drought) in agricultural systems, but assessment of irrigation as a resiliency strategy has remained incomplete at the nationwide scale due to sparse data records. As a result, much of the research linking irrigation and weather events has relied on predictive models or estimates to forecast future climate change impacts on agricultural systems. Most studies linking irrigation and climate lack a foundation in historical behaviors and observations, so the past cannot robustly inform the future. Here, we use a new historical irrigated production dataset to evaluate the historical relationship between irrigation for major row crops and extreme drought events at the US county-level from 1945-2017. Specifically, we isolate extreme weather events both geographically and temporally to analyze how growers have changed their irrigation strategies to mitigate environmental risk. Results can be used to better inform projections of future irrigated water use and better equip management decisions for water conservation.

PRESENTER BIO: Alexandra Dixon is a Plant Science major specializing in Sustainable Crop Production. She works at the Land and Water Lab conducting independent research. She plans to go on to pursue her masters in Environmental Science and Policy. Her interests include urban and agricultural ecology, water quality, and sustainable community development.

INVESTIGATING DRIVERS OF SEASONAL SHIFTS IN FISH HABITAT USE IN THE HOMOSASSA RIVER SYSTEM

*Mike Allen[1], **Taylor Dluzniewski**[1], Eric Johnson[2], Adrian Stanfill[2], Phillip Stevens[3] and Alexis Trotter[3]*

[1]University of Florida, Gainesville, FL, USA
[2]Florida Fish and Wildlife Conservation Commission, Lakeland, FL USA
[3]Florida Fish and Wildlife Research Institute, St Petersburg, FL USA

In the southeastern U.S., some subtropical marine fishes use thermal refugia during winter at the northern limits of their range. In the Gulf of Mexico, coastal water temperatures can fall to lethal levels for select marine fishes during winter months. Previous research found that marine species abundance (dominated by Common Snook and Grey Snapper) increased in several spring-fed rivers during winter, consistent with theoretical use of the warm water springs as thermal refugia. The Homosassa River, located centrally among several spring-fed rivers in north-central Florida, was chosen to investigate: 1) seasonal water quality parameters and their influence on the timing of marine species immigration, 2) the timing of the winter influx and subsequent habitat overlap between marine (Common Snook, Grey Snapper) and freshwater fishes (Largemouth Bass, Redear Sunfish), and 3) fish movement and habitat associations between marine and freshwater fish species in the mainstem and backwater habitats of the Homosassa River system. Acoustic telemetry, electrofishing, mark-recapture, habitat assessment and abiotic measurements were used to identify species interactions, distribution, and movement in the Homosassa River system. Results depict marine fish species abundance was nine times greater during cold periods (November–March). Peak abundance of marine fishes during cold periods indicated overwintering in the Homosassa River system. The majority of tagged marine fish emigrated from the study area in early spring (February–March). Electrofishing data showed freshwater fish abundance in backwater habitats was two times greater than the mainstem; a seasonal shift in distribution between winter and summer was not apparent. Acoustic telemetry results indicated that freshwater fish distribution was restricted by high salinities and likely influenced by some degree of habitat complexity. The data provided in this study can assist resource managers with enhancing aquatic habitat for resident freshwater fish species, while maintaining important refugia for migratory marine species.

PRESENTER BIO: Taylor Dluzniewski Is a Fisheries Biologist for the Florida Fish and Wildlife Conservation Commission and a Masters student at the University of Florida. Taylor studies biological interactions and ecosystem change in coastal spring-fed river systems. She also has extensive experience with habitat and species conservation in freshwater and estuarine systems.

SOCIAL AND AGRICULTURAL VULNERABILITY TO CLIMATE CHANGE HAZARDS IN THE SOUTHERN REGION

***Megan Donovan*[1]** *and Kevin Ash*[2]

[1]School of Natural Resources and Environment, University of Florida, Gainesville, FL, USA

[2]Geography Department, University of Florida, Gainesville, FL, USA

Food systems face distinct vulnerabilities to the hazards intensified by climate change due to a rapidly evolving economic, environmental and social environment. Considerable literature explores social vulnerability using various indices (e.g., HVRI SoVI, CDC SVI) to hazards in an array of both hazard and geographic contexts. Similarly, index construction is prevalent in the literature on agricultural sustainability. The present study seeks to approach solutions for food systems in the face of climate change by assessing hazards of both the social and agricultural dimensions of vulnerability. The geographic area of interest is the USDA defined Southern Region: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, Virginia and the U.S. Virgin Islands. I used SHELDUS data of hazard frequencies and crop damages of drought, flood, hurricanes and tornadoes due to their climate sensitive nature and their significance for the study area. Additionally, I incorporate SoVI scores and percentiles and irrigated acreage data from the 2017 Census of Agriculture to represent the social and agricultural dimensions of vulnerability, respectively. Clear spatial trends in how hazard vulnerability functions emerged when examining social and agricultural systems as inherently coupled systems. A robust understanding of both social and agricultural vulnerability to climate sensitive hazards can inform policies and recommendations to help foster sustainable and resilient food systems.

PRESENTER BIO: Megan Donovan is a PhD candidate in the School of Natural Resources and Environment at the University of Florida. She has extensive experience in the nonprofit sector, particularly in affordable housing and community development. She currently works on a research project investigating decision-making of farmers operating organic high tunnel systems.

WIND, WATER, AND PUBLIC SAFETY: SOCIOECONOMIC DISPARITIES IN HURRICANE SAFETY, SOUTH FLORIDA HOUSING

William Greene, Hannah Boyette, Meagan Siegfried, Austin Deal, and ***L. Donald Duke***
The Water School, Florida Gulf Coast University, Fort Myers, FL, USA

Hurricane mitigation policies in the U.S. encompass a wide range of planning and response measures, including flood- and wind-resistance building codes for structures potentially exposed to hurricanes. In Florida, many code modifications arose from “lessons learned” about structural failures in past events, extending back to the great Okeechobee Hurricane of 1928 that where destruction in rural residences produced thousands of fatalities; through codes modified after Hurricanes Andrew in 1992 and Charley in 2004. In many historic events, lower-income communities experienced greater risks – and greater losses – partly because regulatory protections were unequally specified and/or implemented. The objective of this research was to identify, characterize, and quantify certain hurricane-safety risks to residents of Florida owing to different residential structural requirements, particularly with respect to differing socioeconomic status. Federal, state, and local policies and regulations for structural protections differentiate between site-built residences and manufactured homes, the latter of which data show are present in greater proportion in areas with lower income. Florida’s building codes in designated zones require site-built homes to withstand high winds (150 - 160 miles per hour (mph)) and rise above inundation (lowest occupied floor 1 - 2 feet above FEMA-determined Base Flood Elevation (BFE)) to a greater degree of protection than homes – subject to Federal regulations, which specify wind protection only to 100 mph (in designated hurricane zones) and elevation only at the BFE (in FEMA-designated floodplains). Manufactured homes constituted only 9.5% and 2.7% of residential units in Lee and Palm Beach Counties, respectively – two populous, growing, higher-median-income counties. GIS analysis showed those counties hold nearly 20,000 homes within FEMA-designated floodplains. By contrast, rural, lower-income Hendry and Glades Counties had a smaller number (9,500) but greater proportions (40.1%, 50.6%), such that nearly half their populations experienced the greater hurricane risks of manufactured homes.

PRESENTER BIO: Dr. Duke is Professor of Environmental Studies at FGCU. He holds a Ph.D. in Civil and Environmental Engineering from Stanford University and has 30 years of academic experience in quantitative and qualitative analysis of scientific and engineering data to assess effectiveness of watershed management and environmental protection policies and regulations.

HYDROGEOLOGY OF LOCAL WATER BALANCES IMPACTED BY A DYNAMIC SALTWATER INTERFACE

***Brady Evans*[1], *James Jawitz*[2], *Harald Klammler*[3], *and Michael Annable*[1]**

[1]Department of Environmental Engineering Sciences, University of Florida, Gainesville, FL, USA
[2]Department of Soil and Water Sciences, University of Florida, Gainesville, FL, USA
[3]Department of Geosciences, Federal University of Bahia, Salvador, Brazil

Understanding the relationship between freshwater and saltwater in coastal aquifers is important for management of water resources and protection of water quality and infrastructure. The Ghyben-Herzberg approximation tells us for every 1 m increase in freshwater head there is a 40 m decrease in the elevation of the interface between fresh and salt water. Based on this principle, long-term cyclical dynamics of freshwater head would lead to concomitant cycling of large volumes of freshwater and saltwater in coastal aquifers. The timescales of lags between freshwater-saltwater interface responses and changes in freshwater head depend on the hydrogeological setting. A recent study found evidence for multidecadal recharge-discharge time lags in 9 watersheds overlying combinations of confined, unconfined, and semi-confined conditions in the deep and highly conductive Floridan Aquifer System (FAS). In this study, simulations were run using the numerical model SUTRA (Saturated-Unsaturated TRAnsport) to build a more robust definition of the hydrogeologic conditions leading to freshwater-saltwater aquifer dynamics that may produce lagged groundwater discharge on multidecadal scales. The approximate hydrogeologic conditions of these 9 watersheds were simulated using a 2D profile model of a coastal aquifer with inland lengths of 3 km, 15 km, and 50 km. Sensitivity analyses revealed inverse relationships between time lag and both recharge flux and permeability. Pending further results, the large time lags modeled in different hydrogeologic settings could suggest a direct impact of the freshwater-saltwater interface on both freshwater availability and solute delivery from aquifer to stream in the FAS.

<u>PRESENTER BIO</u>: Brady Evans is a PhD candidate under the supervision of Dr. Annable. He specializes in quantitative research in groundwater hydrology with experience in numerical modelling and the managing and processing of large datasets.

METAGENOMIC ANALYSIS OF ALGAL COMMUNITIES INHABITING THE NEAR SURFACE AQUIFER OF AN ALASKAN GLACIER

***Quincy Faber**, Christina Davis, Brent C. Christner*
Microbiology and Cell Science University of Florida, Gainesville, FL, USA

Phototrophs in supraglacial algal blooms have been studied extensively due to their role in new carbon production and darkening ice, which accelerates further melting. To date, algal blooms on ice surfaces have received the most attention; however, surficial environments represent only a portion of the liquid habitat on glaciers and ice sheets. For instance, solar radiation absorbed by ice in the ablation zone of glaciers generates internal meltwater, creating a near-surface aquifer that stores meltwater during summer months. According to previous studies, the flux of photosynthetically active radiation through several meters of ice is sufficient to support photosynthetic activity. In this study, I used metagenomic sequence data collected from samples of the Matanuska Glacier's (Alaska) near-surface aquifer in 2014 and 2015 to conduct a taxonomic and functional analysis of microbial communities of the weathering crust aquifer. Using small subunit ribosomal RNA genes, I show that phototrophs were highly abundant in near surface ice. Phylogenetic analysis showed that the two most abundant taxa are closely related to *Ancylonema nordenskioeldii* (93.14-100% identity), a species of green algae commonly associated with ice algal blooms, and *Ochromonas* CCMP 1899 (95.15-99.85% identity), a mixotrophic genus of golden algae isolated from Antarctic Sea ice. A functional analysis based on gene content showed the samples contained genes for photosynthesis, light harvesting, and carbon fixation, confirming the potential for light-based autotrophy in this ecosystem. When considered with other biogeochemical data collected in parallel with these samples, these results indicate that the habitat for glacier algae is not restricted to ice surfaces and extends several meters into the underlying porous ice. Future studies that measure rates of photosynthetic activity and rates of carbon remineralization in these ecosystems are important for constraining carbon fluxes from large ice masses and their downstream impacts to subglacial and proglacial watersheds.

PRESENTER BIO: Quincy Faber is a PhD candidate in the Christner Lab in the Microbiology and Cell Science Department at the University of Florida. Her research focuses on the composition and function of microbial communities in glacial environments.

IMPACT OF HYDROLOGIC REGIME ON SOIL ORGANIC MATTER ACCUMULATION IN A STORMWATER TREATMENT WETLAND

***Alexandra Feldman**, Lauren Leverett, David Kaplan*

Department of Environmental Engineering Sciences, University of Florida, Gainesville, FL

Despite covering only 6% of Earth's land surface, wetlands store nearly one-third of global soil carbon, making them critically important for global climate regulation. Human-made wetlands, including stormwater wetlands, also store carbon; however, carbon accumulation rates and their primary drivers can vary widely in such engineered systems, prompting additional study. Here, we report the results of a case study of the impact of hydrologic regime on soil organic matter (SOM) content within the Stormwater Ecological Enhancement Project (SEEP) in Gainesville, FL. The SEEP is a three-acre bioretention pond within the Natural Area Teaching Laboratory on the University of Florida campus. The SEEP was designed to improve water quality by increasing stormwater retention and filtration, as well as to provide habitat and interpretative and educational opportunities. Additionally, the SEEP has several designated treatment areas which are typically waterlogged, promoting anaerobic conditions, which facilitate organic carbon accumulation. We hypothesized that low-lying areas with high nutrient loading, dense vegetation, and consistently saturated conditions will have the highest organic matter accumulation rates. Replicate soil samples of at least 25 cm depth were collected across wetland zones, dried, and burned in a Muffle furnace following standard loss on ignition (LOI) procedures to determine organic matter (OM) content. The OM results were compared to studies from 2003 and 2012, as well as between the different SEEP zones, using a two-factor ANOVA. Preliminary results showed the highest OM accumulation rates in the SEEP's initial forebay and in the deepest areas of cypress swamp. Overall, this study aims to compile existing and newly gathered SEEP data into a comprehensive report to document changes in OM% over time and to demonstrate the potential of the SEEP (and other similar stormwater wetlands) to uptake and store carbon.

PRESENTER BIO: Alexandra is an environmental engineering undergraduate at the University of Florida. She is especially interested in manmade wetlands, equity in public policy, and interactions between humans and the environment. In her spare time she enjoys painting and exploring local trails.

FUSING REMOTE SENSING DATA WITH SPATIOTEMPORAL IN SITU SAMPLES FOR RED TIDE DETECTION

***Ronald Fick**, Miles Medina, Christine Angelini, David Kaplan, and Paul Gader*
University of Florida, Gainesville, FL, USA

A novel method for combining remote sensing data with spatiotemporally distributed in situ water samples was developed to detect red tide (*Karenia brevis*) blooms off the southwest coast of Florida. The neural network classifier detects blooms (100,000 cells/L) over a 1 km grid, using six depth-normalized ocean color features from the full lifespan of the MODIS-Aqua remote sensing platform (2002-2021) and in situ red tide sample data collected by the Florida Fish and Wildlife Conservation Commission (FWC). The in-situ data were used to label the remotely sensed data for training and to generate a feature encoding recent, nearby ground truth (*K. brevis* concentrations) through a KNN spatiotemporal proximity weighting scheme. The network trained on both remotely sensed data and in situ data provided greater detection performance than either network trained on a single dataset, and the classifier outperformed several existing bloom detection methods. All code for this method is available on Github. (https://github.com/Compcon-UF/red-tide-ML)

PRESENTER BIO: Dr. Fick is a research scientist with the Center for Coastal Solutions. He completed his PhD in computer engineering focused on machine learning. He has been working to identify harmful algae blooms with remote sensing data.

INVASIVE HOGS ALTER SALT MARSH FUNCTIONING, ECOSYSTEM SERVICE PROVISIONING, AND RESILIENCE

Hallie Fischman[1]*, Ashley Smyth*[2]*, Christine Angelini*[1]
[1]University of Florida, Gainesville, FL
[2]Tropical Research and Education Center, University of Florida, Homestead, FL

Invasive wild hogs are a known nuisance in Florida, the Southeast US, and globally. Through their wallowing and rooting activities, they reduce vegetation cover, release buried soil carbon, and reduce biodiversity in salt marshes. In addition, hogs consume ribbed mussels, a key foundation species in salt marshes ecosystems. To assess the direct impacts of hog disturbance and hog predation of mussels in marshes, we compared marshes with no hog access to marshes with known hog activity in Northeast Florida. Marshes with hog access showed a significant reduction in mussel cover and mussel aggregations contained fewer individuals than at marshes without hogs. A caging experiment revealed that hogs, not small mammals or nektonic predators, strongly contribute to the differences in mussel populations. We further quantified the effects of hogs on marsh functions that are mediated by mussels: invertebrate community composition, sediment denitrification, carbon storage, and sediment deposition. We found that the presence of hogs significantly reduced marsh crab densities within mussel aggregations and increased surface soil organic carbon. The reduction in mussel cover by hogs led to a reduction in biodeposition on the hog impacted marshes. However, hog activity enhanced sediment denitrification. Overall, hogs are transforming the marsh landscape through their disturbance to vegetation and sediment and their consumption of a foundational marsh species. These impacts generally, though not exclusively, reduce the ecosystem services provided by marshes and the resilience of marshes to sea level rise.

PRESENTER BIO: Hallie Fischman is a PhD student in Environmental Engineering Sciences. Her work focuses on the ecology and restoration of coastal ecosystems including salt marshes, sand dunes, and oyster reefs.

SURFACE-GROUNDWATER MIXING STIMULATES NITROUS OXIDE PRODUCTION IN CARBONATE AQUATIC SYSTEMS

Madison K. Flint*, Jonathan B. Martin and Andrew Oberhelman*

Department of Geological Sciences, University of Florida, Gainesville, FL, USA

Extensively developed secondary porosity in eogenetic karst systems allow ample exchange of surface water and groundwater. The exchange delivers vital substrates including surface water derived organic carbon (OC) to subsurface microbes living in low energy environments. The exchange alters aquifer redox conditions and influences nitrogen dynamics, which is often a limiting nutrient in terrestrial ecosystems. One nitrogen species of particular concern is nitrous oxide (N_2O), a long-lived and potent greenhouse gas that originates primarily from heterotrophic denitrification, which couples OC respiration to nitrate (NO_3^-) reduction, with N_2O produced as an intermediate species. Thus, the quantity and quality of OC substrates has the potential to influence N_2O dynamics through heterotrophic denitrification reactions. A natural OC quantity and quality gradient that occurs in the Santa Fe River in north-central Florida provides an ideal site to investigate N_2O dynamics linked to OC variations. The ~120 km river transect can be divided into three main sections: 1) an upstream section where the regional Floridan aquifer is confined by an overlying siliciclastic unit, leading to high OC concentrations of allochthonous origin (recalcitrant), 2) a downstream section, where the confining unit is absent, leading to low OC concentrations of autochthonous origin (labile), and 3) an intermediate section located at the erosional edge of the confining unit where these two endmembers mix. N_2O concentrations in upstream waters are approximately at equilibrium with atmospheric concentration while downstream river waters have N_2O concentrations ~ 2.5 times that of upstream waters. The highest N_2O concentrations, reaching up to 2,000% saturation relative to atmospheric equilibration, occur at these intermediate locations. These elevated N_2O concentrations correlate with mixing of the allochthonous and autochthonous OC sources, suggesting that these mixing zones are hot-spots of N_2O production which may be linked to variations in OC reactivity stimulated by mixing of these distinct OC pools.

PRESENTER BIO: Madison Kelsey Flint is a Ph.D. candidate working under Dr. Jonathan B. Martin at the University of Florida, Geological Sciences Department. The primary focus of her research is investigating nitrogen cycling in aquatic ecosystems with a particular emphasis on N_2O dynamics.

DECOMPOSITION AND LABILITY OF SOIL ORGANIC MATTER AND CARBON STOCKS ACROSS A SEAGRASS LANDSCAPE

*Jason L. Howard, Christian C. Lopes, Sara S. Wilson, Vicki McGee-Absten, Claudia I. Carrión and **James W. Fourqurean***
Florida International University, Miami, FL, USA

The paradigm for understanding the accumulation of organic carbon (C_{org}) in coastal "blue carbon" habitats holds that burial of C_{org} slows decomposition and leads to stability of carbon stocks. Further, it is generally assumed that the presence of the plant communities contributes to the buried organic matter and the stability of the carbon stocks. This study tested these assumptions and examined the lability of soil C_{org} as a function of environmental and plant community drivers. Samples of surficial sediment and seagrass community characteristics were collected at 93 locations across the ca. 15,000 km^2 of seagrass beds in south Florida. Ramped pyrolysis was used to describe the relative lability of soil organic carbon across the landscape. Organic matter (OM) was lost at all temperatures from 180° C to 600° C, suggesting that even the relatively high combustion temperature of 550° C underestimates OM content by ≈ 10% on average. Additionally, deployments of model substrates (canvas strips) were used to examine decomposition rates of buried and surficial organic material at a subset of these sites. On average, finer, muddier soils contained slightly higher C_{org} stocks than coarser sediment sites, but the relationships between sediment grain size and seagrass community structure was weak. The lability of soil organic carbon varied with grain size; as much as 80% of the C_{org} was refractory in coarse-grained soils compared to less than 30% in muddy soils. In muddy soils, burial decreased cellulose decomposition rate by an average of 22 - 39 % compared to surficial breakdown, but in coarse-grained soils, burial enhanced cellulose decomposition rate by at least 55 %. Taken as a whole, this study suggests that burial does not enhance C_{org} storage in all blue carbon environments, and that soil C stores are only weakly correlated with seagrass biomass at the landscape scale.

PRESENTER BIO: Dr. Fourqurean is a Distinguished University Professor of Biological Sciences and the Associate Director of FIU's Institute of Environment. He is a coastal marine ecologist and biogeochemist.

ASSESSMENT OF SOIL AMENDMENT TYPES AND RATES FOR REDUCED TURFGRASS IRRIGATION

Ronald Fox *and Eban Bean*
University of Florida, Gainesville, FL, USA

A growing population in Florida is expected to increase the freshwater demand by 1.0 billion liters per day (15%) between 2020 and 2040. This increase in demand poses a challenge to planning efforts that seek to ensure an adequate public water supply while also maintaining the health of freshwater-dependent ecosystems. In some regions of Florida, more than half of the water supplied to residential communities is used for turfgrass irrigation. Previous studies have shown that amending soil with compost before turfgrass establishment can improve soil and turfgrass quality, and it is hypothesized that irrigation may be reduced given the improved conditions. However, the rate at which compost should be incorporated, as well as the extent to which irrigation may be reduced has not been widely studied. To address these questions, we established a 120-plot study in Citra, Florida to test the effect of various amendment types, amendment rates, and reduced irrigation rates on St. Augustine (*Stenotaphrum secundatum* (Walt.) Kuntze) turfgrass quality, soil organic matter, bulk density, and available water capacity. Turfgrass quality was evaluated every 1-2 weeks, and soil samples were collected four times over the course of two growing seasons (March 2020 - November 2021). Soil properties were improved at amendment incorporation rates at or above 2 yd^3 1,000 ft^{-2} compared to unamended control plots. Results also suggest that irrigation may be reduced by up to 50% when soil is amended at a rate of 4 yd^3 1,000 ft^{-2}, while maintaining improved turf quality compared to unamended control plots.

PRESENTER BIO: Ronald Fox is a second-year master's student in the department of Agricultural and Biological Engineering at the University of Florida, with research experience in the fields of plant molecular biology, horticulture, and urban water resources. He received his bachelor's degree in molecular genetics from The Ohio State University in 2016.

RESILIENCE – A WATER MANAGEMENT DISTRICT PERSPECTIVE

Tom Frick
St. Johns River Water Management District, Palatka, FL, USA

Sea-level rise, increased severity of tropical storm events, and shifting rainfall patterns are effects of a changing climate which is expected to impact Floridians, property, and the state's natural resources. These increased risks pose many challenges to state and local governments. The St. Johns River Water Management District is committed to assisting communities to become more resilient in preparing for and adapting to these changes. Come hear how District staff incorporate resiliency principles every day in their individual programs by identifying, developing, and completing projects for the sustainability of the communities within the district. This presentation will identify specific project examples that can help you and your communities.

PRESENTER BIO: Mr. Frick is the St. Johns River Water Management District's Resilience Coordinator and has spent more than 25 years in the public and private sectors focused on data collection, ecological assessments, and waterbody restoration.

COLD BLOOD IN WARMING WATERS: CONSERVING GULF STURGEON USING PRECIPITATION AND GROUNDWATER MODELS

***Bethany M. Gaffey*[1] *and Andrew K. Carlson*[2]**

[1]Florida Cooperative Fish and Wildlife Research Unit, School of Forest, Fisheries, and Geomatics Sciences, University of Florida, Gainesville, FL USA

[2]U.S. Geological Survey, Florida Cooperative Fish and Wildlife Research Unit, School of Forest, Fisheries, and Geomatics Sciences, University of Florida, Gainesville, FL USA

Understanding the impacts of changing climate and weather patterns on cold-blooded species is crucial for informing and advancing conservation efforts. Lotic ecosystems are particularly important to study because they link land and sea, and they contain thermal refuge habitats for species affected by ongoing changes in water temperature and precipitation regimes. As a Federally threatened anadromous species, Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) are considered “canaries in the coal mine” of rivers, estuaries, and nearshore habitats within the Gulf of Mexico. Documenting, modeling, and predicting the availability and distribution of suitable thermal habitats for Gulf Sturgeon across their life history will not only inform conservation efforts for this species, but also protect key environments for many other species. Current data and models of Gulf Sturgeon habitat use do not address linkages between air temperature, water temperature, precipitation, and groundwater dynamics as variables for predicting thermal habitat suitability in a changing climate. In this talk, we will discuss ongoing thermal habitat research in the Choctawhatchee River and describe insights for developing common metrics for assessing landscape-level threats to Gulf Sturgeon populations, with emphasis on the understudied juvenile life stage.

PRESENTER BIO: Bethany graduated from UF in 2017 with a B.S. in Interdisciplinary Studies and Mass Communication. Now an M.S. student in SFFGS, Bethany is simultaneously working in aquatic sciences and communications. By studying the art of science and the science of art, Bethany is pursuing a career in Science Communication.

TRANSVERSE STRUCTURE OF TIDAL AND EXCHANGE FLOWS IN A MAGELLAN GLACIAL FJORD

***Maria Fernanda Gastelu-Barcena**, Arnoldo Valle-Levinson*
University of Florida, Gainesville, FL, USA

Glacial mass losses in recent decades have sparked attention to the study of glacial fjord hydrodynamics. The freshwater derived from glacier melting drives a feedback loop in exchange of water and heat that accelerates its contribution to global sea-level rise. The increased rate of submarine melting in tidewater glaciers has been linked to heat transport from the ocean through fjords. Despite the global relevance of ice melting in glacial fjords, little is known about their dynamics and transverse structure. The objective of this study was to challenge the typically viewed geostrophic dynamics in fjords. The objective needed resolution of the spatial structure of tidal and exchange flows in a glacial fjord off the Strait of Magellan, Chile. Data from a towed current profiler and temperature-salinity casts were collected along two transects during one semidiurnal tidal cycle in December 2003. Salinity profiles showed an easy-to-miss 3 m buoyant layer over a homogeneous water column. Tidal flows displayed marked transverse and vertical variations caused by geometry and stratification. Residual (or tidally averaged) flows showed Inflows of only a few centimeters per second, distributed underneath the buoyant outflow. Both, tidal and residual flows described a clockwise surface gyre that invalidates the geostrophic approximation.

PRESENTER BIO: Fernanda Gastelu is a PhD student at ESSIE-UF, a 2019-WIGF Fellow and a member of the interdisciplinary NSF funded SILA project. Her PhD research focus in fjord hydrodynamics. Fernanda collaborates with the CCS-UF working on estuarine hydrodynamics in Sanibel Island. She is also a 2021-Fellow Mesoamerican Reef leadership program

TRENDS AND VARIABILITY OF AGRICULTURAL DROUGHT UNDER CLIMATE CHANGE IN ETHIOPIA

***Fikadu Getachew*[1]**, *Haimanote Bayabil*[1], *Gerrit Hoogenboom*[2], *Yu Ziwen*[2], *Gregory Kiker*[2], *Li Yuncong*[1]

[1]Department of Agricultural and Biological Engineering, Tropical Research and Education Center, IFAS, University of Florida, Homestead, FL, USA

[2]Department of Agricultural and Biological Engineering and Institute for Sustainable Food Systems, University of Florida, Gainesville, FL, USA

Most of farmlands in Ethiopia are located in the highlands. The total amount of rainfall is 1600 mm per year, but they are still affected by short-term droughts, especially during the dry season. The erratic nature of the seasonal rainfall distribution affects the rainfed agricultural system in the country. Moreover, the frequency of agricultural drought is reported to further increase due to climate change. Therefore, assessing the historical and future agricultural drought projections under climate change is critical. The objective of this study was to investigate the trends and variability of agricultural droughts in Ethiopia under five Global Circulation Models (GCMs; GFDL_ESM4, MPI_ESM1_2_HR, MRI_ESM2_0, and UKESM1_0_LL), two Shared Socioeconomic Pathways (SSPs; SSP245 and SSP585) and three climatological periods (Baseline; 1991-2020, 2035s; 2021-2050, and 2065s; 2051-2080). Downscaling of GCMs was conducted using the Bias Correction/Constructed Analogues with Quantile Mapping Reordering (BCCAQ) method. Trends and variability of short-term agricultural drought were investigated using a 3-months standard precipitation index (SPI) and consecutive dry days (CDD) in Ethiopia. The Mann Kendall test was used to evaluate temporal trends of agricultural drought. Most of the GCMs showed consistent projections of an increasing agricultural drought in Ethiopia for the two periods (2035s and 2065s). Results also showed a significant increase trend in SPI and CDD in most parts the country. Up to 65% of the total area of country is projected to be affected by an increasing agricultural drought (mild (0 - -0.99 of SPI) to severe (-1.5 - -1.99 of SPI)) under the two SSPs in 2035s. However, the proportion of drought affected areas is projected to decrease almost by half in 2065s compared to in 2035s. Trends in CDD are also projected to increase under the two SSPs in 2065s. This result indicates that future agriculture will likely suffer from a more frequent and intensive agricultural droughts (Mild to severe). Therefore, management decision should aim to tackle short term agricultural droughts through different interventions.

PRESENTER BIO: Mr. Fikadu Getachew is currently a Ph.D. Student at the University of Florida in the Agricultural and biological engineering department. He has eight years of working experience in crop and climate modeling. He has also been awarded an International Climate Change Protection fellowship from the Alexander Von Humboldt in Germany, Young Scientist support program 2012, and recently won the Intergovernmental panel on climate change (IPCC) scholarship program 2021. His research interest is detecting a proxy of drought indices from surface and satellite observations using crop simulation modeling approaches. His current research looks into the effects of supplemental irrigation and shifting planting dates to mitigate climate change impacts on sorghum production.

WATER USE IN YOUNG CITRUS TREES ON METALIZED UV REFLECTIVE MULCH COMPARED TO BARE GROUND

***Hossein Ghoveisi*[1]**, *Davie M Kadyampakeni*[1], *Jawwad A Qureshi*[2]

[1]Soil and Water Sciences, Citrus Research and Education Center, University of Florida, Lake Alfred, FL, USA

[2]Department of Entomology, Southwest Florida Research and Education Center, University of Florida, Immokalee, FL, USA

Accurate estimation of plant water use could improve irrigation management and lead to a better understanding of plant-water interactions. Metalized polyethylene mulch as a ground cover (M) combined with irrigation management can improve water and fertilizer use efficiency than bare ground (NM) and achieve accelerated growth and yield. Thus, a study was undertaken to (i) compare daily water use using the stem heat balance method on ≤2-yr-old citrus trees using three irrigation methods (Regulated Deficit Drip Irrigation (RDI), Conventional Drip Irrigation (CD) and microsprinkler irrigation (MS)) on two Florida sandy soils (Spodosols on the Flatwoods site and Entisols on the Ridge site); and (ii) determine soil moisture content as well as total available soil water (TASW) in the irrigated zones. The sap flow data suggest that RDI system resulted in higher water use than both CD and MS systems. The hourly sap flow was 120%, 99% and 163% greater in M-RDI than M-CD, NM-CD and NM-MS respectively. The soil moisture data showed that the reflective mulch treatment had higher average soil moisture content at all layers (8 cm, 15 cm and, 45 cm). For instance, the highest difference is at 15 cm soil depth at the Ridge site (37%) followed by 45 cm (30%) and 8 cm (25%) soil depths at the Flatwoods site, respectively. The TASW results were between 100 to 136% for both mulch and bare ground treatments. All irrigation systems showed water contents close to field capacity at both sites, indicating that water was nonlimiting in each irrigation system despite having different irrigation schedules. The higher water uptake using intensive irrigation systems is ascribed to frequent irrigation and improved water distribution in the irrigated zone.

PRESENTER BIO: Dr. Ghoveisi is a postdoctoral research associate at University of Florida. He has studied water/pollutant movement in soil/sediments with various irrigation practices. Ghoveisi is interested in modeling of dispersion-adsorption processes into the soil and sediment. His focus is to improve water use efficiency in citrus production systems and water quality.

LAKE OKECHOBEE'S TROPHIC "TEMPERATURE"

Joseph L. Gilio
Limnological Science for Lake Okeechobee, USA

Lake Okeechobee has undergone 12%, reductions in surface area, depth by 30% and volume by 50%. Since 1972, Total phosphorus (TP) inloads have been ~ 3.5 X greater than total maximum daily loads [TMDL]. Water column TP levels have increased from ~ 40 mg/l (1940's) to 150 ug/l (2020). Lake trophic levels are proxies of Chlorophyll a (Chl), TP and Secchi depth (SD) for light penetration. Carlson, 1977 Trophic State Index (TSI) log transforms these parameters into TSI's from 0-100. Combing into a ∑TSI = (TSI.Chla+ TSI.TP+ TSI.SD)/3 calculates its trophic "temperature", a valuable numerical for public and managers This work used DBHYDRO data set (www.sfwmf.gov) to calculate average concentrations of Chl, TP and SD, corresponding TSI's and corresponding time series. Annual changes ($p \leq 0.01$) were: TP +2.1 ug/l, Chla -0.16 ug/l and SD - 0.007 m over a maximum 48-yr. POR. Chl decreased inversely with TP but directly correlated with SD. This inverse may be a more general response in large surface area lakes of shallow and large fetch than previous findings. TSI's correlated positively with underlying chemical or water clarity. The larger the ∑TSI, the higher the potential metabolic activity [primary and secondary production]. Time series of ∑TSI "temperatures" vs. POR found 2 different pelagic station arrays with all pelagics stations > littoral/SAV > Caloosahatchee outflow ~ Kissimmee River inflow > marsh /EAV. Highest "temperatures" were lake waters compared to inflow / outflow indicating within lake top sediment overturn as a major factor in increasing pelagic TP water column levels that correlate with recent decadal blooms of *Microcystis aeruginosa* despite turbidity inhibition. This HAB has released human and nature toxins both within the lake and its regulated discharges to the Caloosahatchee and St. Lucie River ecosystems. Lake Okeechobee's trophic "temperature" has increased from ~ 41 to 75 [1981-2020.

<u>PRESENTER BIO</u>: Mr. Gilio has 40+ years in teaching at FL tech (at Jensen Beach], regional ecological planner at TCRPC and 25 years as founder and CEO of Wetlands Management, Inc. (WMI). At WMI, he planned, designed and installed over 500 retention lakes / wetland in multi-use projects that mimic nature.

SCENARIO PLANNING TOOL FOR FOREST WATER YIELD IN NORTH FLORIDA

Katie Glodzik[1]*, Matt Cohen*[1]*, and Joseph Prenger*[2]
[1]University of Florida, Gainesville, FL, USA
[2]US Department of Agriculture, Beltsville, MD, USA

Meeting regional water demand while protecting flows and levels in natural aquatic ecosystems requires attention to both direct and indirect water uses. The emphasis in north Florida has been appropriately directed at direct consumption, but changes in water availability due to changing land cover and land use are also important to consider. Recent work suggests that water yields can be increased by adopting conservation forestry practices, such as tree thinning and regular application of prescribed fire.

While conservation forestry has many goals, including habitat and biodiversity improvement, the water yield impacts are now more effectively quantifiable using information on site properties. The water yield benefits are potentially significant. For example, restoration of a typical intensive silviculture stand to low-density longleaf pine savanna can increase water yield by nearly 200,000 gallons per acre per year. At present, no scenario planning tool exists that embeds water yield predictions within a geographic information system that allows easy evaluation of parcel management options. The goal of this project is to create such a tool for use by land conservation organizations in Florida.

Applying results from recent predictive modeling, this ArcGIS-based tool will integrate information about site aridity (the ratio of potential evapotranspiration and precipitation, obtained from existing climate observation networks), forest structure (leaf area index, measured in the field and estimated from satellite imagery), and hydrogeologic setting (water table depth approximated by whether the aquifer is confined or unconfined, which can be obtained from hydrogeologic maps) to yield robust predictions of water yield change resulting from management options. The user can select management scenarios driving the temporal dynamics of leaf area index for individual parcels or groups of parcels, allowing informed decision-making regarding rotation lengths, thinning schedules, and other aspects of forest management.

PRESENTER BIO: Dr. Glodzik is a Postdoctoral Associate at University of Florida in the School of Forest, Fisheries, and Geomatics Sciences. She specializes in wetland ecology, quantitative ecology, and geospatial analysis. Her PhD research focused on saltwater intrusion and hydrologic change impacts to salt marsh and coastal forest along Florida's Gulf Coast.

WATER COLUMN SATURATION PROFILES OF N_2, CO_2, AND CH_4 IN NATURAL AND CONSTRUCTED SUBTROPICAL PONDS

***Audrey H. Goeckner*[1]**, *AJ Reisinger[1], Ashley Smyth[2] and Meredith Holgerson[3]*
[1]University of Florida, Gainesville, FL, USA
[2]University of Florida Tropical Research and Education Center, Homestead, FL USA
[3]Cornell University, Ithaca, NY, USA

Urban stormwater wet ponds (SWPs) capture runoff and retain nutrients (N, P) and sediments before water is discharged downstream. However, Florida ponds exhibit low N removal efficiencies and high capacities to mineralize carbon (C) to carbon dioxide (CO_2) and methane (CH_4), both important greenhouse gases. To better understand internal nutrient and energy dynamics of SWPs, we assessed relationships between morphological, biological, and chemical factors and dissolved N_2, CO_2, and CH_4 gas concentrations, reflecting denitrification (N_2) and C respiration (CO_2, CH_4) of SWPs and natural ponds of southwest and central Florida. We also tested the effect of littoral vegetation, a common SWP management strategy, on N and C cycling. We collected water samples from three depths (depths selected based on pond stratification) at twenty-one sites during the dry season (May 2021) and a subset of ten sites during the wet season (August 2021). We quantified N_2 (via membrane inlet mass spectrometry) and CO_2 and CH_4 (via gas chromatography) concentrations, as well as dissolved organic matter composition (via spectrofluorometry), nutrient ions (NO_3^-, NH_4^+, and PO_4^{3-}), and other water conditions (temp, pH, conductivity, dissolved oxygen). Preliminary analyses suggest that natural ponds are more supersaturated with N_2 than SWPs and N dynamics may be driven by primary producers (e.g., algae) in the ponds. Furthermore, we expect pond morphology that supports anoxic sediments and profundal waters will influence CH_4 and N_2 saturation and that littoral vegetation will positively enhance N_2 saturation and CH_4 production. This study can enhance our knowledge of the role that small and urban subtropical ponds play in greenhouse gas production, their ability to remove N from urban runoff, and benefits of implementing biological management strategies.

PRESENTER BIO: Audrey is a second-year PhD student in the Soil and Water Sciences Department working in Dr. AJ Reisinger's Urban Ecosystem Ecology Lab. Her work focuses on drivers of urban pond biogeochemistry and ecosystem functioning and how their discharge influences downstream aquatic ecosystems.

WETLAND PULSE AMPLITUDE BETTER PREDICTS AQUATIC SPECIES RICHNESS THAN STATIC WETLAND SIZE

Sergio C. Gonzalez *and H. Dail Laughinghouse IV*
University of Florida - Fort Lauderdale Research and Education Center, Davie, FL, USA

Pond drying is known to play an important role in the structure of aquatic faunal assemblages by filtering species by aquatic larval development time and via the identity of top predators. However, the effects of seasonal habitat size fluctuations are not well studied. Pond size and other hydrological parameters can be difficult to estimate in the field and are frequently limited to rough size estimates, an average hydroperiod value, or a relative categorical assignment (i.e., large vs. small, short vs. long). As such, few studies have quantitatively investigated the role of seasonal habitat expansion on wetland community structure in natural settings. In this study we examine a series of naturally occurring fishless ponds across a size and permanence gradient to assess the importance of hydrological expansion on aquatic faunal diversity. We measured the extent of the shift in the aquatic terrestrial transition zone throughout the year by mapping pond perimeters, thus quantifying the area of periodically flooded riparian zones. Aquatic fauna (insects, larval anurans, and decapods) were surveyed by dipnet and identified to species. Relative primary productivity was estimated using periphyton accumulation rates. We then modeled species richness using a suite of limnological parameters, including aquatic pulse amplitude. We found evidence for the importance of wetland pulse processes in maintaining biodiversity. When the variable measuring aquatic habitat amplitude was incorporated into the base model it replaced median wetland size as a predictor of species richness. This could be reflective of the importance of bottom-up nutrient cycling mechanisms to promoting faunal diversity in wetlands when major predators are removed. This conclusion is supported by the fact that our data also illustrate that primary productivity, as measured by periphyton accumulation rates, was predicted by our wetland area, amplitude, and depth variables.

PRESENTER BIO: Sergio C. Gonzalez is an ecologist and pilot with over 10 years of professional experience in wildlife and habitat management, landscape ecology, amphibian ecology, wetland ecology, and invasive species management. He also specializes in aerial logistics, aerial survey techniques, vegetation mapping, and unmanned aerial systems.

WASTEWATER TREATMENT RESIDUALS AND NATIVE PER- AND POLYFLUOROALKYL SUBSTANCES

***Caleb R. Gravesen**, Jonathan J. Judy*
University of Florida, Gainesville, FL, USA

Per- and polyfluoroalkyl substances (PFAS) are a class of exclusively anthropogenic and environmentally persistent contaminants commonly detected in biosolids. PFAS enter the terrestrial environment via a variety of pathways, including land-application of biosolids. The physiochemical characteristics of wastewater residuals (WWRs) (e.g., biosolids and sewage sludges) are known to affect PFAS release to water; thus, mobility and bioavailability may vary with different wastewater treatment plant (WWTP) processes. The release from WWTP residuals to water can be described using biosolid-water partition coefficients--making development of predictive tools to estimate these coefficients of critical utility to regulatory bodies and informing WWTP design. For twelve WWRs, we measured both partition coefficients (Kds, L/kg) and total incidence of a range of PFAS native to the residuals along with biosolids characteristics including oxalate extractable Fe and Al, organic matter content, dissolved organic carbon, and total protein content. Total detected PFAS concentrations ranged from ~600 to 3500 ng g^{-1}. Simple linear regression analysis yielded significantly associated physiochemical characteristics that varied for each PFAS, indicating that no overarching characteristic controls partitioning behavior. While OM was strongly associated for some PFAS, the association of total protein and both Fe and Al oxides indicates that forces other than hydrophobic partitioning affect many PFAS retention/release behavior in WWRs. Analysis of partitioning trends as a function of number of fluorocarbon units also suggested that while hydrophobicity and relative molecular size of a given PFAS influences retention in WWRs, the relative significance likely varies due to individual PFAS characteristics. Results are expected to be of high interest to academia, government, and industry and to potentially influence WWTP configuration and biosolids disposal practices.

PRESENTER BIO: Caleb Gravesen is a recent Phd graduate from the University of Florida, Department of Soil and Water Sciences. His past research areas include biosolids-borne PFAS and antibiotics work, as well as trace element contaminated soils.

GIS TOOL FOR DISTRIBUED WATER MANAGEMENT PROJECTS IN THE CENTRAL FLORIDA WATER INITIATIVE REGION

Paul Gray[1], *Del Bottcher*[2], *and Andrew James*[2]
[1]Audubon Florida, Lorida, FL, USA
[2]Soil and Water Engineering Technology, Inc., Gainesville, FL, USA

The greater Orlando area is one of the most rapidly growing areas in Florida and is experiencing water shortages. It sits at the headwaters of three watersheds which makes rainwater flow away from it. The region is heavily drained, accelerating the exit of regional water. The Central Florida Water Initiative (CFWI) was initiated to address these issues and covers 5,300 square miles centered around the Orlando region.

To identify projects that can help enhance and sustain water resources in the region, Audubon worked with Soil and Water Engineering Technology, Inc. to develop a GIS-based mapping tool that could identify suitable locations for passively storing surface water and/or recharging ground water. The tool used four primary considerations to evaluate potential areas: hydrography, topography, land use and soils. Secondary data sets (GIS layers) that are in the interactive tool include property values, number of landowners, proximity to conservation and greenway lands, listed species, wetlands, flood zones, and other parameters of interest.

Due to the geology of the region, areas that recharge the aquifer are different from those that hold surface water. Recharge areas have deep sandy soils that allow water to freely move downward, while surface storage areas have soils that reduce or prevent downward penetration. Therefore, the mapping tool separated recharge areas from surface storage areas. Recharge areas should be managed to hold water on-site for percolation and surface storage areas can hold surface water but are relatively poorer at recharge.

Basins larger than 400 acres were selected as a minimum effective size for a project. In all, 224 possible surface storage project locations were identified. This tool, which is a GIS web-based interactive tool, will be made available to agencies, local governments, landowners and regional stakeholders to help evaluate possible projects.

PRESENTER BIO: Paul Gray has been a staff scientist in Audubon Florida's Everglades Restoration Program for 26 years and works on land, water, and biodiversity conservation.

NITROGEN LOAD REDUCTION FROM ALACHUA COUNTY'S FERTILIZER ORDINANCE AND BEHAVIOR CHANGE CAMPAIGN

Stacie Greco[1], *Dorian Morgan[2], and Suzy Baird[3]*

[1]Alachua County Environmental Protection Department, Gainesville, FL, USA
[2]Uppercase Inc., Tampa, FL USA
[3]Wood., Gainesville, FL USA

Water resources within Alachua County are impaired by too many nutrients, with landscape fertilizers being one of the major sources. To reduce such, Alachua County amended its Landscape Fertilizer Ordinance in 2019 to include a ban on fertilizers containing nitrogen from July through February. Funding was obtained from the Florida Department of Environmental Protection Department to design, implement, and evaluate a behavior change campaign for decreasing fertilizer use and to calculate the resultant nitrogen load reduction to local water bodies.

Survey data was used to identify homeowners perceived benefits and barriers to reducing fertilizer use, to segment the audience, and to market test campaign strategies. Only 53% of respondents believed that residential fertilizer use contributes to algal blooms and 57% said they would reduce fertilizer use if they felt it harmed the environment. Hence many of the campaign strategies implemented via television, social media, billboards, print media, and direct mail were designed to increase awareness regarding residential fertilizers and water quality.

The post survey showed that the number of people not fertilizing at all increased from 55% up to 65% and up to 73% for those that saw the fertilizer campaign. Additionally, 40% of respondents who use fertilizer said they decided to use less fertilizer as a result of the campaign. There was a 40% increase in the belief that residential lawns can contribute to algal blooms between the pre and post survey.

Survey, spatial, and literature data were combined with fertilizer label information to estimate a 20% reduction in annual nitrogen loading in Alachua County. The Simple Model was used for calculating the 8,000 pound reduction to surface water and the Nitrogen Source Inventory Loading Tool (NSILT) was used for estimating the 12,000 pound reduction to groundwater, at a cost of $1.4 - $8.3 per pound.

<u>PRESENTER BIO</u>: Stacie Greco is the Water Resources Program Manager with the Alachua County Environmental Protection Department. She received a B.S. from Warren Wilson College in Asheville, NC prior to her M.S. in Environmental Engineering from UF. She also has a graduate certificate in Social Marketing for applying marketing tools to influence behaviors.

GROUNDWATER RISK AND RESILIENCE IN SOCIAL-HYDROLOGICAL SYSTEMS

***Edgar Guerron Orejuela**[1], Mark Rains[1], Kai Rains[1], Shawn Landry[1], William Kleindl[2] and Sarah Church[2]*
[1]University of South Florida, Tampa, FL, USA
[2]Montana State University, Bozeman, MT, USA

Groundwater is an essential, yet limited resource. Across the globe, including the Kenai Peninsula Lowlands, Alaska, a great percentage of the water that is used for domestic, commercial, industrial, and agriculture purposes is groundwater. However, groundwater is not only used by people, but also by groundwater-dependent ecosystems, including many wetlands, streams, and estuaries. In the Kenai Peninsula Lowlands, groundwater discharge from seeps and springs plays a fundamental role in supporting streamflow, modulating stream temperatures, and delivering nitrogen subsidies from hillslopes to streamside wetlands and streams. These processes are critical for maintenance of stream habitat for salmonids. As human population continues to grow in the area, the consumptive use of groundwater also continues to grow, further stressing this limited but shared resource. Lacking a shared understanding, information, and tools to facilitate communication, continued groundwater depletion could lead towards economic, ecological, and cultural collapse. Therefore, stability and resilience of communities, like the one in the Kenai Peninsula Lowlands, depend on well-informed, science-based, collaborative decision-making. In this study, we seek to identify areas where groundwater resources, including aquifers and the seeps and springs they support, are most vulnerable to anthropogenic impacts using GIS-based Multi Criteria Decision Analysis (MDCA) framework. MCDA is a methodology for appraising alternatives on individual criteria and combining them into one overall assessment which can then be used to compare different plausible outcomes and aid management decisions. The results of this study include information, including visualizations, identifying areas with higher degrees of groundwater vulnerability to anthropogenic impacts under specific conditions. These products will then be used to inform local discussions and decision-making regarding groundwater management and will further showcase the use of groundwater vulnerability modeling and collaborative decision-making to other communities facing competition for groundwater so they, too, may consider this approach.

PRESENTER BIO: Edgar is a PhD candidate at the University of South Florida and a NOAA Margaret A. Davidson Fellow at the Kachemak Bay National Estuarine Research Reserve in Homer, Alaska. His research focuses on understanding the interactions between hydrologic processes, human activities, and water dependent ecosystems.

EXPLORING THE RELATIONSHIP BETWEEN CYANOBACTERIAL TOXINS AND HUMAN DISEASES IN FLORIDA

Yi Guo[1], *Edward J. Phlips*[2], *Mark V. Hoyer*[3], *Jaclyn M. Hall*[1], *Jiang Bian*[1], *William R. Hogan*[1], *Stephen M. Roberts*[4], *Nancy D. Denslow*[4] *and John Glenn Morris*[5]

[1]Department of Health Outcomes and Biomedical Informatics, College of Medicine, University of Florida, Gainesville, FL, USA
[2]School of Forest, Fisheries and Geomatics Sciences, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, USA
[3]Florida LAKEWATCH, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, USA
[4]Department of Physiological Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL, USA
[5]Emerging Pathogens Institute, University of Florida, Gainesville, FL, USA

Recent massive cyanobacteria blooms experienced in Florida in 2016 and 2018 have heightened public anxiety about harmful algal blooms. The incidence and intensity of harmful algal blooms involving toxic cyanobacteria have increased in recent decades driven by cultural eutrophication of water bodies and rising temperatures which favor cyanobacteria. In Florida, while the driving factors supporting cyanobacteria blooms in certain ecosystems have been the focus of intensive research, many uncertainties remain over the consequences for human health. The goal of the current study was to begin the process of defining the linkage between toxic cyanobacteria blooms and threats to human health in Florida using electronic health records (EHRs) data from the OneFlorida clinical research network (CRN). As one of the nine CRNs that contributes to the National Patient-Centered Clinical Research Network, OneFlorida contains longitudinal and linked patient-level records of ~15 million Floridians from various sources, including Medicaid and Medicare claims, cancer registry, vital statistics, and EHRs from its clinical partners. In 2012-2019 OneFlorida data, we identified patients diagnosed with diseases potential related to harmful algal blooms, including non-alcoholic liver diseases (n = 555,231), paralytic shellfish poisoning (n = 320), amyotrophic lateral sclerosis (n = 3,586), Alzheimer's disease (n = 101,876), Parkinson's disease (n = 53,931), hepatocellular carcinoma (n = 14,182), non-alcoholic cirrhosis (n = 74,958). Using ArcGIS, we plotted a density map of the rates of the diseases at the census tract level across the State to show the geographic locations of higher concentrations. To identify the spatial clusters of significantly higher rates of diseases, we performed a Hot Spot Analysis using the Getis-Ord Gi* statistic in ArcGIS at the census-level. Our results revealed multiple spatial clusters of hot and cold spots for all diseases except for paralytic shellfish poisoning.

<u>PRESENTER BIO</u>: Dr. Guo is an Associate Professor with expertise in experimental and observational study design, electronic health records-based risk prediction and risk stratification, and statistical modeling. He has over 10 years' experience in serving as principal investigator or biostatistician on extramurally funded projects that examined health disparities among vulnerable populations.

TOOLS TO ADRESS CURRENT IRRIGATION MANAGEMENT CHALLENGES IN CITRUS PRODUCTION

Sandra M. Guzmán
University of Florida, Indian River Research and Education Center (IRREC), Fort Pierce, FL, USA

The use of sensor-based technologies and smart apps has proven to provide significant water use efficiency increments for crop production. However, the rate of irrigation technology adoption is still low if we consider the advantages of these technologies and the incentives available for their implementation. Some of the barriers in irrigation technology adoption include 1) lack of understanding of the data collected and the reliability of these technologies for irrigation management, 2) lack of centralized decision support systems (DSS) that incorporate multiple sources of data and multiple sensor brands, and 3) low flexibility to incorporate outdated and new technologies in an intuitive DSS. To solve some of the abovementioned issues and barriers we developed CropMonitor, an Internet of Things (IoT) based DSS for citrus irrigation scheduling. CropMonitor was initially designed for growers without telemetry systems and growers with outdated sensors and computing systems. Currently, we have growers with both outdated and new sensor systems as users of the DSS. Centralized DSS's such as CropMonitor allows the visualization of multiple sources of data related to irrigation management including soil moisture, weather data, sap flow, and others. This DSS is currently being tested by citrus growers across southeast and southwest FL. Future developments include the incorporation of AI to generate recommendations and forecasts based on the multiple sources of irrigation and water management data collected.

PRESENTER BIO: Dr. Guzman is an assistant professor in the department of agricultural and biological engineering at the University of Florida. Located in Fort Pierce FL, her research and extension programs focus on the development of programs for the use of in-field sensor data for water management, development of decision support systems for irrigation, hydrological processes, and Best Management Practices (BMPs) evaluation.

MACHINE LEARNING-BASED PROBABILISTIC ENSEMBLE FOR URBAN WATER DEMAND FORECASTING

***Yi Han**, Nikolay Bliznyuk*
University of Florida, Gainesville, FL, USA

Quality forecast of urban water demand is critical to effective water resource management. Machine learning and ensemble techniques have been widely adopted to provide accurate deterministic forecasts but have less emphasis on uncertainty quantification (UQ). Here we propose a novel probabilistic ensemble scheme that can capture different aspects of predictive uncertainties in water demand forecasts. We first propose or identify UQ techniques for an array of popular machine learning algorithms, including random forest, gradient boosting machine, and neural network. Then, we implement the ensemble scheme to estimate the predictive uncertainty for long- and short-term future monthly water demand on a household level. The results show that our ensemble scheme successfully improves the predictive distribution regarding log-likelihood from all individual models in both long- and short-term forecasting problems. To further assist the decision-making process in water management, we provide a long short-term memory (LSTM) model with deterministic forecasting accuracy as the primary concern. The model is parsimonious (requires monitoring only two variables to make forecasts), light, and accurate, which is practically useful for operations.

PRESENTER BIO: Yi Han is a Ph.D. candidate in Agricultural and Biological Engineering department at the University of Florida. His expertise and research interests include statistics, machine learning, and deep learning for agricultural and environmental problems.

LONG-TERM SURFACE WATER QUALITY TRENDS RELEVANT TO DRINKING WATER SUPPLY IN TAMPA, FLORIDA

***Casey Harris**, AJ Reisinger, and Wendy Graham*
University of Florida, Gainesville, FL, USA

The Hillsborough River has supplied surface water for the City of Tampa's drinking water since the mid-1920s, and the greater Tampa Bay, FL, region has relied in part on surface water from both the Hillsborough and Alafia Rivers for drinking water since around 2002. These rivers and their watersheds also have long histories of water quality challenges driven by urban/suburban growth as well as agricultural and mining operations. To gain a better understanding of water quality trends in these rivers and how trends may be related to climate and land use, we examine how several water quality characteristics relevant to drinking water supply (alkalinity, fluoride, specific conductance, sulfate, total organic carbon, true color, and turbidity) have changed over recent decades (periods of record ranging from 10 to 29 years) at eight monitoring stations across the two watersheds. We use weighted regression on time, discharge, and season from the USGS EGRET package in R to calculate observed and flow-normalized trends graphically and estimate the uncertainty of long-term trends. We examine potential drivers of these trends, including climate and land use variables, and implications for future water quality and drinking water use. These results will help drinking water managers develop water quality priorities when considering future demand and potential threats due to climate and land use change.

PRESENTER BIO: Casey Harris is a PhD student at the University of Florida. She previously worked in the field of environmental science in Florida and in the greater southeastern and northwestern US.

SOUTH BROWARD DRAINAGE DISTRICT GREEN INFRASTRUCTURE PROJECTS AND CLIMATE CHANGE IMPACTS

***Kevin M. Hart**, P.E., CFM*
District Director, South Broward Drainage District

South Broward Drainage District (SBDD) is an independent, drainage district located in SW Broward County, Florida. With a jurisdictional area of over 72 square miles, SBDD is the largest single-purpose drainage district in the County.

SBDD continues to see the impacts of climate change and sea level rise on its operations, especially during periods of king tide events. These impacts are starting to become more prevalent and more severe. Although SBDD's eastern boundary is located 7.7 miles from the Atlantic coast, the District is seeing fluctuations in tail water conditions that mimic the coastal, tidal fluctuations, and limit SBDD's ability to discharge water through its gravity gates. These impacts were evident during the 2020 rainy season when SBDD experienced record rainfall, including Tropical Storm Eta when significant portions of SBDD experienced a 100-year rainfall event.

Over the past 10 years, SBDD has completed several successful green infrastructure projects including the following:

- Installation of by-pass sluice gates at all seven (7) of SBDD's stormwater pump stations with a reduction to-date of 8,935 hours of diesel-engine run time, $264,666 in costs, and 813 tons in CO_2 emissions.
- Conversions of narrow ditches to grass swales.
- Construction of new grass swales for improved drainage.
- Construction of a "green" retaining wall at one of SBDD's sluice gates.
- Installation of solar panels on SBDD's maintenance garage expansion.
- District-wide initiatives to improve water quality and educate the public.

PRESENTER BIO: Kevin M. Hart is the District Director of the South Broward Drainage District with over 40 years of civil engineering experience in South Florida. He is a graduate of Virginia Tech (1981); a professional engineer in the State of Florida; and a Certified Floodplain Manager.

PROFITABILITY OF ALTERNATIVE NUTRIENT AND IRRIGATION MANAGEMENT SYSTEMS IN CORN, PEANUT, AND CARROT

***Fei He**, [1]Dogil Lee[2], Tatiana Borisova, Wendy Graham[2,5], Kevin Athear[3], Robert Hochmuth[3], Charles Barrett[3], Michael Dukes[4,6], and Jason Merrick[4]*

[1]Food and Resource Economics Department, University of Florida, Gainesville, FL, USA
[2]The Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL, USA
[3]U.S. Department of Agriculture, Washington, DC, USA
[4]North Florida Research and Education Center – Suwannee Valley, University of Florida, Live Oak, FL, USA
[5]Water Institute, University of Florida, Gainesville, FL, USA
[6]UF/IFAS Center for Land Use Efficiency, University of Florida, Gainesville, FL, USA

Agriculture and nature-based tourism activities are critical for economic development in rural areas, and therefore, agricultural water quality policy should be designed to balance environmental and economic considerations. This study examines the profitability of corn, peanut, and carrot production for three nutrient and irrigation management systems in the Suwannee River Basin, North Florida. Corn and peanut production is a key agricultural land use in the region. Carrot is a new crop being added to the traditional corn-peanut rotation. Such changes can boost farm profitability but also increase nitrate leaching and impact fragile water resources in the region. Nutrient loading can be moderated, however, by adjusting fertilizer application and irrigation. This study examines farm-scale net returns for two crop rotations - traditional corn-peanut vs. modified corn-carrot-peanut. We also consider three management systems that combine alternative fertilizer rates and irrigation scheduling methods to reflect a range of approaches used in the region. Net returns are simulated using the Monte Carlo technique to account for nitrogen fertilizer and crop sales price variability and yield variability. The analysis uses USDA-Agricultural Marketing Services price data, UF/IFAS production budgets, and crop yields data produced by The Soil and Water Assessment Tool (SWAT). SWAT is calibrated to local conditions using carrot production experiments data (2016-2019) and the 30-year historical weather information. We find higher net returns for the modified crop rotation as compared with the traditional corn-peanut rotation. The three irrigation and nutrient management systems result in comparable net returns. Using SWAT estimates of farm-scale nutrient leaching, we illustrate the economic-environmental tradeoffs between profitability and water quality for the combinations of the crop rotations and management systems. This tradeoff analysis can assist the development of agricultural water quality policy and outreach strategies in the study region and beyond.

Acknowledgement: This study is a part of a project "Floridan Aquifer Collaborative Engagement for Sustainability" (FACETS), supported by the National Institute of Food and Agriculture, United States Department of Agriculture, under award number 2017-68007-26319.

PRESENTER BIO: Fei He is a third-year Ph.D. student in Food and Resource Economics Department. For the past five years, she has been contributing to FACETS. As a part of this project, Fei examines the farm-scale and regional economic and environmental outcomes associated with alternative agricultural land uses in North Florida and South Georgia.

CHALLENGES AND OPPORTUNITIES FOR AI IN GEODOMAINS: CASE STUDIES OF GEOAI IN HYDROLOGICAL APPLICATIONS

***Wenchong He**, Zhe Jiang*
Department of Computer and Information Science and Engineer, University of Florida, Gainesville, FL, USA

Over the last decade, artificial intelligence (AI), such as methods in machine learning and deep learning, has achieved tremendous success in computer vision and natural language processing. There is an growing anticipation of the same level of accomplishment of AI in geospatial domains (a.k.a. GeoAI). However, unique challenges exist such as the spatio-temporal autocorrelation, heterogeneity, teleconnection, missing domain physics and constraints, and paucity of ground truth. This poster presents our recent work that addresses some of these challenges. First, we develop a novel terrain-aware spatial machine learning model called hidden Markov contour tree (HMCT) for observation-based flood extent mapping. HMCT is a probabilistic graphical model with a contour tree structure to reflect the flow directions between locations on a 3D surface. Compared with existing AI models, our model achieved higher accuracy on high-resolution Earth imagery when the imagery has significant noise and obstacles (e.g., tree canopies). Second, to address the paucity of high-quality ground truth, we develop a novel weakly-supervised spatial learning framework that can train neural network parameters based on the noisy vector labels with registration uncertainty. The framework can also refine the vector labels at the same time. Preliminary results show that our framework outperforms baselines such as self-training in the application of National Hydrography Dataset refinement. The poster will also list future research directions, such as physics-informed GeoAI models and model robustness and interpretability.

<u>PRESENTER BIO</u>: Wenchong He is a Ph.D. student in Department of Computer and Information Science and Engineer at University of Florida. His research interests include spatiotemporal data mining and deep learning. He was a Ph.D. intern at the Los Alamos National Laboratory in Summer 2021 working on geophysical problem.

INVASIVE SPECIES PATHWAYS: USING THE NAS DATABASE TO IDENTIFY CASE STUDIES FOR GAP ANALYSIS

***Zoey Hendrickson**[1], Wes Daniel[2], Charles Martin[3]*
[1]University of Florida, Gainesville, FL, USA
[2]USGS Wetlands Aquatic Research Center, Gainesville, FL USA
[3]University of Florida, Gainesville, FL, USA

Invasive species are recognized globally as a major threat to native ecosystems and cost millions of dollars to manage. Aquatic invasive species (AIS) are nearly impossible to eradicate once introduced and are considered especially problematic. Preventing introductions of AIS is the most effective way to avoid the negative impacts they impose. Despite current federal efforts, new introductions of AIS are reported each year, indicating that prevention measures for specific introduction pathways are either ineffective or non-existent. To develop comprehensive management recommendations for improving AIS prevention, we are conducting a gap analysis of invasive species' primary and secondary pathways to determine where prevention measures are lacking. The results of this analysis will assist thirteen federal agencies involved in AIS prevention as well state governments that are responsible for regulating interstate transportation of AIS. We reviewed the U.S. Geological Survey's Nonindigenous Aquatic Species (NAS) Database containing over 1380 AIS documentation records to identify 15 AIS representative of 7 taxonomic groups (amphibians, reptiles, crustaceans, fishes, marine fishes, mollusks, and plants) and 8 introduction pathways (stocked, shipping, aquarium release, bait release, aquaculture, canals, pet escape, and hitchhiker). We narrowed the data by eliminating species based on origin, date of first documentation, number of records, and percentage of records within the last decade (since 2010). Our review will identify species to serve as case studies representative of the current state of management in a formal gap analysis of introduction pathways. The gap analysis will describe and quantify the difference between the current state of management and what we will establish as the ideal state. Upon completion of the gap analysis, we will evaluate whether new policies or other prevention measures are possible, identify tools available to managers for implementing new policies, and develop metrics to gauge the success of new prevention measures.

PRESENTER BIO: Zoey Hendrickson is a master's student in the SFFGS Fisheries and Aquatic Sciences program at the University of Florida. She received her B.S. in Biological Science from Florida State University and has worked for several years studying and increasing public awareness to the threats facing Florida's freshwater ecosystems.

IMPACTS OF CLIMATE CHANGE AND SEA LEVEL RISE ON SOUTHEAST FLORIDA'S GROUNDWATER RESOURCES

***Young Gu Her*[1]**, *Jung-Hun Song*[1], *and Satbyeol Shin*[2]
[1]University of Florida, Homestead, FL, USA
[2]University of Florida, Gainesville, FL, USA

Sea level rise is one of the most impacting consequences of climate change, especially to low-lying coastal areas such as southeastern Florida. Climate change alone can affect groundwater resources with the increased intensity and frequency of extreme weather events, including storms and drought. Besides, excessive groundwater extraction can accelerate saltwater intrusion processes. This study investigated how projected changes in climate, sea level, and groundwater intake can individually and collectively impact groundwater resources in southeastern Florida in the future to provide information necessary when developing water management plans and policies for improved sustainability. A three-dimensional numerical groundwater model was used to represent the aquifer system and its interaction with seawater along the coastal lines. Future climate, sea level, and groundwater pumping scenarios were projected and incorporated into the groundwater model. The modeling experiment showed that groundwater levels would be sensitive to the projected changes, and the impacts would vary depending on seasons and locations. Such findings suggested a holistic approach for water resource management in southeastern Florida and highlighted water systems' dynamic nature. This study demonstrated how changes in weather patterns and resulting increases in seawater levels could directly affect local water resources.

PRESENTER BIO: Young Gu Her is an assistant professor of hydrology and agricultural engineering at the Tropical Research and Education Center, IFAS/UF. He has extensive experience with hydrological modeling and monitoring, and his research focuses on evaluating and developing management practices under changing environments for improved sustainability.

INSTREAM HABITAT QUANTIFICATION USING SYSTEM FOR ENVIRONMENTAL FLOW ANALYSIS

Gabriel Herrick
Southwest Florida Water Management District, Brooksville, FL, USA

The System for Environmental Flow Analysis (SEFA) is a software program that provides a set of tools for quantifying effects of flow variation on aquatic habitat. Data collection and analysis using SEFA can be performed in numerous ways depending on river morphology, structural alterations, and management objectives. A typical analysis begins with collection of topobathymetric elevations, water depths, water velocities, substrate, and cover data at points along several cross sections. Cross sections are selected based on mesohabitat type and river location. Habitat suitability curves relate depth, velocity, substrate type, and cover availability to habitat suitability, and can be developed for particular species, life history stages, and functional groups. Hydraulic modeling is used to develop relationships between flow and habitat availability, known as reach habitat curves. Combined with time series of daily flows, reach habitat curves can be used to provide a picture of habitat changes under alternative flow regimes. Results from Florida rivers have shown how various habitats respond differently to flow changes.

PRESENTER BIO: Dr. Herrick is a lead environmental scientist at the Southwest Florida Water Management District. He oversees data collection and analysis on multiple projects and synthesizes diverse results into clear management recommendations. He provides technical expertise in physical habitat modeling with SEFA, water quality assessments, and statistical analysis of ecological data.

TRACING FREQUENCY AND MAGNITUDE OF FLOW REVERSALS IN FLORIDA SPRINGS

Paul Donsky[1], *and* ***Samantha Howley***[2], *Matthew Cohen*[1]
[1]School of Forestry, Fisheries and Geomatics Sciences, University of Florida, Gainesville, FL, USA
[2]School of Natural Resources and Environment, University of Florida, Gainesville, FL, USA

Since the late 1990s, many of north Florida's springs have shifted from a state dominated by dense submerged aquatic vegetation (SAV) beds to one overtaken with filamentous algae, reducing ecosystem functions and value to humans. Deterioration due to anthropogenic press disturbances such as nutrient inputs and climate change have been well researched. In contrast, the impacts of pulse disturbances, including periodic reversal events, remain understudied. During a reversal, floodwaters from adjacent blackwater rivers displace the clear groundwater of the spring system, altering the light, oxygen, and solute regime causing potentially harmful effects on SAV and cascading detrimental ecosystem impacts. Despite preliminary evidence of their impacts, the dynamics of flow reversals are not adequately tracked among Florida's springs. We analyzed high frequency time series of stage and solute composition from ~15 springs in the Suwannee River basin to develop criteria for assessing the frequency, duration, and magnitude of flow reversals. Using the time series of electrical conductivity and river-spring head differential, we developed a signature for reversal disturbances. From the high frequency solute signals, we evaluated the dynamic responses of temperature, pH, dissolved oxygen and nitrate concentrations during and after reversals. Our results suggest that reversal events are readily detectable and constitute a significant, often prolonged, departure from the stable physical and chemical conditions typical in springs. This novel data-driven definition for flow reversals indicates a dramatic gradient in reversal incidence and duration across the population of springs, offering a promising tool to understand and predict the ecological consequences of these unique surface-groundwater exchanges. Moreover, as climate change and urban development continue to affect regional flow dynamics and alter the frequency and duration of reversals, this definition will allow managers to better understand the role of pulse disturbances in the widespread ecological regime shifts, and appropriate avenues for prevention and restoration.

PRESENTER BIO: Sam completed her undergraduate degree at UF where she conducted research on stormwater pond nutrient dynamics and prescribed-burn effects on pine savanna wetlands. She hopes to continue researching hydrologic ecosystems in her post-graduate career.

A *LIMNOLOGICAL YARDSTICK* BASED ON PHOSPHORUS LIMITATION

Mark V. Hoyer *and Daniel E. Canfield, Jr.*
Fisheries and Aquatic Sciences, School Forest, Fisheries, & Geomatics Sciences, University of Florida, Gainesville, FL, USA

A new tool called a Limnological Yardstick was developed using long-term (15 to 35 years) lake chemistry data from 396 lakes collected by volunteers of the Florida LAKEWATCH program. The Yardstick can assist managers of aquatic systems with identifying where there is a great probability that phosphorus is not only the limiting nutrient, but the limiting environmental factor. When a lake's phosphorus-chlorophyll data lie below the Yardstick's lower 95% confidence interval, phosphorus may be the limiting nutrient but not the limiting environmental factor, indicating where phosphorus control strategies will most likely fail. The Limnological Yardstick cannot directly identify the limiting environmental factor(s) as this requires a thorough limnological study of the lake because each lake is an individual. Limiting environmental factors discussed are nitrogen, true color (Pt-Co units), non-algal suspended solids, flushing rate and aquatic macrophytes. The potential impacts of the limiting environmental factors on the classification of lake trophic states and eutrophication are also discussed.

<u>PRESENTER BIO</u>: Mark is the Director of Florida LAKEWATCH. Mark has worked at the University of Florida for 40 years participating in many teaching, research and extension projects examining relations among nutrients, aquatic plants, fish and wildlife in streams, lakes and estuaries throughout Florida.

BALL MILLED BIOCHAR EFFECTIVELY REMOVES SULFAMETHOXAZOLE AND SULFAPYRIDINE ANTIBIOTICS FROM WATER AND WASTEWATER

Jinsheng Huang[1], *Andrew R. Zimmerman*[2], *Hao Chen*[3], *Yulin Zheng*[1], *Yicheng Yang*[1], *Yue Zhang*[1] *and Bin Gao*[1]

[1]Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL, USA
[2]Department of Geological Sciences, University of Florida, Gainesville, FL, USA
[3]Department of Agriculture, University of Arkansas at Pine Bluff, AR, USA

Release of antibiotics into the environment, which often occurs downstream of wastewater treatment plants, poses a human health threat due to the potential development of bacterial antibiotic resistance. In this study, laboratory experiments were conducted to evaluate the performance of ball milled biochar on the removal of two sulfonamide antibiotics, sulfamethoxazole (SMX) and sulfapyridine (SPY) from water and wastewater. Aqueous batch sorption experiment using both pristine and ball milled biochar derived from bagasse (BG), bamboo (BB) and hickory chips (HC), made at three pyrolysis temperatures (300, 450, 600 oC), showed that ball milling greatly enhanced the SMX and SPY adsorption. The 450 oC ball milled HC biochar and BB biochar exhibited the best removal efficiency for SMX (83.3%) and SPY (89.6%), respectively. A range of functional groups were produced by ball milling, leading to the conclusion that the adsorption of sulfonamides on the biochars was controlled by multiple mechanisms including hydrophobic interaction, π–π interaction, hydrogen bonding, and electrostatic interaction. Due to the importance of electrostatic interaction, SMX and SPY adsorption was pH dependent. In laboratory water solutions, the Langmuir maximum adsorption capacities of SMX and SPY reached 100.3 mg/g and 57.9 mg/g, respectively. When tested in real wastewater solution, the 450 oC ball milled biochar still performed well, especially in the removal of SPY. The maximum adsorption capacities of SMX and SPY in wastewater were 25.7 mg/g and 58.6 mg/g, respectively. Thus, ball milled biochar has great potential for SMX and SPY removal from aqueous solutions including wastewater.

PRESENTER BIO: Jinsheng is a Ph.D. candidate, and his research interest is mainly on emerging water contaminants (e.g., antibiotics and microplastics) and environmental nanotechnology. He has already published ten peer-reviewed research papers (three as the leading author) in top environmental science and engineering journals and a book chapter on emerging contaminants in the environment.

INTEGRATING OBSERVATIONS TO INVESTIGATE HARMFUL ALGAL BLOOM DYNAMICS IN FLORIDA'S MARINE WATERS

Katherine A. Hubbard
Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute, Saint Petersburg, FL

Florida has more than 50 harmful algal bloom (HAB) species, several of which produce biotoxins that have the potential to cause negative impacts on the health of wildlife, humans, ecosystems, and economies. Three marine HABs (*Pyrodinium bahamense, Pseudo-nitzschia* spp., and *Karenia brevis*) produce neurotoxins that cause recurring issues. Other species also form ecosystem disruptive blooms but may not be associated with toxicity, such as nanoplankton including the brown tide alga *Aureoumbra lagunensis*, and the marine cyanobacterium *Synechococcus*. These diverse and often overlapping bloom events necessitate a broad, adaptive, and highly integrated observation network. In a single year, thousands of seawater samples collected statewide are processed using light microscopy, genetic tools, and flow cytometry to allow high throughput, sensitive, and/or in situ detection of cells to help increase both spatial coverage and frequency of observational data. These data coupled with environmental observations, targeted physiology studies, and modeling, have the potential to provide novel insights into the diverse and complex factors that impact bloom dynamics – from initiation to termination – for each type of HAB and across Florida's distinct marine ecosystems.

PRESENTER BIO: Dr. Kate Hubbard leads the harmful algal bloom (HAB) program for the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute. As a research scientist, she works with a broad network to sustain and advance comprehensive HAB observations and research in Florida and across the United States.

AI MODELING OF COMPLEX REAL-WORLD ECOSYSTEM DYNAMICS

***Ray Huffaker**, Rafael Muñoz-Carpena, and Kati Migliaccio*
Agricultural and Biological Engineering, University of Florida, Gainesville, FL, USA

We propose a novel symbiosis of *echo state neural network AI* (ESNN), *empirical nonlinear dynamics* (END), and *global sensitivity analysis* (GSA) with *high-performance computing* (HPC) to simulate/forecast complex real-world soil-moisture dynamics reconstructed from high-dimensional field and remote-sensing data. Soil-moisture dynamics are integral to plant growth and ecosystem functions, climate change and weather prediction, and pollution mitigation. Complexity emerges endogenously from strong nonlinear interactions among soil-moisture co-variates, which potentially co-evolve along *attractors* bounded within a low-dimensional subset of state space. ESNN can learn long-term nonlinear dynamics on attractors with relatively few degrees of freedom regardless of the complexity/dimensionality of the system itself. This makes ESNN a valuable *dimension-reducing* technique for analyzing complex nonlinear soil-moisture signals. Recent proof-of-concept demonstrates that ESNN can learn complex nonlinear dynamics from clean data generated by closed 'toy' models. However, in modeling open real-world systems we do not know all covariates involved or whether/how they interact. We do not directly observe state-space dynamics and must infer them from noisy data. We seek to make ESNN a skillful simulator/forecaster of complex real-world physical systems by using: (1) END pre-processing to test data inputted into ESNN for nonlinear dynamics, reconstruct real-world state-space dynamics that ESNN is targeted to learn, and make these dynamics easier to learn by ensuring that inputted data are denoised and stationary and co-variates in the data set are causally interactive; and (2) GSA post-processing with HPC to optimize quickly best performing ESNN hyperparameter architectures. Preliminary results indicate that ESNN can skillfully learn complex nonlinear dynamics from soil-moisture sensor data and reliably forecast out-of-sample. We will leverage nonlinear forecasting power to develop an AI-based early-warning system of catastrophic soil-moisture events (extreme droughts, wildfires, landslides, foundation stability of buildings and other structures under sea level and climate change extremes, etc.) patterned after those in the cyber-breach literature.

PRESENTER BIO: Huffaker's research reconstructs nonlinear spatial and temporal dynamics of endogenously unstable real-world and experimental systems from observational data, maps out and measures causal interactions in real-world networks, and constructs data-driven biophysical models of real-world system dynamics with recurrent neural network AI modeling.

THE WATER SCIENCE COMMUNICATION PROBLEM: WATER KNOWLEDGE AND THE ACCEPTANCE OR REJECTION OF WATER SCIENCE

***Sadie Hundemer**, Martha Monroe, and David Kaplan*
University of Florida, Gainesville, FL, USA

A “science communication problem” exists when scientifically-supported, policy-relevant fact is disputed because it conflicts with political perspectives or other culturally-relevant influences. This study aims to determine whether such a problem exists on water topics, where it could obstruct productive discourse when water policies are introduced. To identify water topics on which partisan individuals reject water science, we developed and applied a Rasch-modeled scale of “ordinary water science knowledge” (OWSK) and an associated assessment of beliefs. Our sample, consisting of 806 Florida and Georgia residents, possessed low OWSK levels and limited understanding of water topics beyond their direct experiences. Though knowledge levels were low, participants aligned their personal beliefs with their perceptions of scientists’ beliefs so long as the science did not activate partisan positioning. Partisan positions were easily activated, however, with some politically right-leaning individuals adopting personal water beliefs contrary to their perceptions of scientists’ beliefs (i.e., a water science communication problem). This divergence occurred in response to statements on the effects of climate change on water availability and on the adequacy of water supply to meet demand 20 years in the future. These topics have relevance far beyond the study area, suggesting a water science communication problem may exist at broader regional and national scales.

PRESENTER BIO: Dr. Hundemer is a post-doctoral associate at the University of Florida specializing in natural resources communication. Her cross-disciplinary research draws from the fields of psychology, sociology, behavioral economics, political science, and communication science to understand and respond to the human dimensions of environmental challenges including stakeholder conflict and political polarization.

WATER QUALITY TRENDS IN LAKE OKEECHOBEE: CLIMATE CHANGE OR OTHER INFLUENCE?

Nenad Iricanin *and Steven D. Hill*
South Florida Water Management District, West Palm Beach, FL, USA

Forty-eight years of water quality data collected from Lake Okeechobee were used to demonstrate if potential effects of climate change could be observed using a long period of record. Water quality data were compiled for six stations within the lake and were aggregated as monthly averages of water temperature, dissolved oxygen, water pH and specific conductance. Trend analyses were determined using a seasonal Mann-Kendall tests.

The results of these trend analyses showed that water temperature and pH did not exhibit any significant change during the period analyzed. In contrast, a significant decreasing trend was observed for dissolved oxygen; however, the annual rate of the change was too low to be detectable. Specific conductance, on the other hand, exhibited a highly significant decreasing trend with an approximately 40% decrease over 48 years. Anomalously high specific conductance levels (mean = 624 µS/cm) were observed during the first decade. Specific conductance averaged approximately 400 µS/cm in last 10 years and reflects more typical levels for a Florida lake.

Increases in regional rainfall could be a consequence linked to climate change. In turn increased precipitation could result in decreases of specific conductance over time in Lake Okeechobee, which receives regional flows and a considerable amount of rainfall. To evaluate this, major ion data were used to identify potential causes for the observed trend in specific conductance. Typically, dilution though increased rainfall is not expected to have a substantial impact on the relative composition of major ions. However, a change in the ionic composition over the period could suggest that the source of ions to the lake has shifted and resulted in changes to the observed specific conductance levels. Based on the major ion data collected in the lake, the ionic composition of lake water shifted from being Na-Cl and Ca-HCO_3 co-dominant during the first two decades to Ca-HCO_3 dominant by the latter decades. Therefore, increased rainfall may not explain the observed trend as other factors, such as changes in land use, hydro-management, and local and regional anthropogenic activities, exert a greater influence on water quality.

PRESENTER BIO Dr. Iricanin is a principal scientist with more than 30 years of experience regarding water quality issues in fresh and marine waters. He has been involved in various Everglades restoration projects, as well as the derivation of the water quality-based effluent limit for inflows to the Everglades Protection Area.

DEVELOPMENT OF PROJECTED (2050–2089) PRECIPITATION DEPTH-DURATION-FREQUENCY CURVES FOR SOUTH FLORIDA

Michelle M. Irizarry-Ortiz[1], *John F. Stamm*[2], *Carolina Maran*[3] *and Jayantha Obeysekera*[4]
[1]United States Geological Survey, Orlando, FL, USA
[2]United States Geological Survey, Lutz, FL, USA
[3]South Florida Water Management District, West Palm Beach, Florida
[4]Florida International University, Miami, Florida

The Flood Protection Level of Service Program (FPLOS) at the South Florida Water Management District (SFWMD) has been evaluating hydrologic basins throughout south Florida to determine their current and future required level of service for flood protection. In addition to sea level rise scenarios, it is imperative to evaluate projections of future precipitation as part of flood vulnerability assessments. In cooperation with the SFWMD, the U.S. Geological Survey has developed an ensemble of projected changes in precipitation depth-duration-frequency (DDF) curves. The DDF curves were developed by fitting a probability distribution function to simulated precipitation extremes extracted from various bias-corrected statistically- and dynamically- downscaled climate datasets from the World Climate Research Programme Coupled Model Intercomparison Project phases 5 and 6.

An ensemble method was used to determine median change factors and variability in extreme precipitation depths at locations throughout south Florida. These median change factors and their variability can be applied to existing historical DDF curves from NOAA Atlas 14 to obtain a range of plausible future DDF curves. DDF curves were developed for durations of 1, 3, and 7 days and return periods of 5 to 200 years. Change factors were computed as the ratio of two DDF curve values fitted to precipitation extremes from 40-year periods, representing: (1) a model-projected climate for the period 2050–2089 under Representative Concentration Pathways 4.5 and 8.5, and (2) modeled historical conditions from 1966–2005. A constrained maximum likelihood method was used for fitting consistent DDF curves across rainfall durations. Change factors from a subset of climate models that best capture historical precipitation extreme indices will be presented. Median change factors for south Florida increase with return period and range from 1.0 to 1.4, suggesting an overall increase in future extreme precipitation events.

<u>PRESENTER BIO</u>: Michelle Irizarry-Ortiz is a hydrologist with the U.S. Geological Survey Caribbean-Florida Water Science Center with more than 20 years of experience in hydrologic modeling and statistical hydrology. She has extensive experience modeling the hydrology and water management system of south Florida and its vulnerability to climate change.

WATERSHED ASSESSMENT MODEL USED TO EVALUATE RESTORATION OPTIONS FOR THE BOB JANES PRESERVE

***Andrew I. James**, Del Bottcher*
Soil and Water Engineering Technology, Inc., Gainesville, FL, USA

The Bob Janes Preserve (BJP) is a 5,620-acre parcel of land that was previously a working part of Babcock Ranch. Located on the northern border of Lee County, BJP was purchased by the Lee County Board of County Commissioners in July of 2006. This study focused on developing a plan for the integration of optimized and strategically selected best management practices (BMPs) and water quality improvement projects to reduce nutrient loads to the Caloosahatchee River, while helping restore the BJP to a more productive native ecosystem.

The Watershed Assessment Model (WAM) was used to assess the hydrologic and water quality responses within the BJP for when it was in agricultural production (circa 2000), its current condition (2019), and for various proposed restoration alternatives. These simulations allowed for the selection and optimization of BMPs and water quality control projects that will help Lee County to achieve their restoration goals for the preserve and meet BMAP targets. The following tasks were completed to meet the above stated objectives:

- Relevant hydrologic, water quality, and physiographic characterization data for the BJP were gathered and analyzed.
- WAM was set up to simulate the hydrologic and nutrient transport processes within the BJP as well as for all upstream flows into the BJP.
- Simulations were used to identify nutrient hotspots and optimal locations for the application of BMPs and water quality projects.
- Use WAM to design and evaluate the cost effectiveness of various BMP and water quality projects.

The completion of these tasks resulted in water quality BMPs, invasive species control, and water quality projects being recommended in coordination with existing BJP habitat management programs.

PRESENTER BIO: Dr. James is the senior modeler at Soil and Water Engineering Technology with more than 25 years of experience in hydrologic and water quality modeling and analysis of watersheds in Florida.

SPATIOTEMPORAL MACHINE LEARNING FOR HYDROLOGY: A COUPLE OF EXAMPLES

Zhe Jiang[1]
[1]University of Florida, Gainesville, FL, USA

With rapidly increasing spatiotemporal data being collected from remote sensing and simulation models, there is a growing need for machine learning (ML) techniques to analyze such rich spatiotemporal data in Earth science (e.g., national water resource management, disaster response). However, spatiotemporal data poses unique challenges in ML, such as spatial and temporal autocorrelation, heterogeneity, paucity of ground truth, and the existence of domain constraints. This talk will demonstrate some novel spatiotemporal ML techniques in the context of flood inundation mapping and National Hydrography Dataset refinement.

BIO: Dr. Jiang is an assistant professor in Department of Computer & Information Science & Engineering (CISE) at the University of Florida. His lab's mission is to advance AI and machine learning foundations inspired by interdisciplinary applications (e.g., Earth sciences, smart cities, biomedicine).

IMPLEMENTING FULL AND DEFICIT IRRIGATION PRACTICES USING SOIL MOISTURE AND SAPFLOW SENSORS FOR WATER SAVINGS IN CITRUS PRODUCTION SYSTEMS

Davie Kadyampakeni*, Hossein Ghoveisi and Samuel Kwakye*

Soil and Water Sciences, Citrus Research and Education Center, University of Florida, Lake Alfred, FL, USA.

Citrus production in Florida has declined as a result of the devastating impact of citrus greening. Use of modified irrigation practices and soil moisture sensors appear to improve tree health, water use and water storage. We have been conducting studies for the past 3 years where we compared the full irrigation (100% evapotranspiration, ET) and deficit irrigation (75-80% ET) practices under greenhouse and field conditions. In the field, we used reflective mulch to compare water savings and evaporation losses with bare ground. Soil moisture sensors (EC-5 and 10-HS) were used to monitor water availability and water volumes were estimated with water meters. Additional measurements included stem water potential, canopy size, soil moisture and sap flow water use. Results of soil moisture, stem water potential and sapflow data show comparable tree response of deficit irrigation treatments to full irrigation rates. In addition, tree growth and size appear to be greater with reflective mulch compared to bare ground under field conditions. Use of deficit irrigation practices would result in 20 to 25% water savings without compromising tree performance on Florida sandy soils. These studies have been conducted on Florida central ridge soils, southwest flatwoods and southeast flatwoods and will provide useful data for developing novel guidelines for optimizing citrus water management.

PRESENTER BIO: Dr. Kadyampakeni is an Assistant Professor of Soil and Water Sciences and the UF Water Institute Early Career Fellow between 2019-2022. He has a research and extension appointment focusing on irrigation and nutrient management and soil/crop modeling of citrus and other horticultural crop production systems.

DRIVERS OF WATER BALANCE VARIABILITY IN THE "CIENAGA DE LAS MACANAS" WETLAND, PANAMA

Andrea Santamaria[1], Yvanna Serra[1], ***David Kaplan**[2]*, *Conrado De Leon[3], Jose Fabrega[1]*
[1]University of Florida, Gainesville, FL, USA
[2]University of Florida, Gainesville, FL, USA
[3]Centro Regional RAMSAR, Panama City, Panama

The "Ciénaga de las Macanas" is the largest wetland in Central Panama, with a protected area of approximately 900 ha. The wetland is categorized as a "Managed Resource Area" by the Ministry of Environment, which allows for a diversity of land management activities, ranging from conservation, to ecotourism, to livestock and agricultural production. The wetland's ecological function and economic production are both highly dependent on its hydrologic behavior, and the region has been affected by both drought and flooding events in the past years. Although the various stakeholder groups who use the wetland are generally aware of the possible environmental and economic effects caused of climate variability and change, there are not existing studies supporting an understanding of the wetland's hydrological regime and resulting ecological and economic functions. This study quantifies the wetland water regime and quantifies the primary wetland water budget components. Data from existing meteorological stations and satellite images were used to obtain historical information on climatic variables and land cover from 2000 to the present. Over that time, temperature increased by 0.54 °C, and precipitation showed a significant and consistent increase of approximately 10 mm/yr. The water balance and corresponding satellite imagery indicate drought years in 2000, 2015 and 2019, pointing to low precipitation as a primary factor in lower water volume and wetland area in these years. Across years, the wetlands showed a strongly seasonal hydropattern, with low water levels from January to April, flooding events in July and August, and consistent inundation in October and November. This hydrological assessment shows that the "Ciénaga de las Macanas" is vulnerable to climate-driven variability, suggesting that water management throughout the basin must consider the water needs of this downstream ecosystem. Furhter hydrological and water quality analyses that provide objective data are important for informing the integrated management of this protected area.

PRESENTER BIO: Dr. David Kaplan is an Associate Professor in the UF Environmental Engineering Sciences Department and Director of the H.T. Odum Center for Wetlands. Research in Dr. Kaplan's lab focuses on linkages among the hydrological cycle, ecosystem processes, and human activities, with the goal of advancing natural resources conservation and management.

MCINTOSH PRESERVE WETLANDS PROJECT – INTEGRATED WATER RESOURCES MANAGEMENT FOR MULTIPLE BENEFITS

***Chris Keller**[1], Amy Tracy[2], Lynn Spivey[3], Jack Holland[3]*

[1]Wetland Solutions, Inc., Gainesville, FL, USA
[2]Dewberry|Hydro, Lakeland, FL USA
[3]City of Plant City, Plant City, FL, USA

Plant City's 360-acre McIntosh Preserve includes an existing, enhanced stormwater treatment wetland (ESTW) that was designed to provide water quality treatment and flood attenuation for the East Canal watershed. The benefits of the original ESTW have been limited by the flashy nature of stormwater runoff and dehydration of the treatment wetlands between storms.

The proposed McIntosh Preserve wetlands project, expands upon the original project by adding more than 100 acres of multi-purpose constructed treatment wetlands. To address the dehydration experienced by the original wetland and increase treatment, this project reconfigures the original wetland cells and adds additional treatment wetlands in the center and western portion of the site. The proposed wetland cells will receive supplemental water from Plant City's reclaimed system during dry periods to maintain suitable wetland hydroperiods and maximize wildlife habitat value. The project will also increase the stormwater system capacity to reduce localized flooding conditions. The expanded wetland treatment system is estimated to decrease nutrient loading to East Canal, above and beyond the original project, with a net improvement of over 7,000 pounds per year (lb/yr) of total nitrogen (TN) and 2,000 lb/yr of total phosphorus (TP).

The final component of the project is the enhancement of public recreational access facilities. The City is enhancing the park elements through a series of phased projects to match the construction timeline of the wetland's expansion. Phase I of the recreational improvements was completed in April 2021 and included two miles of upland pedestrian hiking trails, a three-story wildlife observation tower, and a playground for children. Additional parking, and educational signage, benches and trash cans were also included. Future phases will include additional trails, boardwalks, educational signage, and restroom facilities.

This project maximizes environmental and public recreational benefits through the implementation of an integrated water resources management strategy.

PRESENTER BIO: Chris Keller is president and lead engineer at Wetland Solutions, Inc. Amy Tracy is a senior environmental scientist with Dewberry|Hydro. Lynn Spivey is the Director of Utilities for the City of Plant City. Jack Holland is the Director of the City of Plant City's Parks and Recreation Department.

PHOSPHORUS SOURCE CONTRIBUTIONS UNDER CURRENT AND FUTURE CLIMATE IN A LAKE OKEECHOBEE SUBWATERSHED

Yogesh P. Khare[1]*, Satbyeol Shin*[2]*, Rajendra Paudel*[1]*, and Younggu Her*[2]

[1]The Everglades Foundation, Palmetto Bay, FL, USA

[2]Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL, USA

Progressing towards Lake Okeechobee environmental water quality target requires the identification of critical phosphorus sources and quantification of their contributions under current as well as future climatic conditions. While restoration plans aim at reducing the long-term average annual loads originating from Lake Okeechobee watershed, the focus has remained on quantifying the effectiveness of conservation practices and identification of water quality improvement projects. In this study, we investigated the contributions of legacy phosphorus, inorganic fertilizers, and other phosphorus sources to existing phosphorus loads from the highly impacted Taylor Creek Nubbin Slough (TCNS) sub-watershed. The Watershed Assessment Model (WAM) was developed and employed in environmental plan formulation in Lake Okeechobee watershed. For this study a pre-calibrated WAM setup (Baseline) for TCNS obtained from the Florida Department of Environmental Protection was used. Quantification of phosphorus sources' contributions was made by adopting a scenario analysis approach. The hypothetical alternative scenarios were formed by reducing legacy phosphorus and/or inorganic fertilizer application rates from the Baseline values to zero. The scenario analysis was conducted under the current climate for an 11-year period from 2003 to 2013 and for two future climate periods (a) Near Term – 2034 to 2044 and (b) Far Term – 2074 to 2084 under Representative Concentration Pathway (RCP) 8.5. The future climate scenarios (rainfall and temperature) were based on the downscaled and bias corrected 5 General Circulation Models (GCMs) that performed the best in capturing rainfall and drought characteristics in TCNS. Preliminary WAM scenario analysis phosphorus load estimates indicate that under the current and future climate projections legacy phosphorus is the most dominant contributor of phosphorus loads from the TCNS followed by all other phosphorus sources. Future work focusing on analyzing legacy phosphorus dynamics in the Lake Okeechobee watershed is warranted from the perspective of developing new strategies to curb phosphorus loads.

PRESENTER BIO: Dr. Khare received PhD from the University of Florida (2014) focusing on hydrologic and water quality modeling and uncertainty & sensitivity analysis. In his current role as a water quality scientist at the Everglades Foundation, he is engaged in Everglades water quality research and restoration planning during last 6 years.

DEVELOPMENT OF ENVIRONMENTAL FLOW ANALYSES FOR SPRING SYSTEMS IN THE SUWANNEE RIVER BASIN

Sean King
Suwannee River Water Management District, Live Oak, FL, USA

The Suwannee River Water Management District (SRWMD) applies environmental flow analyses to develop minimum flows and levels (MFLs) for priority waterbodies. These MFLs set the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. As required by state rule, ten water resource values (WRVs) are considered during the MFL development process to address important recreational and environmental aspects of each waterbody as applicable. Over the past two decades, the SRWMD has developed and adopted MFLs for a majority of its rivers and is nearing completion on MFL evaluations for the Upper and Middle Suwannee River segments and associated priority springs. These river and spring MFLs are based on a suite of environmental flow analyses that relate changes in flows or levels to relevant WRV metrics, such as maintaining instream fish and invertebrate habitats and adjacent floodplain wetland communities. While the SRWMD utilizes several analytical methods that were initially developed by other water management districts, we are working to refine these methods and develop new methods with particular focus on springs. The SRWMD contains over 450 identified springs including nineteen first magnitude spring systems and fourteen Outstanding Florida Springs. This presentation will review environmental flow analyses that the SRWMD has applied to springs MFLs and discuss ongoing efforts to develop new analytical approaches.

PRESENTER BIO: Dr. King is the Minimum Flows and Water Levels Office Chief at the Suwannee River Water Management District where he serves as a technical expert in aquatic ecology and water resources engineering and leads the establishment of MFLs for priority rivers, springs, lakes, and groundwater systems.

LIGHTENING THE WATER FOOTPRINT OF FLORIDA'S NEW RESIDENTIAL DEVELOPMENTS

***M. Jennison Kipp**[1], Lesley Bertolotti[2], Pierce Jones[1], Beth Lewis[2]*
[1]University of Florida, Gainesville, FL, USA
[2]The Nature Conservancy, Maitland, FL USA

Each day, nearly 1,000 people move to Florida. Along with this influx of residents comes the demand for new home construction – the Sunshine State had over 30,000 housing starts in the first quarter of 2021 alone. Public supply now accounts for the largest share of our state's freshwater withdrawals (Marella, 2015), and typically half to 2/3 of the water consumed by new homes and residential communities goes to landscape irrigation. These water use trends highlight the need for a substantial and widespread shift in the urban development status quo if we are to protect the water resources upon which new residents and, ultimately, all Floridians depend. Factoring in the real, consequential, and cascading effects of climate change, this need for a paradigm shift becomes even more apparent.

At the 2020 Water Symposium, we presented an emerging public- private partnership (P3) aimed at making the business case for "irrigation-free" landscaping and other water conservation measures. In this presentation, we will: 1) highlight how these partnerships have evolved; 2) introduce an integrated, incentive-based, and dynamic sustainability performance framework for Florida's master-planned community development projects, known as the Sustainable Floridians Benchmarking and Monitoring Program (SF-BMP) which is being expanded through these partnerships; and 3) present SF-BMP pilot projects that function as "living laboratories" to benchmark, set, adopt, implement, manage, monitor, and adapt an integrated suite of ecological and sustainability performance metrics and targets for incorporation into the program. Session attendees will learn about the long process of partnership and program building that has led to current work on projects with 30- to 50-year buildout horizons and the potential to measurably reduce the water, energy, and ecosystem footprints of tens of thousands of new Florida homes.

PRESENTER BIO: Ms. Kipp is an ecological economist and Sustainable Floridians state coordinator with the UF Program for Resource Efficient Communities (PREC) and Center for Land Use Efficiency (CLUE). Her work focuses on promoting the adoption of best design, construction, and management practices that measurably reduce environmental degradation from urban development.

DATA AGGREGATION, CITIZEN SCIENCE, AND AI - OH MY!

Barbara Kirkpatrick *and Robert Currier*
Texas A&M University Department of Oceanography/GCOOS-RA

The Gulf of Mexico Coastal Ocean Observing System Regional Association's mission is to provide information about the Gulf's coastal and open waters on demand that is accurate, reliable, and benefits people ecosystems and the economy. GCOOS has used several strategies to push forward this mission. The first, is the aggregation of ocean data and making it openly accessible to all. Most people think of real time physical oceanography data (currents, temperature, and salinity) however, GCOOS has also aggregated a lot of historical or legacy data. To achieve the spatial and temporal coverage needed for informed decision making, GCOOS has empowered citizen scientists to assist in data collection/observations. Finally, the use of artificial intelligence, or AI, is being used to analyze large datasets in new novel ways. Specific examples of how GCOOS has used these three strategies will be discussed.

PRESENTER BIO: Dr. Barbara Kirkpatrick is the Senior Advisor for the Gulf of Mexico Coastal Ocean Observing System Regional Association and a Research Scientist at Texas A & M University. She has several decades of experience in Harmful Algal Bools and Human Health. She is a member of the Florida Governor's Harmful Algal Bloom Taskforce.

GLOBAL HIGH-RESOLUTION EARTH SYSTEM MODELS REPRESENTATION OF REGIONAL CLIMATE CHANGE AND VARIABILITY

Ben Kirtman
University of Miami – RSMAS, Miami FL USA

This presentation focuses on southeast US climate variability and change simulated by global earth system models at unprecedented ocean (~10 km) and atmosphere (~25 km) resolution, and how these simulations differ from traditional IPCC climate simulations at ~100 km resolution in both that atmosphere and ocean. Particular focus is placed on large-scale drivers of regional extremes in rainfall, temperature and coast sea-level contrasting how north Atlantic variability and change drives regional southeast US changes in extremes that are not detected at more typical resolutions.

PRESENTER BIO: Dr. Kirtman is a professor of atmospheric science and was a coordinating lead author of the IPCC 5th Assessment Report. He has published over 225 peer-reviewed papers on climate variability and change.

A PRESRIPTION FOR COST EFFECTIVE RESTORATION OF FLORIDA'S SPRINGS

Robert L. Knight
Howard T. Odum Florida Springs Institute, High Springs, FL, USA

Florida's natural artesian springs are experiencing "death by a thousand cuts". Average flows have been reduced by more than one third and nitrate-nitrogen concentrations have increased on average by more than twenty fold. Many springs now stop flowing during droughts and have lost their native plant communities to excessive growths of filamentous algae. Wide spread depletion and pollution of the groundwater that brings life to these highly adapted and naturally productive aquatic ecosystems has reduced the environmental health of Florida's springs and spring runs, statewide. Although the State of Florida is expending large sums of public money in springs restoration programs, lack of oversight and prioritization of the most effective projects is evident in the documented continuing decline of springs health. The root problems negatively affecting Florida's springs are well understood and primarily include excessive groundwater pumping and use of nitrogen fertilizers, and inadequate wastewater management. All three of these root causes of spring decline can be addressed at relatively low cost to the public. Clean groundwater is a public resource and Florida law mandates its protection. Existing law allows for establishment of limits on groundwater withdrawals and nitrogen pollution. A cap and fee system on groundwater and nitrogen use is recommended to curtail springs declines and to foster restoration.

PRESENTER BIO: Dr. Knight is Director of the Florida Springs Institute. He has 40 years of professional experience as an environmental scientist and has conducted ecosystem assessments of more than 50 springs in Florida He taught graduate level classes in Springs Ecosystems and Treatment Wetlands Design at the University of Florida.

QUANTIFYING THE ANCILLARY BENEFITS OF CONSTRUCTED TREATMENT WETLANDS

Scott Knight[1], *Baris Yildirim-Alicea*[1,2]
[1]Wetland Solutions, Inc., Gainesville, FL, USA
[2]University of Florida, Gainesville, FL, USA

Constructed treatment wetlands are a widely applied technology in the state of Florida and around the world to manage a variety of water quality issues associated with municipal wastewaters, industrial wastewaters, agricultural runoff, and stormwater. While the water quality benefits of wetlands have been widely studied and documented, wetlands also provide a range of ancillary benefits that have been less widely evaluated. A major ancillary benefit of treatment wetlands is the wildlife habitat that is provided by the ecosystems to wetland dependent species. Birds are one of the most obvious and easily observed wildlife groups that use wetlands. Birds are also of particular interest to a range of recreational user groups and receive significant public attention.

This presentation will focus on bird utilization at the Sweetwater Wetlands Park in Gainesville, Florida based on analysis of a large, citizen-science dataset of bird observations. These data are combined with visitor counts to quantify the effort associated with birding and changes in bird utilization following treatment wetland development.

PRESENTER BIO: Dr. Knight is a vice president at WSI and a water resources engineer with more than 10 years of experience working on constructed treatment wetlands.

EVALUATION OF HYDRODYNAMIC EFFECTS OF WATERWAY RESTORATION ON AN ESTUARINE ECOSYSTEM

***Megan Kramer**, Mauricio Arias*
University of South Florida, Tampa, FL, USA

Estuaries are hydrodynamically complex for they are influenced by tidal forces, freshwater flows, salinity variations, and often intricate coastal land morphology. Furthermore, many estuaries are subject to constant anthropogenic stresses due to dense coastal populations, which are expected to be exacerbated by changing climate trends. The 1,800 home residential Manchester Waterway community located in Charlotte Harbor, Southwest Florida, is interested in improving boat access by restoring a previous connection between the local waterway and the harbor, separated by a barrier peninsula. The proposed connections aim to reduce boat traffic and travel time through the waterway, which would result in environmental benefits such as reduced fuel consumption, erosion, and air pollution. Additional benefits include improved emergency response time and more recreational opportunities. This study evaluates how connectivity and coastal land morphology influence flow patterns by modeling the effects of the proposed restoration project on water movement between Manchester Waterway and Charlotte Harbor. An unstructured grid, 3D model was developed utilizing Delft3D Flexible Mesh to simulate estuary hydrodynamics under three different connectivity scenarios for both normal and extreme weather conditions. Elevation and model boundary data for Charlotte Harbor were gathered from NOAA and USGS databases. High resolution bathymetry and water level data were collected during field visits within the Manchester Waterway for model calibration and validation using sonar and installed level logger devices, respectively. Results will be compared to current flow patterns to analyze changes in water levels, flow speed and direction, and salinity. As this project is a community driven effort, research findings are regularly communicated with the Manchester community. Model simulation results will aid local decision making for the future of the waterway, and also improve understanding of the major influencing forces in intricate estuarine environments and how these ecosystems may respond to human activities and climate projections.

PRESENTER BIO: Megan Kramer is a second year PhD student in the department of Civil and Environmental Engineering at the University of South Florida. Her research is focused on addressing issues related to coastal sustainability, coral reef restoration, and international development.

INFORMING SEPTIC TO SEWER CONVERSION OUTREACH IN FLORIDA THROUGH COMMUNITY-BASED SOCIAL MARKETING

***Lisa Krimsky*[1]**, *Laura Warner [2], Shelli Rampold[3] and Ricky Telg[4]*

[1]University of Florida IFAS Extension and Florida Sea Grant, Ft. Pierce, FL, USA

[2]University of Florida IFAS Department of Agricultural Education and Communication, Center for Land Use Efficiency, Gainesville, FL, USA

[3]The University of Tennessee Agricultural Leadership, Education and Communications, Knoxville, TN, USA

[4]The University of Florida Center for Public Issues Education in Agriculture and Natural Resources, Gainesville, FL, USA

Onsite sewage treatment and disposal systems, a.k.a. septic systems, are widely used in Florida. Conventional septic systems contribute an estimated 100 billion L/year of effluent which can be a contributor of nitrogen and phosphorus to groundwater sources. Septic to sewer conversion programs are being widely implemented across Florida as a means of reducing nutrient loading to impaired waterbodies. However, many of these programs are voluntary and success of conversion projects is dependent on community acceptance and an understanding the numerous barriers to conversion. This project utilized a community-based social marketing approach to develop more effective outreach strategies for local governments conducting septic to sewer conversions.

We conducted focus groups and public opinion surveys to determine perceived barriers, motivators, and other educational needs that may influence the willingness of Florida residents to convert from septic to sewer. This study compared three different counties with statewide residents to determine if Floridians have the same educational needs and beliefs or if the promotion, development, and dissemination of education and outreach materials for septic phase-out programs need to be tailored to specific communities. The results of our study indicate that while there are minor differences between communities, a statewide marketing plan for septic to sewer conversion projects can be used so long as it does not follow a one-size-fits-all approach. In general, attitudes regarding conversion were positive. Homeowners prioritized personal benefits to conversion including the reduction in maintenance burdens and increases in property values. Based on our results, outreach materials should not focus on environmental and water quality benefits. Instead, information should address homeowner priorities and provide information that will make the process easier. The barrier of upfront costs can be removed if they are dispersed over time. Alternative funding and fee structures should be considered to remove the primary external barrier to conversion.

PRESENTER BIO: Dr. Lisa Krimsky is a faculty member with the University of Florida IFAS Extension and Florida Sea Grant Program. Lisa is one of five Water Resource Regsional Specialized Agents located across the state. Her extension efforts focus primarily on water quality and harmful algal blooms in coastal and estuarine ecosystems.

ASSESSING CITRUS WATER USE WITH LYSIMETRY USING EVAPOTRANSPIRATION-BASED IRRIGATION IN FLORIDA

Samuel Kwakye *and Davie Kadyampakeni*
Citrus Research and Education Center, University of Florida, Lake Alfred, FL, USA

Irrigation in Florida citrus production is important for better growth and development of trees affected by citrus greening (or huanglongbing aka HLB). A greenhouse study was conducted from October 2019 to July 2021 at the Citrus Research and Education Center in Lake Alfred, FL to assess water use dynamics in 2- to 4-year-old HLB-affected 'Valencia' orange (*Citrus sinensis*) trees on 'Kuharske citrange' rootstock (*Citrus sinensis x Poncirus trifoliata*). This study is important because citrus growers could reduce irrigation water use thereby cutting irrigation expenses. Four treatments consisting of 100% evapotranspiration (ET) or full irrigation and 80% ET (or deficit irrigation), on HLB- and non HLB-affected (NHLB) trees were used with 5 replications for each treatment. All pots were mulched to minimize surface water evaporation. We measured water use, stem water potential, root length and diameter, and compared all parameters among treatments. Stem water potential data showed no significant water stress among HLB-affected trees with full irrigation (100% ET) and or the deficit irrigation treatment (80% ET). Root growth was higher in non HLB trees than HLB-affected trees. However, considering root length and diameter, there was no significant difference between full- and deficit-irrigated HLB-affected trees. In Spring 2021, HLB-affected trees that received 100% ET showed higher water-use relative to trees that received 80% ET. However, there was a comparable water-use between 100% ET and 80% ET in HLB-affected and non HLB trees in Fall 2020. Estimates of 24-hour sap flow data showed that trees used available water between 10:00 and 20:00 hours in April 2021 with the highest peaks at 13:00 and 15:00 hours. A correlation between water-use and stem water potential for Spring 2021 gave a correlation coefficient of r= -0.57 and an R^2=0.32. For HLB-affected trees, irrigating at 80% ET is appropriate and may save water for other uses.

PRESENTER BIO: Samuel Kwakye is a PhD candidate at the Soil and Water Science department. He has an MS degree in Plant, Soil and Environmental Sciences with a major in soil fertility and plant nutrition. He has over 3 years of experience working on nutrients and water management in citrus production.

ASSESS VULNERABILITY OF OSTDS TO SLR AND STORM SURGE TO DEVELOP ADAPTATION PLANS

***Dr. Tricia Kyzar*[1]**, *Jessica Beach*[2], *and Dr. Eban Bean*[3]
[1]Wildwood Consulting, St. Augustine, FL, USA
[2]City of St. Augustine, St. Augustine, FL USA
[3]University of Florida, Gainesville, FL, USA

Onsite Treatment and Disposal Systems (OSTDS) face multiple threats from climate change yet are rarely addressed in discussions of climate change impacts on structures or infrastructure. Like public infrastructure such as roads, buildings or public wastewater treatment facilities, OSTDS in coastal areas are at risk from high tide flooding, sea level rise, and other related impacts. High tide flooding can saturate drainfields causing temporary failure of effluent processing. Rising sea levels can permanently inundate drainfields and elevate groundwater, both saturating the vadose zone and leading to greater nitrogen release into ground and surface waters. Historically, OSTDS have been the predominant wastewater treatment system in our coastal communities, where a majority of our populations live, and where some of the most significant forms of climate change are being experienced today. Until now, very little work has been done to understand what risks OSTDS face from climate change. We present a method to identify and quantify the risks that OSTDS face from climate change related impacts in low lying coastal communities. We begin by using ArcNLET to gauge the current nitrate loadings of OSTDS in the study area. Next, a vulnerability assessment method was developed, customized to the specific community (St. Augustine, FL). This method identifies the impacts that are most relevant to that community, establishes a risk ranking for each impact, and weights them against each other. This results in estimates of current nitrate loading and a vulnerability score that quantifies the level of risk each septic system is facing. The results provide communities with critical information to understand where OSTDS are already impacting water quality and are at greater risk from climate change related impacts. This information is being used by the City of St. Augustine to guide the decision-making process for future opportunities for septic to sewer conversion projects.

PRESENTER BIO: Dr. Kyzar is a spatial analyst and project manager with experience in spatial statistics, nutrient modeling and vulnerability assessments. She works with a variety of stakeholders including local, regional, state and federal agencies. Analysis results inform local and regional policies and assist in reducing impacts to the aquatic environment..

MODELING THE IMPACTS OF AGRICULTURAL MANAGEMENT PRACTICES ON GROUNDWATER IN THE SANTA FE RIVER BASIN

***Dogil Lee**[1], Nathan Reaver[2], Rob de Rooij[2], Sagarika Rath[1], David Kaplan[3] and Wendy D. Graham[1,2]*

[1]Department of Agricultural and Biological Engineering, University of Florida, Gainesville, Florida, USA

[2]Water Institute, University of Florida, Gainesville, Florida, USA

[3]Environmental Engineering Sciences Department, University of Florida, Gainesville, Florida, USA

Aquifers throughout the world are damaged by over-pumping and nutrient enrichment. In particular, the Floridan Aquifer of the southeastern U.S., has experienced increasing agricultural and urban water withdrawals and nutrient load from human activities. Agriculture has been identified as a large groundwater user and a primary source of nutrients in groundwater, springs and streams in the Santa Fe River Basin, which overlies the Floridan Aquifer in North Florida. Grazed pasture, row crops, and hay fields are the major agricultural land uses in the basin. Quantifying the impacts of alternative water and nutrient management practices for these land uses is important for understanding the potential changes needed to improve groundwater quantity and quality in the region. The main objectives of this study are to model the hydrologic system in the Santa Fe River Basin using the Soil and Water Assessment Tool (SWAT) and to evaluate nitrate leaching, groundwater recharge, and crop yield from row crops, hay fields and grazed pasture. Farm-scale management practices in SWAT were calibrated using available data from corn-peanut rotation, corn-carrot-peanut rotation, and Bermuda grass cultivation experiments. Three management practices scenarios were established to analyze the effects of agricultural management practices on quality and quantity of groundwater which feeds the Santa Fe River and its springs. The results of this study will be useful for incentivizing growers to adopt management practices with lower water and nutrient footprints, and for establishing a model to estimate water quality and quantity of the Santa Fe River depending on land management and land use changes.

<u>PRESENTER BIO</u>: Dogil Lee is a third year PhD student in the Agricultural and Biological Engineering Department at the University of Florida. His research interests include field and watershed scale modeling of the impacts of agricultural management practices on water quality and quantity.

UNDERSTANDING THE HYDROLOGIC CONNECTIVITY BETWEEN UPLAND FORESTS AND WETLANDS

***Esther Lee**, Joshua Epstein, and Matthew Cohen*
School of Forest, Fisheries, and Geomatics Sciences, University of Florida, Gainesville, FL, USA

Wetlands are key landscape elements that store and connect surface and subsurface water, and provide ecological, hydrological, and biogeochemical functions. Wetlands play a significant role in landscape ecohydrologic functions by supplying water storage, buffering water-table dynamics, providing critical habitat, activating carbon and nutrient cycling, and regulating microclimate. These emergent functions are deeply coupled to the surrounding land cover that exerts control on hydrologic variation in space and time. Here we explore the ecohydrologic impacts of upland forest on adjacent wetland and landscape hydrologic function focusing specifically on the dynamics of connectivity in terms of water and energy exchange. Based on the synthesis of field measurements—including hydroclimatic variation, upland evapotranspiration rates, integral hydrologic responses in wetland stage time series, and landscape topographic gradients—we identified patterns of connectivity across over 75 geographically isolated wetlands from 5 wetlandscapes. Using a daily water budget approach and net flow under disconnected conditions, we found that reduced vegetation density in the upland forest increases wetlandscape water yield. We conclude that a trio of factors controls wetland hydrology: topography, hydroclimate variation, and adjacent forest structure. This synthesis broadens our understanding of the hydrologic connectivity between forested uplands and wetlands, which provides important guidance for forest and wetland management.

PRESENTER BIO: Dr. Lee is a postdoctoral researcher in Ecohydrology, with a focus on wetland studies. She studies the connectivity between ecohydrologic processes in wetlands by synthesizing model and data to broaden our understanding of the ecohydrological significance and the role of wetlands to improve the preservation and restoration of wetlandscapes.

CYANOBACTERIAL DIVERSITY WITHIN THE EUTROPHIC LAKE OKEECHOBEE AND THE ST. LUCIE ESTUARY, FLORIDA

Forrest W. Lefler[1], *Maximiliano Barbosa*[1], *David E. Berthold*[1], *Paul V. Zimba,*[2,3], *H. Dail Laughinghouse IV*[1]
[1]University of Florida Ft. Lauderdale Research and Education Center, Ft. Lauderdale, FL, USA
[2]Center for Coastal Studies, Texas A&M University-Corpus Christi, Corpus Christi, USA
[3]PVZimba, Inc., Chester, VA, USA.

Lake Okeechobee is a large eutrophic subtropical shallow lake in the southern Florida peninsula which frequently experiences *Microcystis* dominated cyanoHABs. These blooms are re-occurring and in 2018 a state of emergency was declared as >90% of the lake's surface was covered by cyanobacterial scum and microcystin levels were detected above WHO guidelines across much of the lake. Therefore, it is imperative to understand the community structure during bloom and non-bloom events to identify potential drivers of these microbial communities. From August 2019 to September 2020, Lake Okeechobee and the connected St. Lucie River and estuary were sampled for 16S rRNA metagenomic analysis and limnological parameters. Results revealed community structure varying spatially and temporally within Lake Okeechobee and the St. Lucie River and estuary. The most abundant cyanobacterial families within Lake Okeechobee over the course of this study included Aphanizomenonaceae, Microcystaceae and Prochlorococcaceae and the most abundant bacterial families included Chitinophagaceae, Pirellulaceae, and Sporichthyaceae. While the majority the cyanobacterial ASVs corresponded to Prochlorococcaceae, several toxigenic genera were detected within the lake, with *Dolichospermum* and *Microcystis* occurring frequently. Additionally, cyanotoxins also varied spatially and temporally, with several different microcystin congeners detected as well as anatoxin-a and nodularin throughout both the lake and river. This study provides insights into drivers of the cyanobacterial and associated microbial communities within Lake Okeechobee, and highlights potential drivers of bloom forming taxa and their toxins

PRESENTER BIO: Forrest Lefler is a PhD student in the School of Natural Resource and Environment. His research is focused on cyanobacteria, including harmful algal blooms, and uses taxonomic, genomic, and metagenomic methods to understand their ecology, diversity, and treatment.

THE DEVELOPMENT OF PERFORMANCE METRICS FOR THE ACF WATERSHED

***Steve Leitman*[1]**, *W. Ken Jones PE*[2]
[1]Apalachicola Bay Science Initiative, Florida State University, Tallahassee, FL, USA
[2]Riparian Counties Stakeholders Coalition, Tallahassee, FL USA

An important, yet often under-emphasized, aspect of watershed management is the development of performance metrics for government agencies and water dependent stakeholders to distinguish between unacceptable and acceptable results in order to rank a series of management options in an objective manner. Watershed management models can be used to evaluate flow and reservoir elevations under varying future consumption, management and climate scenarios, but it is through the development of quantifiable and measurable performance metrics that the output from a watershed model can be translated into ecological and engineering contexts where decisions can be made based on public values and science. Our experience suggests that considerable time and money are put into the development of river basin modelling tools while the development of performance metrics to interpret the results of such models is often undervalued.

In this presentation we will focus on:

1. on the minimum criteria which should be considered in defining performance metrics for a large watershed such as the Apalachicola-Chattahoochee-Flint (ACF) drainage basin,
2. the metrics which have been developed historically for various actions associated with the management of the ACF basin including development of the ACF Compact, those developed by the ACF Stakeholders, those used by the U.S. Army Corps of Engineers in developing the recently adopted Water Control Manual for the basin and those used by the U.S. Fish and Wildlife Service in preparing a Biological Opinion for the Manual with a focus on their consistency with the minimum criteria,
3. A recent project working with the Riparian County Stakeholder Coalition to develop performance metrics of the watershed.

PRESENTER BIO: Dr. Leitman currently works for the Apalachicola Bay Systems Initiative and Ken Jones PE is a consulting engineer currentling working with the Riparian County Stakeholder Coalition. Both have worked on ACF basin issues for over 30 years.

STREAMFLOW FORECASTING IN WEST-CENTRAL FLORIDA USING CLIMATE DRIVERS

***Jia-Yi Ling**, Christopher J. Martinez and Nikolay A. Bliznyuk*
University of Florida, Gainesville, FL, USA

Streamflow forecasts help make efficient environmental and economic decisions, such as water supply management and planning for flood/drought hazards. Large-scale climate pattern can provide information for streamflow forecasts due to the associations between streamflow and sea surface temperatures in the Pacific Ocean associated with the El Niño–Southern Oscillation (ENSO). The goal of this study was to evaluate the ability of machine learning models to forecast streamflow in West-Central Florida using ENSO.

Four Niño indices along with the preceding streamflow were used as covariates in a suite of machine learning models to predict streamflow. As opposed to point forecasts, this work aims at estimating the entire predictive distribution of the future streamflow that may be directly embedded in the probability-of-exceedance analyses and decision tools. We compared the forecast performance in the dry season to investigate the relative predictive skill as a function of ML model, the location, and the month of the year. The results showed that using four Niño indices improved the streamflow forecast in West-Central Florida. The forecasts provided by multiple linear models, general addictive model, and tree-based models were found to be skillful over the baseline of the climatology forecast with lower bias and lower uncertainty.

PRESENTER BIO: Jia-Yi Ling is a Ph.D. student specialized in hydrological forecasting through statistical and machine learning models. Her research mission is to fabricate or apply statistical models to monitor or forecast hydrological and environmental changes and assess the risks and impacts of such changes.

EXAMINING THE PRACTICE OF PRE-WASHING PYRETHROID TREATED NETS TO MITIGATE TOXICITY IN INVERTEBRATES

Love, D.H.[1]*, Welsh, R.*[2]*. Larsen, D.A*[2]*., Hinz, F* [3]*,Wilson, P.C.*[3]*, Bisesi, J.H.*[1]*,*

[1]Department of Environmental and Global Health, Center for Environmental and Human Toxicology, University of Florida, Gainesville, FL, USA

[2]Department of Public Health, Food Studies and Nutrition, Syracuse University, Syracuse, NY, USA

[3]Department of Soil and Water Sciences, University of Florida, Gainesville, FL, USA

The distribution of insecticide treated mosquito nets (ITNs) is a great public health success story, with studies suggesting these nets reduced the global burden of Malaria by approximately 40%. ITNs are typically treated with pyrethroids, which are known to have a low toxicity to mammals and high toxicity to aquatic organisms. Recent studies have shown that ITNs are being used for alternative use, including fishing. In a study from a waterside community located on Lake Tanganyika, 87.2% of people utilized their mosquito net for fishing as opposed to malaria protection. Coinciding with reports of off label fishing, there are reports of a decrease in fish quality and quantity. Our previous research has shown that pyrethroids from ITNs can rapidly leach into water, causing overt toxicity in both larval fish and Daphnia. However, it is unclear whether this leaching persists beyond the initial submersion of the net. The first goal of our study is to determine whether prewashing the nets reduces leaching and toxicity associated with ITN fishing. The second goal of our study was to determine whether or not this practice is effective for two different pyrethroid compounds; alpha cypermethrin and Deltamethrin. We conducted a series of exposure experiments using D. magna by introducing them to different sized ITNs. These nets ranged from 1cm2-20cm2. The nets were pre-washed once, twice, or three times before being used in exposure experiments. Each washing consisted of submerging the net for 30 minutes in 300mL of moderately hard water and dried for 30 minutes prior to exposure. Once the nets were placed in exposure beakers, they remained for 30 minutes and were then removed and discarded. We quantified the leaching using liquid-liquid hexane extractions at different time intervals as well as using varying net sizes. The time intervals tested were dip, 12,24,48 and 72 hours. The extracts were analyzed by gas chromatography with electron capture detection. For pre-washing experiments, there was a reduction in toxicity when the nets were prewashed for 30 minutes, when compared to non-prewashed nets from previous experiments. For our leaching experiments, we observed the highest concentration of pyrethroids after 12 hours and the lowest concentration leaching after 72 hours. Results from these studies indicate that the use of ITNs for fishing represents a significant potential hazard to aquatic organisms and that leaching from the nets is occurring. However, we have found that prewashing the nets may be useful to reduce aquatic organism toxicity. Educational strategies may need implementation alongside ITN distribution to decrease this practice and reduce risk to aquatic organisms.

PRESENTER BIO: Deirdre Love is a 3rd year PhD student in the department of Environmental and Global Health. Her research revolves around the off label use of insecticide treated nets for fishing; and the impact these chemicals have on ecosystem health.

BENEFICIAL REUSE OF WASTEWATER: AN UPDATE ON TRENDS IN FLORIDA AND INTERDISCIPLINARY RESEARCH OPPORTUNIITIES

***Mary G. Lusk*[1]**, *Kevin Ash*[2], *Bin Gao*[3], *Jennifer Jones*[4], *Davie Kadyampakeni*[5], *Alexander J. Reisinger*[6], *and Andrew R. Zimmerman*[7]

[1]Soil and Water Sciences Department, Gulf Coast Research and Education Center, University of Florida, Wimauma, FL, USA
[2]Geography Department, University of Florida, Gainesville, FL, USA
[3]Agricultural and Biological Engineering Department, University of Florida, Gainesville, FL USA
[4]Family Youth and Consumer Sciences Department, University of Florida, Gainesville, FL USA
[5]Soil and Water Sciences Department, Citrus Research and Education Center, University of Florida, Lake Alfred, FL USA
[6]Soil and Water Sciences Department, University of Florida, Gainesville, FL USA
[7]Geological Sciences Department, University of Florida, Gainesville, FL USA

Reclaimed water is former domestic wastewater that has been treated and disinfected at a wastewater treatment facility and is then discharged to the environment or put to some form of reuse. To meet both water quality and water quantity needs in Florida, recent legislative actions in the state are focused on the reuse of reclaimed water. In particular, there are new statewide rules related to expanding the use of reclaimed water for agriculture and as a potable drinking water source, as well as new rules that may disallow almost all future surface water discharges of reclaimed water. Here we report on the current state of the science and the legislation of reclaimed water use in Florida. We discuss reclaimed water usage trends, the implications of new rules related to its reuse, current understandings of public perceptions related to reuse, and the need for interdisciplinary research to ensure effective and safe reuse of reclaimed water in Florida and other water-stressed areas of the world. To that we end, we also introduce the UF Water Institute Graduate Fellows (WIGF) faculty team, which was created in 2020 to address statewide research needs associated with expanded reuse of reclaimed water.

PRESENTER BIO: Dr. Mary Lusk is an assistant professor in the University of Florida Soil and Water Sciences Department. She researches strategies for water stewardship in urban landscapes, including water conservation and nutrient management, with emphasis on reclaimed water, stormwater, and wastewater effluents.

GEOLOGICAL HISTORY OF FLORIDA'S WATER OVER THE PAST 40 MILLION YEARS

Bruce J. MacFadden
Thompson Earth Systems Institute (TESI), Florida Museum of Natural History, University of Florida, Gainesville, FL USA

Based on the sedimentary rock exposures on the peninsula today, Florida has existed as a geological entity for at least 40 million years since the Eocene epoch. This talk provides an overview of the geological history of coastal and marine waters offshore and freshwater springs, rivers, streams, and lakes developed on the emerging Florida peninsula since the Eocene. In addition, a major geomorphic feature affecting the distribution of terrestrial waters during this time was the development of karst topography on the dominant limestone bedrock, including the Floridan aquifer.

Our understanding of this geological history of Florida waters also comes from the kinds of fossils preserved in sediments that indicate ancient ecologies and environments. Marine fossils include whales and giant sharks; terrestrial fossils include extinct megafauna such as the terror bird, horses, rhinos, proboscideans and giant ground sloths.

Geological evidence also documents the changes in subaerial paleoenvironments on the Florida peninsula that fluctuated with changing sea-levels. During the Pliocene Warm Period about 3 million years ago, about 80 % of the current Florida peninsula was inundated and this serves as a model for what will happen as a result of global warming and sea-level rise in the future.

PRESENTER BIO: Dr. MacFadden is UF Distinguished Professor and Director, TESI. A UF faculty member since 1977, he is the author of 200 peer-reviewed papers and the recent *Broader Impacts* book (2019, Cambridge). His primary field of scientific research is vertebrate paleontology and evolution.

BIOLOGICAL METRICS FOR DEVELOPMENT OF MINIMUM FLOWS AND LEVELS IN THE SUWANNEE RIVER BASIN

Louis Mantini *and Sean King*
Suwannee River Water Management District, Live Oak, FL, USA

The Suwannee River Water Management District (District) establishes and implements Minimum Flows and Levels (MFLs) for their priority water bodies by assessing whether water flow and or water level reductions due to withdrawals will cause significant harm to the water resources or ecology of the system. State Water Policy (Rule 62-40.473, F.A.C.) provides guidance in MFL development and identifies ten important environmental or ecological Water Resource Values (WRVs) for consideration in protection of a specific water body. WRV metrics are quantitative surrogate measures of water resource values that are relatable to flow. The association between flow (or stage or velocity) and a WRV metric is referred to as a response function. The District has recently led the development of several response functions for biological WRV metrics that are being applied to MFLs for the Upper and Middle Suwannee River segments. These metrics include fish passage over shoals, fish and invertebrate instream habitat, floodplain habitat, and Gulf sturgeon spawning. This presentation will demonstrate how WRVs are chosen for a water body, and describe how these biological metrics are identified and related to hydrologic or hydraulic characteristics to determine protective water levels or flows.

<u>PRESENTER BIO:</u> Louis Mantini is an Environmental Scientist with the SRWMD. He holds a B.S. in Microbiology and an M.S. in Fisheries Science. His work experience includes food microbiology, freshwater fisheries management, and wetland science. Louis is also a Professional Wetland Scientist.

REGIONAL CLIMATE PROJECTIONS – FUTURE RAINFALL ESTIMATES FOR FLORIDA

Carolina Maran
South Florida Water Management District, West Palm Beach, FL, USA

Water resources planning and management is highly dependent on rainfall occurrence and spatial distribution. Changes in rainfall patterns might result in more frequent and intense flooding or drought events. Due to the varied connections to Florida climate and weather, identifying trends in rainfall observations involves a series of complex analyses. Nonetheless, significant upward trends were observed in some wet season months in certain regions, potentially influenced by climate change and multidecadal oscillations. Understanding current and future rainfall patterns is, therefore, critical to guide operational decisions, flood protection, water supply and resiliency planning efforts. Downscaled global climate model results in Florida show relatively large bias, as a result of low resolution in existing climate models that do not fully capture rainfall influencing conditions in the State. The development of a statewide regional climate model would be to capture processes critical to rainfall occurrences, including Tropical Cyclones and sea breeze thunderstorms as well as air-sea interaction and ocean dynamics, among other important climatic processes.

PRESENTER BIO: Carolina Maran, P.E., Ph.D. is the Chief Resiliency Officer for South Florida Water Management District with more than 20 years of experience in water resources management and resiliency.

INVESTIGATION OF MECHANISMS FOR METHYLMERCURY BIOREMEDIATION BY INDIGENOUS BACTERIAL STRAIN IN COMPARISON WITH NON-INDIGENOUS METAL RESISTANT STRAIN OF BACILLUS THROUGH PROTEOMICS STUDIES

Victor Ibeanusi, ***Walker Marechal*** *and Charles Jagoe*
Florida A&M University, Tallahassee, FL, USA

Methylmercury (MeHg) is highly toxic and poses a severe threat to biota worldwide. Theseriousness of toxicity of this neurotoxin is characterized by its ability to augment food chains. The general population is primarily exposed to MeHg through the consumption of contaminated fish and marine mammals. Still, recent studies have reported high levels of MeHg in rice and confirmed that in China, human exposure to MeHg is related to frequent rice consumption in mercury (Hg) polluted areas. Several remediation approaches have been implemented to rehabilitate MeHg contaminated sites. Bioremediation is considered a cheaper and greener technology than conventional physicochemical means. Therefore, the main objective of this studyis to investigate the mechanisms for MeHg bioremediation by indigenous bacterial strain in comparison with non-indigenous metal resistant *Bacillus* strain (MRS-1) bacteria through proteomics studies. Since MeHg resistant bacteria could be used for remediation of MeHg in contaminated water and soils, the evaluation of the molecular and cellular mechanisms underpinning MeHg resistance can pave the way to improve the bioremediation process.

PRESENTER BIO: My name is Walker Marechal, and I am Ph.D. Candidate at Florida A&M University, School of The Environment, majoring in Aquatic Terrestrial and Ecology. I have a Bachelor's degree in Agronomy Sciences from Université Caraïbe and a Master of Science in Entomology from FAMU. I obtained a diploma in Journalism.

SNOOK USE OF THERMAL REFUGIA ALONG THE NATURE COAST: IMPLICATIONS FOR MINIMUM FLOWS AND LEVELS

Charles W. Martin[1], *Scott B. Alford[1], Micheal S. Allen[1], Sean King[2], Brian Klimek[3], Eric Latimer[4], Louis Maintini[2], Ashley M. McDonald[1], Caleb Purtlebaugh[3]*

[1]UF/IFAS Nature Coast Biological Station, University of Florida
[2]Suwannee River Water Management District
[3]Florida Fish Wildlife and Conservation Commission
[4]Duke Energy Mariculture Center

Globally, rising temperatures have resulted in numerous examples of poleward expansions of species distribution patterns with accompanying changes in community structure and ecosystem processes. In the northern Gulf of Mexico, higher mean temperatures and less frequent winter freezes have led to the expansion of tropically-associated marine consumers, such as Common Snook *Centropomus undecimalis* into the Cedar Keys area of Florida, USA (29 deg N). The snook is an economically and recreationally important sportfish found from southern Brazil to south Florida. The area surrounding Cedar Key, FL and the Lower Suwannee River is north of the snook's historically documented range, likely due to lethal water temperatures during winter. The locations of winter thermal refuges (e.g., freshwater springs) are of critical importance for annual persistence of this population and require identification. Moreover, snook use of springs during cold periods have implications for land-use policy and minimum-flow regulations for rivers and thus snook may be used as an ecological indicator for management purposes. Here, we discuss ongoing efforts to highlight fish use thermal refugia throughout the Nature Coast region. Preliminary results from acoustic tagging indicate strong seasonal use of springs, rivers, and other inshore wetlands, especially during colder periods. Future work will focus on the behavioral ecology of snook in these areas during critical thermal periods, as well as quantification of thermal refugia during variable discharge and temperature conditions. This work has strong implications for setting minimum flows and levels for the management of groundwater and aquifers throughout snook's recently expanded area.

PRESENTER BIO: Dr. Martin is an estuarine ecologist at the UF/IFAS Nature Coast Biological Station in Cedar Key, Florida. He has over two decades of experience in research of Gulf of Mexico ecosystems with over 48 publications, most notably focusing on habitat-animal interactions in nearshore Gulf ecosystems.

EFFECTS OF EXPERIMENTAL NUTRIENT ENRICHMENT ON PHYTOPLANKTON ASSEMBLAGE STRUCTURE AND CYANOTOXINS

***Viviana Mazzei*[1]**, *Emily Karwacki*[1], *Keith A. Loftin*[2], *Jose V. Lopez*[3], *Lauren E. Krausfeldt*[3], *Barry H. Rosen*[4], *and Hidetoshi Urakawa*[4]

[1]U.S. Geological Survey, Caribbean-Florida Water Science Center, Orlando, FL, USA
[2]U.S. Geological Survey, Kansas Water Science Center, Lawrence, KS, USA
[3]Nova Southeastern University, Dania Beach, FL, USA
[4]Florida Gulf Coast University, Ft. Myers, FL, USA

Eutrophication is the most cited cause of harmful algal blooms (HABs). However, there is contradictory evidence regarding the direct role of elevated nutrients as a trigger for HAB formation and toxin production. In-situ mesocosms were used to experimentally test the short-term (72 hours) effects of ammonium (NH_4), nitrate (NO_3), and phosphate (PO_4) enrichment on the natural phytoplankton assemblage of the Caloosahatchee River, Florida and examine their ability to trigger a bloom, drive bloom assemblage structure, and influence cyanotoxin production. Three independent experiments were conducted to capture natural temporal variability in water quality and phytoplankton assemblages. Quantitative taxonomic analysis was performed to characterize the phytoplankton assemblage structure across treatment over the 72-hour experiment. Changes in the abundance of potentially toxic cyanobacteria in response to nutrient enrichment was determined by measuring the concentrations of the cyanotoxin biosynthesis genes for anatoxin (*anaC*), saxitoxin (*sxtA*), microcystin (*mycE*), cylindrospermopsin (*cyrA*), and nodularin (*ndaF*). The influence of elevated nutrient treatments on expression of these genes was determined by measuring the concentration of cyanotoxins encoded by those genes.

NH_4, NO_3, and SRP were significantly elevated in their corresponding treatment chambers relative to control chambers during all three mesocosm deployments. Total algal cell density, chlorophyll-a, and phycocyanin were significantly elevated in the NH_4 and NO_3 treatments by 72 hours during the June 2020 and February 2021 deployments, but a switch to dominance by cyanobacterial HAB species in response to elevated nutrients was not observed. These results imply that nitrogen rather than phosphorus is limiting in the lower reaches of the Caloosahatchee River and that algal responses to nutrient enrichment are seasonally variable. There were no significant treatment effects on cyanotoxin biosynthesis gene or cyanotoxin concentrations relative to controls during any of the three deployments suggesting that nutrient enrichment is not the key driver of toxic HABs in freshwaters.

<u>PRESENTR BIO</u>: Dr. Mazzei is a community ecologist and phycologist. She is currently a Mendenhall Postdoctoral Research Associate at the USGS Caribbean-Florida Water Science Center where she is working on several projects investigating HAB dynamics and toxicity in freshwaters across the nation.

LONG TERM WATER YIELD IMPACTS FROM PINE PLANTATION MANAGEMENT STRATEGIES IN THE SOUTHEAST

***Kathryn McCurley Pisarello*[1]**, *Robert J. Fletcher*[2], *Ge Sun*[3]

[1]USDA-ARS, Southeast Watershed Research Laboratory, , Tifton, Georgia, USA

[2]Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, Florida, USA

[3]Eastern Forest Environmental Threat Assessment Center, Southern Research Station, USDA Forest Service, Research Triangle Park, USA

In the American Southeast, novel changes in global biofuel consumption have catalyzed pine plantations as a supplied energy source alternative to fossil fuels. Such evolving energy interests congruently alter landscapes and embedded ecosystem services that cooperate to satisfy those demands. However, the suite of possible pine plantation management scenarios and their relative impacts on long term mean annual (1961-2015) water yield (Q) has yet to be simultaneously examined. Here, we theoretically and empirically addressed how thinning, clear-cut, and short rotation influenced Q at site and watershed scales (watershed area ranging 695,953 – 7,374,414 km^2) in northern Florida, southern Georgia, and southern Alabama through statistical and process-based methods, including the Water Supply Stress Index (WaSSI) model. We additionally evaluated climate impacts by simulating changes in precipitation (P) and temperature. Our two theoretical pine plantations provided differently modeled Q results from the empirically-based WaSSI model, which is likely primarily due to spatial scale variability between the two frameworks. For the theoretical pine plantations and for the simulated WaSSI watersheds, clear-cut yielded the greatest management-induced increase in Q (changes of up to approximately 47% and 25% for each framework), while the 10% reduction in annual P yielded the greatest overall Q change in WaSSI watersheds, decreasing Q by approximately 20-30%. In one theoretical pine plantation, the 10- and 18-year short rotation simulations yielded less of a Q increase than the 50% thinning but more than the 10% thinning. In the second theoretical pine plantation, both short rotation scenarios yielded the least Q increase, compared to thinning and clear-cut. Under drought circumstances, landowners can mitigate local water supply shortages by changing agricultural management strategies. Our results can help inform predicted Q changes under pine management scenarios, which landowners can then use to choose which strategy to employ to optimize both profit and desired ecosystem services.

PRESENTER BIO: Dr. Pisarello is an early-career research scientist at USDA-Agricultural Research Service, where she is the unit's lead agroecosystems modeler and supervisor of an extensive database management endeavor. Her experience and trajectory are multi-disciplinary and include landscape hydrology and ecology, as well as human dimensions within an agroecosystems context.

QUANTIFYING FERTILIZER IMPACTS: A CASE STUDY INVESTIGATING YEARS OF EDUCATIONAL WORKSHOPS

***Tina McIntyre*[1]**, *Alexander J. Reisinger*[2]
[1]University of Florida IFAS Extension Seminole County, Sanford, FL, USA
[2]University of Florida, Gainesville, FL, USA

Seminole County is home to the Wekiva Springs River, a National Wild & Scenic River that is impaired by nitrogen and phosphorous. This water resource is economically and environmentally tied to the area through recreation, property values, wildlife support and aquifer recharge. Research by Florida Department of Environmental Protection in the Wekiva Springs Basin estimates 26% of the nitrate entering the basin comes from urban turfgrass fertilizer. To decrease these nitrogen inputs, Fertilizer Workshops were conducted from Sept. 2018 – Sept. 2020 to educate participants on Best Management Practices (BMP's) for landscapes. Workshops targeted homeowners, who received a free bag of fertilizer formulated with 50% slow-release nitrogen for attending, and FDACS licensed landscaping professionals, who received over 520 fertilizer CEUs (271 professionals). Through 70 classes, 2,142 people were educated about fertilizer BMP's. Of those participants, 1078 completed reflective post-surveys which revealed 97.2% increased their knowledge on the impact's fertilizer run-off had on local waterbodies, 98.8% intended to use the information to fertilize their yard appropriately, and 95.3% were more confident they could fertilize appropriately. In a 6 month follow up survey, 86.5% of 579 participants reported they were using BMP's. Using UF|IFAS research on nutrient leaching, these outcomes were estimated to reduce annual N leaching by 112.9 to 1,039.6 pounds, providing an economic benefit of $56,486 to $519,856. These educational efforts resulted in data showing significant behavior changes resulting in a reduction of nitrogen leaching, subsequently decreasing the potential for algae blooms and other water quality impairments. Because of these workshops, participants better understand sources of water contamination resulting from fertilizer misuse and acted to change those behaviors.

PRESENTER BIO: Tina McIntyre is a Florida-Friendly Landscaping Agent who came to Extension with 10 years of experience; four as Senior Biologist at the Orange County Environmental Protection Division and six at the University of Central Florida Arboretum as Program Coordinator and Professor. She specializes in water quality/quantity and landscape BMP's.

NITROGEN-ENRICHED DISCHARGES FROM A VAST WATERSHED INTENSIFY RED TIDE BLOOMS IN SOUTHWEST FLORIDA

***Miles Medina*[1]**, *David Kaplan*[1], *Eric C. Milbrandt*[2], *Dave Tomasko*[3], *Ray Huffaker*[4], *Christine Angelini*[1]

[1]Center for Coastal Solutions, Engineering School for Sustainable Infrastructure and the Environment, University of Florida, Gainesville, FL, USA

[2]Marine Laboratory, Sanibel-Captiva Conservation Foundation, Sanibel, FL, USA

[3]Sarasota Bay Estuary Program, Sarasota, FL, USA

[4]Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL, USA

Karenia brevis (red tide) blooms on Florida's Gulf Coast have severely impacted regional ecosystems, coastal economies, and public health, and a scientific and policy debate has emerged as to whether these blooms are primarily natural or anthropogenic. Recent research suggests that natural processes explain offshore bloom initiation and shoreward transport, while anthropogenic nutrient inputs may intensify coastal blooms. However, past correlation studies have failed to detect compelling links between coastal blooms and watershed covariates indicative of anthropogenic inputs. We contend that linking anthropogenic inputs to bloom intensification ("the anthropogenic hypothesis") is fundamentally a causal hypothesis and explain why correlation is neither necessary nor sufficient to demonstrate causality. Our empirical investigation leverages the fact that systematic temporal patterns may reveal systematic cause-and-effect relationships. Using time series derived from in-situ sample data, we applied singular spectrum analysis—a non-parametric spectral decomposition method—to recover deterministic signals in the dynamics of *K. brevis* blooms and upstream water quality and discharge covariates in the Charlotte Harbor region between 2012 and 2021. Next, we applied causal analysis methods based on chaos theory—i.e., convergent cross-mapping and S-mapping—to detect and quantify persistent, state-dependent interaction regimes between coastal blooms and watershed covariates. We found that nitrogen-enriched Caloosahatchee River discharges consistently intensified K. brevis blooms. Flows were typically most influential at the earliest stages of blooms, while the influence of total nitrogen concentrations was strongest during bloom growth/maintenance stages. These results suggest that discharges and nitrogen inputs may influence blooms through distinct yet synergistic causal mechanisms. Additionally, we traced this anthropogenic influence upstream to Lake Okeechobee (which discharges to the Caloosahatchee River) and the Kissimmee River basin (which drains into Lake Okeechobee), suggesting that watershed-scale nutrient management and modifications to Lake Okeechobee discharge protocols will likely be necessary to mitigate blooms.

PRESENTER BIO: Dr. Medina is a postdoctoral researcher at the UF Center for Coastal Solutions. He has expertise in chaotic dynamics and causality in complex environmental systems, with applied experience in coastal/wetland hydrology, water quality, and ecology.

"WE ARE EXHAUSTED": NAVIGATING INTERAGENCY COORDINATION FOR WATER MANAGEMENT IN THE TROPICS

Oswaldo Medina-Ramírez[1,2], *Jeffrey C. Johnson*[1,2]
[1]University of Florida, Gainesville, FL, USA
[2]UF-Water Institute, Gainesville, FL, USA

Collaborative water management (CWM) is central to sustainable transitions in the allocation, distribution, and use of water. Water managers, a specific group of natural resource managers involved in decision-making around water resources, can play a decisive role in shaping the outcomes of CWM due to their unique position at the intersection of governmental and civilian arenas. Collaborative process can be time and resource demanding, within this context water managers experience participation fatigue a significant but poorly understood barrier to CWG. This research seeks to advance the theorization of collaborative water management in the tropics and contribute a novel conceptualization of participatory fatigue by developing a better understanding on how water managers experience and navigate interagency coordination for water management in the context of the Tempisque-Bebedero (TBW) watershed in Guanacaste, Costa Rica. As it becomes increasingly clear that many water-related challenges may be decided by the ability of water managers to respond to public demands for civilian inclusion in the governing process, this research has the potential to support the design of more just and robust water management networks.

PRESENTER BIO: Oswaldo Medina-Ramírez is a PhD candidate in Anthropology specializing in governance and public policy. He is an interdisciplinary researcher/practitioner who has worked for governmental and non-governmental organizations throughout the Americas. He is part of the Inducing Resilience for Water-Subsidized Systems project, an effort to strengthen connections between the social and natural sciences.

ESTABLISHMENT AND USE OF NATURE COAST SPRINGS SYSTEMS BY COMMON SNOOK (*CENTROPOMUS UNDECIMALIS*)

***Jordan D. Miller**, Kym Rouse Holzwart and Kristina Deak*
Southwest Florida Water Management District, Brooksville, FL, USA

The Weeki Wachee River, Chassahowitzka River, Homosassa River, and Kings Bay/Crystal River Systems are located on Florida's Nature Coast and serve as winter thermal refugia for fish and wildlife. These springs systems face numerous complex threats, including climate change. Recent distribution shifts of species have occurred in the Gulf of Mexico as a result of rising temperatures, including the northward range expansion of Common Snook (*Centropomus undecimalis*). Because of this, we evaluated whether Common Snook are utilizing the Nature Coast springs systems and if their abundance and distribution varied temporally, seasonally, and spatially.

Almost 3,700 Common Snook were captured in the springs systems from Winter 2013 through Winter 2019. Only 21 fish were captured in the Weeki Wachee River System, while almost 1,800 Common Snook were captured in the Kings Bay/Crystal River System. Temporal trends suggested increasing Common Snook across years for the Kings Bay/Crystal River System. In the Homosassa River System, the average number of fish caught during the winter was higher than the average summer catch. Temporal and spatial patterns in the juvenile and adult Common Snook catch were found in all Nature Coast springs systems, and low numbers of young-of-the-year fish were found in two systems.

The results of our investigation demonstrate the establishment of year-round populations of Common Snook in the Nature Coast springs systems and their importance as winter thermal refugia. The continued availability of winter thermal refugia in these springs systems is a critical factor affecting the sustainability of Common Snook populations along the Nature Coast. Research is needed to obtain detailed information regarding the movement, behavior, and habitat use of Common Snook in the Nature Coast springs systems, as well as the effects of their establishment on other fish species.

PRESENTER BIO: Jordan David Miller is, foremost, a lifelong resident of the Nature Coast. With a Masters-level education, and as an Environmental Scientist, he works to design and implement meaningful environmental studies in the region's many freshwater systems. He is a naturalist, a well-traveled adventurer, and a proud father.

MONITORING THE WET SEASON OVER THE FIVE WATER MANAGEMENT DISTRICTS OF FLORIDA

***Vasubandhu Misra*[1, 2, 3]** *and C. B. Jayasankar*[2, 3]
[1]Department of Earth, Ocean and Atmospheric Science
[2]Center for Ocean-Atmospheric Prediction Studies
[3]Florida Climate Institute

In this study, we introduce the concept of the onset and demise of the rainy season over the five Water Management Districts (WMDs) of Florida, verify a remotely sensed rainfall dataset for monitoring the wet season, and demonstrate the efficacy of real-time monitoring of the evolution of the wet season of 2021. Our results indicate that the objective definition of the onset and demise of the rainy season display significant year to year variations affecting the seasonal anomalies of rainfall and length of the season. The remotely sensed dataset shows promise in comparison to rain gauge based rainfall analysis. The real time monitoring of the wet season 2021 provided reliable outlook for the season, which could be complimentary to existing seasonal forecast products.

PRESENTER BIO: Dr. Misra is a Professor of Meteorology with over 25 years of research experience in climate science. In the past decade he has extensively worked on Florida's climate from covering temporal variations from seasons to long-term climate change. He has over 120 journal publications and published 4 books.

PROJECTIONS OF SEA LEVEL RISE AND HIGH TIDE FLOODING FOR THE SOUTHEAST AND FOR FLORIDA IN PARTICULAR

Gary T. Mitchum
College of Marine Science, University of South Florida, FL, USA

The Fifth National Climate Assessment is underway, NOAA is close to releasing an update to their sea level report, and at the state level a Flood Hub has been established at the University of South Florida to provide guidance on sea level change for the State of Florida. I am involved in all of these activities as well with recent research on High Tide Flooding and will provide a report on all of these activities. The High Tide Flooding research is the only portion of this that is complete. That study demonstrates that the frequency of High Tide Flooding in our coastal areas will increase markedly in the next 10 years due to the interaction of the normal modulations of the tides with sea level rise. The other three activities are just getting underway (the National Climate Assessment and the establishment of the Flood Hub) or is not yet completed (the update to the NOAA sea level report), but by the time of the meeting I expect that I will be able to give substantial updates on all of these activities. In the case of the National Climate Assessment we should be at the level of the First Order Draft and as one of the authors of the Southeast chapter I should be able to give a relatively clear picture of how it is evolving. The NOAA report should have been released by then, and as one of the external reviewers I will be able to give a good summary. Finally, the Flood Hub will be fully established by then and I will be able to give a comprehensive view of what this activity will mean for the State of Florida.

PRESENTER BIO: Dr. Mitchum is a Professor of Physical Oceanography and the Associate Dean in his college. Before coming to USF he served as Director of the University of Hawaii Sea Level Center and has been involved in national and international sea level programs, both in situ and satellite, for 35 years.

MULTISPECIES LAWNS: AN ALTERNATIVE STRATEGY FOR LAWN RESILIENCY AND ECOSYSTEM FUNCTIONS

***Brooke Moffis*[1]**, *Wendy Wilber[2], Adam G. Dale[3], J. Bryan Unruh[4], Julia Rycyna[5], Sandra B. Wilson[5], and Basil Iannone[6]*

[1]University of Florida/IFAS, Lake County Extension, Tavares, FL USA
[2]University of Florida/IFAS, Center for Landscape Use Efficiency, Gainesville, FL USA
[3]University of Florida/IFAS, Entomology & Nematology Department, Gainesville, FL USA
[4]University of Florida/IFAS, West Florida Research and Education Center, Jay, FL USA
[5]University of Florida/IFAS, Department of Environmental Horticulture, Gainesville, FL USA
[6]University of Florida/IFAS, School of Forest, Fisheries, and Geomatics Sciences, Gainesville, FL USA

Lawns now comprise over 2% of the total US land cover, more than any other irrigated crop, with over 5 million acres in Florida alone. While providing valuable aesthetic, recreation, and erosion control benefits, lawn maintenance typically includes regular irrigation and fertilization. Fifty percent of household water usage in Florida goes to landscape irrigation. Adding flowering native species to lawns, may limit irrigation needs by increasing green coverage during dry periods. It may also provide other ecological benefits such as pollination, and arthropod biodiversity. The overall goal of this project was to quantify the resiliency, aesthetics, and functional value of multispecies lawns compared to bahiagrass, a drought-tolerant turfgrass species well-suited to Florida. In March 2020, 18 2x2 m plots were randomly assigned one of three planting levels: bahiagrass monoculture, bahiagrass-native forb mixture, or native forbs alone. Once established, plots were only irrigated three times to prevent plot loss. We quantified percent green plant coverage, pollinator visitation, and arthropod communities every 3 months, and administered surveys to green industry professionals to determine how likely they would be to adopt any of the three treatment levels in home landscapes. Throughout the study, we found 5-20% greater green coverage in plots containing forbs in the summer months, while turf only plots had 30% greater green coverage in winter months. Plots with both turf and forbs had the greatest coverage by the end of the study. Plots containing forbs experienced more pollinator visits by a greater diversity of pollinator types than turf only plots, and increased herbivore taxonomic richness and abundance; no difference in other arthropod types were found. Perception survey data are still being collected and analyzed. Adding forbs to bahiagrass lawns enhances green coverage during the growing season and may contribute to reduced irrigation needs during drier times of the year.

PRESENTER BIO: Brooke Moffis is the Commercial Horticulture Agent with UF/IFAS Extension Lake County and a PhD student with the School of Natural Resources and Environment. With 20 years of horticulture experience, she teaches residents, professionals, and municipalities Florida-Friendly Landscaping principles and provides plant diagnostic services.

LAKE-IN-A-BOX: HOW CITIZENS ARE TAKING RESPONSIBILITY FOR DOMESTIC WATER QUALITY

Jerome Madigan, ***Shannon Monahan***
Lake Cane Restoration Society, Orlando, FL, USA

Increased citizen interest in protecting domestic water quality and an ongoing need for high-quality water chemistry testing with short turn-around periods thrive in a symbiotic relationship. Lake-in-a-Box provides a fellowship of people willing to take responsibility and create a case for water quality improvements in their community. This paper describes the application of the Lake-in-a-Box process to Lake Hiawassee, one of many successful cases where this repeatable system has built strong relationships between stakeholders, the natural environment in which they live and the scientific community that is available to them.

Start a team – Once one member of the community spoke up about the declining water quality of Lake Hiawassee, there were many others responding with similar observances while using the lake recreationally. This elicited a sense of community responsibility for the health of the lake, and a team was formed.

Gather meaningful data – Data collection on microbial performance using a bio-electrode sensor that corresponds to available nutrients in the lake, as well as meteorological data were implemented. These data were made available to the team in real-time on a user-friendly interface that allowed the team to discern how various factors affect the quality of their lake.

Create an action plan – With data gathered and processed, the team at Lake Hiawassee determined the golf course near the lake contributed significantly to the excess nutrients in the lake and has led to excessive vegetative growth. Using this information, the team has initiated discussions with other stakeholders to create a plan of action.

Partner smart – Armed with continuous, real-time data, the team can make partnerships with surrounding entities to create solutions to the issues now identified. In the future, this is to include providing the gathered data to larger data repositories such as Water Atlas to increase the recognition of their efforts.

PRESENTER BIO: Shannon Monahan is the Director of Engineering Services for the Lake Cane Restoration Society. Through her work at the University of Central Florida, she possesses extensive experience in water chemistry testing and involving community members in the effort to protect Florida’s natural environment.

CCS3: ADVANCING COASTAL MONITORING THROUGH COLLABORATION: A PANEL DISCUSSION OF LESSONS FROM PINEY POINT

Co-organizers: Elise S. Morrison[1], Ed Sherwood[2], David Tomasko[3]

*Panelists: **Ed Sherwood[2], David Tomasko[3], Mark Rains,[4] Duane De Freese[5]***

[1]Engineering School of Sustainable Infrastructure and Environment, University of Florida, Gainesville, FL, USA
[2]Tampa Bay Estuary Program, Tampa, FL, USA
[3]Sarasota Bay Estuary Program, Sarasota, FL, USA
[4]Florida Department of Environmental Protection, Tallahassee, FL, USA
[5]Indian River Lagoon Council, Sebastian, FL, USA

The restoration and maintenance of coastal habitats (e.g. seagrass, mangrove, oysters) in Florida estuaries has been a primary ecosystem recovery goal for local, regional, and state resource managers since the 1980s. Significant water quality improvements stemming from several decades of enhanced nutrient load management led to peak seagrass coverage gains in 2016 within many Southwest Florida estuaries, for example. However, acute and chronic nutrient discharges are suspected in recent declines of water quality and coastal habitat spatial extent and health within several Florida systems. This session will include an introductory presentation by Ed Sherwood, the Director of the Tampa Bay Estuary Program, and an ensuing panel discussion that will focus on: 1) the monitoring collaborations necessary to initially develop goals and document coastal habitat recovery in Florida estuaries; 2) contemporary triggers and conditions that have led to additional coastal eutrophication concerns for maintaining coastal habitats and natural resources within Florida's urbanizing coast; and 3) a vision for ecosystem monitoring collaborations and needs within Florida's estuaries of national significance that will help ascertain whether recovery and positive restoration trajectories are maintained into the future. Specific case studies from Florida's estuaries, such as Tampa Bay and the Indian River Lagoon, will be discussed.

ORGANIZER BIOS:
Dr. Morrison is an assistant professor in the Engineering School of Sustainable Infrastructure and Environment at the University of Florida whose research focuses on the biogeochemistry and microbial ecology of wetlands and estuaries. She holds a Ph.D. from the UF's Soil and Water Sciences Department and a B.S. from the University of California, Davis.

Dr. Ed Sherwood has served as Tampa Bay Estuary Program's Executive Director since 2018 after serving as the Program Scientist since 2008. He directs TBEP's technical and public outreach initiatives and serves as the primary policy liaison between its many public and private partners. He holds a B.S. degree in Marine Biology from the University of West Florida, and a M.S. degree in Marine Fisheries and Ecology from the University of Florida.

Dr. David Tomasko is the Executive Director of the Sarasota Bay Estuary Program and has more than 30 years of experience in water quality assessments and the development of science-based natural resource plans in the Gulf of Mexico and international locations. He holds a Ph.D. in biology from the University of South Florida, a Master of Science in marine biology from the Florida Institute of Technology, and a Bachelor of Science in biology from Old Dominion University.

SURFACE AND SUBSURFACE HYDROLOGY AND FLOOD MITIGATION IN ESTERO RIVER HEADWATERS, SOUTHWEST FLORIDA

Madison Mullen*, Kallie Unger, Ajpaal Kalyanmasih, Rachel Rotz, and L. Donald Duke*

The Water School, Florida Gulf Coast University, Fort Myers, FL, USA

Climate change has produced increased precipitation, and increased frequency of intense high-precipitation events, in southwest Florida where suburban land use has developed with runoff management, stormwater detention, and flood conveyances sized and designed for smaller events than are now the norm. This ongoing research investigates the role of wetlands, detention ponds, and conveyances in flood mitigation, using the campus of Florida Gulf Coast University (FGCU) in Fort Myers, Florida as an instrumented laboratory to assess hydraulic connectivity and hydrologic responses of the natural and constructed systems. The campus operates 14 stormwater detention ponds, required by Florida regulations for residential and commercial development. Ponds are designed for water quality protection but widely misconstrued as flood protection. Previous research demonstrated that runoff storage - thus flood mitigation capacity - is minimal in the campus ponds but successfully achieved by the extensive campus wetland system. In Fort Myers, wet weather season rainfall (June - September) constitutes 65% of the annual average 135 cm, producing substantial year-long elevation fluctuation in water table and surface waters. The research uses data for the 2020 and 2021 wet weather seasons from a network of elevation gauges on the FGCU campus, including data at 10-minute intervals from automated stations at 5 ponds and up to 7 piezometers. Results show that groundwater-surface water interaction varies by season, producing plentiful excess storage capacity in dry season – when flood protection is least needed. Surface water elevation change from a single event can be dramatic – threatening flooding – when ponds and wetlands fill to capacity during the wet weather season, but the extensive FGCU wetlands have been able to accommodate even Hurricane Irma’s 2017 20-cm one-day rainfall. Conclusions have broad implications for future management decisions throughout Florida about landscape design for flood mitigation.

PRESENTER BIO: Ms. Mullen is a graduate student in the MS Environmental Science degree program of the FGCU Water School.

KARENIA BREVIS UTILIZATION OF DISSOLVED ORGANIC NITROGEN IN WASTEWATER AND STORMWATER POND EFFLUENT

Amanda Muni-Morgan[1,2], *Mary G. Lusk*[1], *Cynthia A. Heil*[1], *Amy McKenna*[3], *Patricia Scanlon Holland1*[1], *Audrey Goeckner*[4]

[1]Soil and Water Quality Laboratory, Gulf Coast Research and Education Center, University of Florida, Institute of Food and Agricultural Sciences, Wimauma, FL, USA

[2]Mote Marine Laboratory, Sarasota, FL, USA

[3]National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL, USA

[4]Soil and Water Sciences Department, University of Florida, Gainesville, FL USA

Karenia brevis, the toxic dinoflagellate responsible for Florida Red Tide, blooms almost annually along the southwest coast of Florida, imposing significant ecological and human health impacts. Researchers have identified 13 nutrient sources supporting these blooms, including nearshore anthropogenic inputs. The influence of dissolved organic nitrogen (DON) from stormwater and wastewater runoff on coastal *K. brevis* blooms is unknown. We examined the bioavailability to *K. brevis* DON from water samples sourced from three stormwater ponds along an age gradient and one municipal wastewater sample, all from Manatee County, Florida, in a 21-day bioassay experiment. Results demonstrate that *K. brevis* was able to utilize a wide variety of N based compounds within each treatment. Specific growth rates for each stormwater pond, SWP 34 (age 34 yrs.), SWP 18 (age 18 yrs.), and SWP 14 (age 14 yrs.) were 0.21 day^{-1}, 0.37 day^{-1}, and 0.39 day^{-1}, respectively, with the highest cell yield in the oldest pond. The municipal wastewater sample had the highest specific growth rate of 0.48 day^{-1} and the lowest biomass. Using Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR MS), we were able to catalogue the molecular composition of the DON pool and identify degradation patterns within specific compound classes. Results showed that *K. brevis* utilized a wide range of compounds in the bulk DON pool, including lipid, protein, and lignin-like compounds. These data confirm the potential for stormwater ponds and/or wastewater to contribute nutrients which can potentially fuel coastal *K. brevis* blooms.

PRESENTER BIO: Amanda Muni-Morgan is a PhD Interdisciplinary Ecology student whose research focuses on the impacts of urban nutrient inputs (i.e., stormwater runoff, municipal wastewater) on harmful algae blooms (HABs) in Tampa Bay, Florida. Amanda has over 3 years of experience researching HABs, including mitigation, bloom ecology, and taxonomic identification.

HIGHLIGHTING FLORIDA NATIVES IN A COMMERCIAL LANDSCAPE

Leslie Nicole Munroe
University of Florida IFAS Extension, Vero Beach, FL 32960

The efforts of the Environmental Horticulture and Master Gardener Volunteer (MGV) programs in Indian River County (IRC) are focused on Florida-Friendly Landscaping (FFL). FFL lecture series and other learning opportunities have been offered to program participants; however, the extension office does not have its own grounds to provide demonstrations of FFL techniques or landscaping options for water conservation. A partnership between Indian River County Parks and Recreation Department and IRC Extension emerged to improve a failing landscape at a newly constructed multi-generational activities facility, the interGenerational Center (iG), and to promote FFL and water conservation through utilization of low water requiring plant species

The urban horticulture agent performed various site visits and provided recommendations to remedy the unfortunate appearance of failed landscape. On condition that the IRC area would be utilize as a FFL demonstration site, MGVs renovated the three largest beds in the entryway. Plants selected and installed for this project were a combination of colorful natives and popular non-invasives that were drought tolerant. The native plants were highlighted at the forefront of the beds. Signage in the beds indicated plant names and the rationale for their selection based upon FFL. Feedback from visitors to the iG Center has been tremendous with many inquiring about where native plants used in the beds could be purchased.

These renovated landscaped beds have helped to provide a more favorable view of Florida-Friendly Landscaping Principles. The Right Plant in the Right Place for this design includes colorful natives, provides for wildlife, and can utilize water more efficiently. Based upon the success of this renovation, plans are already in development for the renovation of highly visual landscapes at other county facilities.

PRESENTER BIO: Leslie Nicole Munroe has been the Environmental Horticulture Agent and Master Gardener Coordinator in Indian River County for the past 5 years. She promotes Florida-Friendly Landscaping and all its benefits in all her programmatic efforts.

IMPROVING WATER-USE EFFICIENCY OF IRRIGATION SYSTEMS WITH ML, AND SOIL MOISTURE AND WEATHER DATA

***Eduart Murcia**, Sandra Guzman*
University of Florida, Gainesville, FL, USA

Machine Learning (ML) and the Internet of Things (IoT) have the potential to increase water use efficiency from traditional irrigation systems. In addition, their combination could make easier the management of data for daily irrigation scheduling. However, ML and IoT research for irrigation scheduling is still limited. There are not many ready-to-use tools that allow to merge data from different sensors into a single comprehensive model, and the ML algorithms still need improvement to predict irrigation on a daily basis. These problems have undermined the farmers' confidence as they need to manage multiple platforms and process complex pieces of data to perform their field management decisions. In this project, we evaluate the efficiency of an adapted Long-Short Term Memory (LSTM) ML algorithm to forecast short-term irrigation recommendations. Data for algorithm training comes from a set of Soil Moisture Sensors (SMS) that collect real time data for three types of sandy soils at a greenhouse setting. In addition, weather data from the Florida Automated Weather Network (FAWN) in Fort Pierce is incorporated. LSTM is compared against three widely used ML algorithms to identify the best ML training algorithm. Results from this ongoing research will provide initial insights for the development of comprehensive irrigation modeling tools that can be easily utilized by citrus growers in southeast Florida.

PRESENTER BIO Eduart Murcia is a first-year graduate research assistant at the University-of-Florida. He holds a bachelor's degree in Agricultural Engineering. His Master Program focuses on developing decision support tools, based on real-time sensor data for irrigation management in specialty crops. His main research interest includes water resources engineering, hydrological-modeling, and extension.

HUMAN-FACILITATED BIVALVE POPULATIONS EFFECT ON ENERGY AND NITROGEN FLOW THROUGH MARINE ECOSYSTEMS

***Anna E. Murphy*[1,2]**
[1]INSPIRE Environmental, Newport, RI USA
[2]Northeastern University, Nahant, MA USA

Eutrophication, the increased supply of organic matter to a system, is often attributed to excess nutrient inputs and can lead to detrimental effects such as low oxygen and habitat loss. However, coastal sediments harbor microbial communities capable of transforming bioavailable nitrogen into inert gas (i.e. denitrification), thus potentially mediating eutrophication. For example, filter-feeding bivalves have been recognized as important facilitators of nitrogen removal by enhancing denitrification in sediments. This talk will explore controls on this critical microbial metabolism using clam aquaculture as a model system. Surprising results showed that, on a local scale, high densities of clams can be a source of nitrogen by facilitating nitrogen recycling and promoting dissimilatory nitrate reduction to ammonium (DNRA), a microbial pathway that competes with denitrification. Depending on the ultimate source of phytoplankton supporting the cultivated bivalves, these filter-feeders may serve as a noncanonical bottom-up control on primary production on a local scale. Since denitrification removes nitrogen while DNRA recycles it, understanding what controls the partitioning between these microbial pathways and how this dynamic may shift in response to changes such as organic matter input, nutrient addition, or salinity is essential to predicting how key ecosystem services will change over time. This is one example where suspension feeders have tremendous influence on these microbial nitrogen transformations, resulting in dramatic shifts in the energy flow through the ecosystem. Another example where anthropogenic activity may result in changes to populations of benthic filter-feeders is the development of offshore wind. The talk will conclude by discussing how shifts in the benthic community associated with the introduction of wind turbine foundations as novel structures may have large impacts to the energy flow of both the pelagic and benthic compartments of the northwest Atlantic outer continental shelf.

PRESENTER BIO: Dr. Murphy is an ecosystem ecologist interested in the response of marine systems to environmental change and anthropogenic stressorss. Her work focuses on understanding controls on the biogeochemical cycling of nutrients and carbon in sediments. She is a senior scientist working on projects monitoring and remediating organically-enriched systems.

NAVIGATING THE WATERS OF FUTURE CLIMATE: LAW & POLICY

Gerald Murphy *and* ***Thomas Ruppert***
University of Florida, Gainesville, FL, USA

Climate change and sea-level rise fundamentally alter the risks of flooding, rendering the "past is prologue to the future" approach to flood risk management obsolete. This fundamental change requires correlative changes in our approaches to developing and implementing plans and policies to avoid these changing, increasing risks.

Some of these flooding events are foreseeable—particularly sea-level rise—and can be modeled to predict the increasing extent of changes. As new information on climate change and its predicted impacts is reaching the public on an almost daily basis, the forecasts of existing models become less robust. But the science underpinning all modeling—existing and future—indicates that current projections upon which most models are based are increasingly optimistic.

Our presentation will begin with an overview of the global-scale implications of climate change-related physical impacts occurring today and the effect of these impacts on water and the water cycle. Next, we'll examine overarching legal, policy, and social implications. This examination will be followed by a deeper dive into specifics of planning and law, including discussion of the No Adverse Impact (NAI) approach to floodplain stewardship and recent developments in Florida law and policy.

The presenters will conclude with lessons learned, including some tentative lessons emerging from the presenters' on-going efforts with the Association of State Floodplain Managers (ASFPM) to build upon historical and contemporaneous water- and flood-related legal resources to develop a No Adverse Impact Legal Guide.

PRESENTER BIOS:
Jerry Murphy, JD, AICP, CFM is Faculty Consultant for the UF|IFAS Extension Program for Resource Efficient Communities, partnering with local governments to improve community resilience.

Thomas Ruppert, Esq. is Florida Sea Grant's Coastal Planning Specialist. He develops legal and policy analysis related to sea-level rise for local governments.

EVALUATING CHANGES AND PREDICTING IMPACTS TO FRESHWATER FISH COMMUNITIES IN FLORIDA

Eric J. Nagid
Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA

The Florida Fish and Wildlife Conservation Commission (FWC) collects standardized fish community data from rivers throughout Florida and conducts site-specific research that can be used in support of Minimum Flows and Levels evaluations. This presentation provides an overview of FWC's long-term monitoring program and how it can be used to highlight distinct differences and changes in fish communities based on stratified stream segments and flow patterns. It will also discuss key findings from studies focused on the importance of floodplain connectivity/inundation, the effects of drought on species composition, fish density, and fish biomass, and an overview of habitat suitability projects that demonstrate potential ecological shifts from simulated flow reductions.

PRESENTER BIO: Eric is a Fisheries Research Administrator with the Florida Fish and Wildlife Conservation Commission. His research focuses on fish community and sportfish interactions with stream flows and levels, which has been used to support water management decisions throughout Florida. He represents his agency in the Instream Flow Council where he was the Past-President, as well as the Water Subcommittee of the Association of Fish and Wildlife Agencies.

SPATIAL AND TEMPORAL PATTERNS OF BENTHIC NUTRIENT CYCLING REVEAL EXTENSIVE ROLE OF INTERNAL LOADING

***Rachel L. Nifong*[1,2]**, *Jason Taylor*[2], *and Stephen DeVilbiss*[2]
[1]Southeast Watershed Research Laboratory, USDA Agricultural Research Service, Tifton, GA, USA
[2]Water Quality and Ecology Unit, USDA Agricultural Research Service, Oxford, MS, USA

Within shallow lakes, benthic denitrification can be an important pathway of reactive N (nitrogen) removal. However, these benthic sediments can also release substantial amounts of ammonium and phosphorus, influencing lake nutrient cycles. Seasonal and habitat specific patterns of temperature, organic matter (OM), and nutrient availability effects on sediment oxygen demand (SOD), dissolved nutrient flux, and N_2-N flux were explored within Beasley Lake, a low-gradient oxbow lake. Time series models indicate a higher probability of positive N_2-N fluxes in fall through spring and significant negative summer fluxes, but timing and magnitude of positive and negative fluxes varied with habitat type. Sediments from dominant open water habitats had net negative annual N_2-N fluxes (-2.34 g m^{-2} Y^{-1}), sediments within cypress habitats had slightly negative net fluxes, while shoreline habitat had positive annual net N_2-N fluxes (0.26 g m^{-2} Y^{-1}). Predictive models explain similar amounts of variation (*Adj.* R^2 = 0.57 vs. 0.47) in benthic N_2-N fluxes associated with changes in temperature, dissolved inorganic N, SOD, and sediment C:N ratios, but the best performing models demonstrated that relationships with predictor variables varied with habitat. Results show substantial annual release of ammonium and phosphorus from sediments with uptake of nitrate occurring during the spring. Results indicate that legacy nutrient cycling in Beasley Lake sediments generates nutrient loads proportional to external loading from the watershed. This poses a significant challenge for improving water quality in oxbow lakes within disturbed landscapes.

<u>PRESENTER BIO</u>: Dr. Nifong is a Research Hydrologist with USDA Agricultural Research Service. She has expertise in quantifying trace gas emissions and ecosystem metabolism. Most recently, her work focuses on how management influences water quality and quantity in aquatic agroecosystems.

DEVELOPMENT OF FUTURE CLIMATE SCENARIOS FOR REGIONAL HYDROLOGIC SIMULATIONS IN SOUTH FLORIDA

Jayantha Obeysekera[1], *Jenifer Barnes*[2], *Walter Wilcox*[2], *Anupama John*[1]
[1]Institute of Environment, Florida International University, Miami, Florida, USA
[2]South Florida Water Management District, West Palm Beach Florida, USA

The South Florida region is characterized by low relief, flat topography, and hydrology driven by both rainfall and evapotranspiration. Until recently, the regional hydrologic modeling used for planning major water resources projects assumed "stationarity" which is based on the concept that past hydrology is an indication of what is to be expected over the planning horizon of projects. Given the current focus on climate change, there is an increasing focus on adopting a "nonstationary" approach by using projected rainfall and evapotranspiration scenarios under future conditions for planning major projects associated with Everglades Restoration and Water Supply Planning. Such projections of future climatic conditions depend on the outputs of a variety of climate model datasets developed through both statistical and dynamical downscaling. The study provides an inventory of available climate model datasets and the development of climate scenarios for regional modeling. It includes a discussion of model culling using selected climate metrics appropriate for regional simulations and the challenges in addressing uncertainties and biases associated with climate model outputs.

PRESENTER BIO: Jayantha Obeysekera served as a member of the federal advisory committee which directed the National Climate Assessment in 2014. He was also a co-author of several regional and national sea level rise projections reports. He is a recipient of the 2015 Norman Medal of the American Society of Civil Engineers.

CRABS TRANSFORM VEGETATION-SEDIMENT-FLOW-MORPHOLOGY FEEDBACKS IN SOUTHEASTERN US SALT MARSHES

Collin J Ortals[1], *Orlando Cordero*[2], *Arnoldo Valle-Levinson*[1] *and Christine Angelini*[1, 3]

[1]Department of Coastal Engineering, University of Florida, Gainesville, FL, USA
[2]Department of Geological Sciences, University of Florida, Gainesville, FL, USA
[3]Department of Environmental Engineering Sciences, University of Florida, Gainesville, FL, USA

Vegetated coastal ecosystems are widely recognized as controlled by vegetation-sediment-flow-morphology feedbacks, which allow these systems to evolve dynamically and recover from external pressures such as manmade disasters, hurricanes, or sea level rise. Within these habitats, consumers, ranging from insects to crabs to horses, can modify vegetation structure and composition across landscapes and/or extirpate plants in localized areas. While consumers are well documented in ecological literature, their effects on altering hydrodynamics and geomorphology have received relatively little attention. To better understand the long-term fate of the vegetated, coastal systems, we need to consider the role of the consumer in vegetation-sediment-flow-morphology feedbacks. This study focuses on understanding the role of *Sesarma reticulatum* (purple marsh crab) in the vegetation-sediment-flow-morphology feedback in the southeast Atlantic Coast in the United States (Sapelo Island, GA). These burrowing crabs coalesce in high abundances in *Spartina alterniflora* dominated salt marsh creekheads, which denude vegetation and create extensive burrowing networks. Creeks with extensive crab grazing have been found to elongate at rates up to 3x faster than creeks without. Using a Riegel Terrestrial Laser Scanner, we quantified and characterized detailed evolution of a study grazed creekhead, and found that the creekhead advanced at a rate of 3.4 m/y. Detailed flows were measured with acoustic Doppler velocimeters and pressure sensors at five representative creeks with varying intensities of grazing. Analyses revealed enhanced flows with increasing crab grazing intensity. Modeling work in development of different creek network scenarios evaluate the alterations of flow and sediment delivery due to crab grazing effects. Taken together, these results demonstrate the importance of consumers in moderating the fate and evolution of these biogenic, coastal landscapes.

PRESENTER BIO: Collin Ortals is a PhD Candidate in the Coastal Engineering department. His research focus is understanding how flows and transport of material interacts with flora and fauna in southeast Atlantic salt marshes (USA).

CONTRIBUTION OF STREAMS TO GROUNDWATER RESOURCE IN THE MISSISSIPPI EMBAYMENT OVER THE PAST 100 YEARS

***Ying Ouyang*[1] *and Wei Jin*[2]**

[1]USDA Forest Service, Center for Bottomland Hardwoods Research, Mississippi State, MS USA

[2]St. Johns River Water Management District, Palatka, FL USA

Water resource sustainability due to increasing water demand under the changing climate is a critical concern worldwide. Many regions of the world, including north Africa, Middle East, south and central Asia, north China, north America, and Australia, are now experiencing water resource depletion and/or shortage. Among them, Mississippi Embayment (ME) of USA is one of the fastest groundwater depletion regions in the world. Mississippi Embayment encompasses Missouri, Illinois, Kentucky, Arkansas, Tennessee, Mississippi, Alabama, and Louisiana and is a key region for crop productions in midsouth USA. To maximize crop yields, some cropland areas of the ME with groundwater irrigation has increased 92% since 1998 and resulted in a significant depletion of groundwater resources. Currently, long term interactions between streams and groundwaters in the ME are basically unknown. Using the US Geological Survey's Mississippi Embayment Regional Aquifer Study (MERAS) model, we estimated the contribution of major streams to groundwater resources in the ME over the past 100 years from 1915 to 2014. The temporal interaction trends between the streams and the groundwaters in the ME were also estimated using the Mann Kendell statistics. Our study provides a useful reference to water resource managers and farmers in the ME and around the world when developing their groundwater supply strategies.

<u>PRESENTER BIO</u>: Dr. Ouyang is a research hydrologist. Over the past 30 years, his working experience has spanned the spectrum from basic to applied research in water resources, hydrology, soil physics, and environmental sciences. He has published more than 150 refereed journal articles with 80 articles as the first or sole author.

BREATHING LIFE INTO A SPRING: EVALUATING RESTORATION ACTIVITIES TO BETTER PRIORITIZE A HIERARCHY OF NEEDS IN FLORIDA'S SPRINGS

***Greg Owen*[1]**, *Matt Cohen*[2]

[1]Alachua County Environmental Protection Department, Gainesville, FL, USA
[2]University of Florida, Gainesville, Fl, USA

Ecological experiments emerge as crucial tools for establishing the preferential ordering of restoration activities and for screening out those activities that may have limited value. Understanding the "hierarchy of restoration needs" helps mangers support their decision making process when evaluating restoration activities. In order to examine a hierarchy of restoration needs in Florida's iconic springs we experimentally evaluated competing restoration actions. For over a one year period researchers monitored the response in plant and algal growth in experimental treatments while manipulating the variables of dissolved oxygen, introduction of grazers, introduction of plants, and removal of algae at Hornsby Springs, located in Alachua County Florida. We found dissolved oxygen to be the main driver of submerged aquatic vegetation growth and that subsequent restoration activities like the introduction of plants and snails would only be successful when the correct initial conditions of dissolved oxygen levels were met. This experiment provides evidence to support the case that restoration activities in Florida's springs ecosystems will have the best chance of success when the initial conditions of dissolved oxygen are met.

PRESENTER BIO: Gregory Owen is a Senior Planner at the Alachua County Environmental Protection Department. Owen has 12 years of experience working with ACEPD's Water Resources Division. He oversees and implements water quality and restoration projects. Owen is also pursuing a Masters degree from the University of Florida with focus on springs ecology and restoration.

ASSESSING AND MITIGATING THE IMPACTS OF SEA LEVEL RISE ON FLOODING IN SOUTH FLORIDA

***Akintunde Owosina**, Hongying Zhao and Carol Ballard*
South Florida Water Management District, West Palm Beach, FL, USA

The South Florida Water Management District (SFWMD) is a regional agency in the state of Florida responsible for managing the water resources of a 16-county service area stretching from Orlando to the Florida Keys. Within this region SFWMD operates and maintains the primary flood control system, the Central and Southern Florida (C&SF) Project, authorized by Congress in 1948 following the great flood of 1947. The project was built by the US Army Corps of Engineers in the 1950s and 60s several of the assets are approaching the end of their design life. In addition, these flood control assets including canals and structures are experiencing conditions such as higher sea level and denser and more spatially extensive urbanization than were assumed at the time of their design.

SFWMD has embarked on an effort, the Flood Protection Level Of Service (FPLOS) Program to assess the ability of these assets to continue to meet their flood protection objectives and to identify what adaptations are necessary to ensure a resilient flood control system into the future considering the effects of continued urbanization, climate change and sea level rise.

This presentation will highlight the key aspects of the FPLOS program including innovative approaches for assessing flood risk at coastal gravity structures, coastal and inland basins, from extreme rainfall, tides, and storm surge. We will describe a collaborative approach to identifying and evaluating regional and local mitigation strategies, present opportunities, challenges, and scale of potential infrastructure investments and adaptations necessary over the next decade. The FPLOS Program approach and findings will be illustrated with examples from ongoing and recently completed studies in South East Florida.

PRESENTER BIO: Akin Owosina is Chief of Hydrology and Hydraulics at the South Florida Water Management District. He is a certified professional engineer with over 30 years' experience in water resources and modeling. He has led multidisciplinary teams responsible for flood control studies and restoration projects across South Florida.

A NEW METHOD FOR ESTIMATING WATER WITHDRAWN FROM PRIVATE DOMESTIC WELLS IN FLORIDA

*W. Scott McBride[1] and **Marco Pazmiño-Hernandez[2]***
[1]U.S. Geological Survey, Caribbean-Florida Water Science Center, Lutz, FL USA
[2]Cherokee Nation Businesses Contractor, U.S. Geological Survey, Caribbean-Florida Water Science Center, Lutz, FL, USA

Sustainable water-use planning benefits from comprehensive knowledge of the current demands and sources for all categories of water use. In 2018, nearly 550 million gallons per day of groundwater was withdrawn for public-water supply in the Southwest Florida Water Management District (SWFWMD). This potable water is used for purposes such as drinking, cooking, and bathing, as well as outdoor uses like lawn irrigation. In addition to public-supplied water, many households supplement their outdoor water supply with water from a private well. In 2015, over 101,000 wells were identified within the SWFWMD as lawn-irrigation wells. The withdrawals from lawn-irrigation wells are likely the largest unaccounted use of water in the SWFWMD for which there are currently no good estimates. The U.S. Geological Survey Caribbean-Florida Water Science Center (CFWSC) and the SWFWMD are working together to better quantify this use.

The CFWSC, in cooperation with the Alachua County Environmental Protection Department, conducted a pilot study from 2018 to present to develop a methodology for measuring the volume of groundwater withdrawn from private domestic wells. Twelve domestic wells in Alachua County were used to develop the methodology which uses an inexpensive electromagnetic meter that records how long the well pump runs. Flow rates are measured periodically at each well using a non-invasive ultrasonic flow meter. Together, the flow rate and run time data are used to calculate the volume of flow produced by each well per month. The Alachua Count pilot study led to a project in cooperation with the SWFWMD in which approximately 40 private wells will be monitored during 2022 in Sarasota and Polk Counties to estimate the average water use for lawn irrigation.

PRESENTER BIO: Marco Pazmiño-Hernandez has been working with the USGS CFWSC as a Cherokee Contractor for two years and specializes in water-use modeling. Marco received his master's degree from the University of Florida in the Department of Agricultural and Biological Engineering Department.

COMPOUNDING EFFECTS OF SURFACE-SUBSURFACE WATER INTERACTIONS AND SEA LEVEL RISE IN NORTH MIAMI

Francisco Peña[1,2,3,4,5]*, Jayantha Obeysekera*[3,5]*, Fernando Nardi*[1,3]*, Assefa Melesse*[4]*, Robert Jane*[7]*, René M. Price*[3,4]*, Fabio Castelli* [2]*, Todd Crowl* [3]*, Noemi Gonzalez-Ramirez*[6] *and Antonio Annis* [1]

[1]WARREDOC, University for Foreigners of Perugia, Perugia, Italy
[2]Department of Civil and Environmental Engineering (DICEA), University of Florence, Florence, Italy
[3]Institute of Environment (InWE), Florida International University, Miami, FL, USA
[4]Department of Earth and Environment, Florida International University, Miami, FL, USA
[5]Sea Level Solutions Center, Florida International University, Miami, FL, USA
[6]Riada Engineering Inc., Nutrioso, AZ, USA
[7]Civil, Environmental, And Construction Engineering Department, University of Central Florida, Orlando, FL, USA

Southeast Florida is highly vulnerable to heavy rainfall, hurricanes, king tides, and shallow water tables due to its flat terrain, geographical location, karst morphology, and rising sea levels. Despite innovations in hydroinformatics to simulate the combined effects of pluvial, fluvial, and coastal flood drivers, groundwater flooding is not envisioned in most 2D hydraulic models and flood mapping products. Here, we proposed an integrated surface-subsurface modeling framework capable of simulating the compound interactions of pluvial, coastal, and groundwater flooding in the Arch Creek Basin in North Miami. The framework applies a copula-based statistical analysis to estimate the flood hazard levels over a range of gauge stations near the study site. A two-way coupled FLO-2D and MODFLOW-2005 model then simulates inundation depths and extents for different combinations of 100-year precipitation – storm tide events paired with predefined water table levels. The analysis was repeated with sea level rise projections to assess the severity of future scenarios. The presented framework for surface-subsurface water interactions reveals that the emergence of groundwater to the surface increases the inundation extent in low elevation areas with minimal flood damage to buildings. The revelation of hidden risks caused by the compound effects of pluvial, coastal, and groundwater flooding may prove beneficial for better urban planning policies as well as prevention, mitigation, and adaptation strategies.

PRESENTER BIO: Mr. Peña is a Ph.D. Candidate in Earth Systems Science and Civil and Environmental Engineering with an extensive professional background in flood risk management. He has applied his flood risk expertise to support environmental, financial, urban resilience, and disaster risk reduction initiatives, projects, and scientific research in multicultural environments.

EFFECTS OF WATER AVAILABILITY ON COFFEE PRODUCTION, FARMER LIVELIHOODS AND ADAPTIVE STRATEGIES

*Reveca Abrego Santo[1], **Percy Peralta[2],** Catherine Tucker[3] and Edilberto Montenegro[1]*
[1]Universidad de Panama, Centro Regional Universitario de Bocas del Toro, Changuinola, Panama
[2]Ramsar Regional Center for the Western Hemisphere (CREHO), Clayton, Panama
[3]University of Florida, Gainesville, FL, USA

The effects of changes in water availability on crop production have been well documented across the globe. In the case of smallholder farmers in tropical regions, water scarcity may have severe effects on their livelihoods, and can drive land use change decisions which can be detrimental to the environment and human populations. Furthermore, when these production systems are located at river headwaters, these effects can be extended along the hydrological basin. Using the case of smallholder coffee farmers of Santa Fe de Veraguas in Central Panama, this study analyzes farmer perceptions of water availability impacts on coffee production, livelihoods, and their socioeconomic vulnerability in relation to potential land use change decisions.

The study addressed experiences and perceptions of farmers affiliated with the "La Esperanza de los Campesinos" agricultural cooperative. Production areas and farmer households were divided according to the perceived water availability: high rainfall, moderate rainfall, and dry zones. Ten households were randomly selected in each one of these three zones to compare results. Key informants were selected using a snow ball sampling technique. Mixed methods included participant observation, semi-structured interviews of key informants, and household surveys.

Compared to the rest of the sample, coffee farmers from dryer areas perceived more severe effects of water scarcity on coffee production (80%), on their livelihoods (80%), and socioeconomic vulnerability (90%) which may drive land use change decisions. Across the sample, 57% of the farmers reported severe impacts from water scarcity on coffee production, 70% reported severe livelihood consequences, and 67% reported severe socioeconomic vulnerability. We recommend that organizations concerned with environmental conservation and livelihoods consider the effects of changes in water availability especially in dry regions, such as in the case of Santa Fe de Veraguas.

PRESENTER BIO: Dr. Peralta is a social environmental scientist and practitioner with 20 years of experience with smallholder communities of users of natural resources in the Amazon, and Panama. He is currently a scientific advisor with Ramsar Center CREHO.

AGRICULTURAL WATER GOVERNANCE AND MANAGEMENT

Christopher Pettit
Florida Department of Agriculture and Consumer Services, Office of Agricultural Water Policy, Tallahassee, Florida, USA

Recent changes to Florida laws have impacted the way in which the Florida Department of Agriculture and Consumer Services' Best Management Practices program is administered. These changes also impact producers enrolled in the program. Until 2016, enrollment in the BMP program was considered voluntary, and implementation of BMPs was evaluated based on site visits and self-reporting by producers. In 2016, the Florida Legislature amended laws to require FDACS to develop procedures to verify implementation of best management practices and enforcement and requiring FDACS to conduct onsite inspections every 2 years during at which time certain nutrient records will be collected.

OAWP has been working continuously since adoption of these new law to develop the required procedures, forms, data management systems, mapping components, evaluation and tracking tools, and data collection tools to meet the intent of the legislation. New products and procedures also require significant staff training, and education and outreach efforts to those producers and industry stakeholders impacted by the changes. This presentation will provide an overview of the current state of BMP governance in Florida and highlight some of the technical challenges and ongoing collaborative research efforts between the University of Florida (as mandated by statute) and OAWP.

PRESENTER BIO: Director Christopher Pettit gained extensive experience with Florida water management, policy, and law serving in the offices of counsel for SFWMD and SWFWMD, and as a Policy and Legislation Manager for Palm Beach county. He has a law degree from UF and an LLM from the University of Cape Town.

EVERGLADES STORMWATER TREATMENT AREAS: MANAGING FLOWS TO ACHIEVE PERFORMANCE GOALS

*Cassondra Armstrong, **Tracey Piccone**, and Sean Sculley*
South Florida Water Management District, West Palm Beach, FL, USA

The Everglades stormwater treatment areas (STAs) are wetlands designed to remove phosphorus (P) from stormwater runoff before sending the water to the ecologically sensitive Everglades. After 2025, the South Florida Water Management District (SFWMD) must achieve the water quality-based effluent limit (WQBEL) of 13 µg P/L annual average from the Everglades STAs. Managing the flow quantity and timing is a key variable for achieving low P concentration. High flows and stages can stress emergent vegetation resulting in die-off, development of “short circuits” (preferential flow paths), tussock formation, and loss of P removal performance. Conversely, low/no flows can lead to dry-out, submerged aquatic vegetation (SAV) community loss, and TP resuspension in the water column upon rehydration.

SFWMD water managers and scientists set weekly STA inflow priorities based on weather forecasts, treatment cell stages, and vegetation condition within each treatment cell. Phosphorus loading rates are also monitored and factored into the inflow priority assessment. In addition, the SFWMD has built flow equalization basins (FEBs) upstream of the STAs to assist in moderating high flows to the STAs during the wet season and providing inflows in the dry season to maintain minimum stages. Flow attenuation helps to reduce the duration that STA treatment cells are above target stage, reducing vegetation stress and improving P removal performance. The FEBs may provide some water quality improvement as well, reducing P loading to the STAs. With the monitoring and management of flows through the STAs, P removal performance can be maximized and help achieve the WQBEL.

PRESENTER BIO: Tracey Piccone is a licensed Civil Engineer with over 30 years of experience in water resources engineering. As Chief Consulting Engineer, she is a key participant in investigating factors that influence phosphorus reduction in the STAs and management approaches to ensure the STAs achieve the mandated discharge phosphorus concentrations.

PESTICIDE CEUS AS A PLATFORM FOR WATER RESOURCE EDUCATION

Morgan G. Pinkerton
University of Florida, IFAS Extension, Seminole County, Sanford, FL, USA

In Florida, a Florida Department of Agriculture and Consumer Sciences (FDACS) pesticide license is required for many professionals to apply pesticides, from landscapers to natural areas managers to farmers. After initial licensure, license holders are required to obtain continuing education units (CEUs) to maintain and renew their licenses. Licenses are renewed annually or every four years with requirements ranging from 4-20 CEUs to renew, equating to up to 20 hours of topic-specific instruction. Many of these CEU classes focus directly on pest control strategies and technical topics related to pest identification and pesticide use. Though not usually the primary focus, water quality and quantity are themes found in many pesticide CEU classes from mixing pesticide solutions to keeping contaminants out of waterbodies. As of October 2021, there is estimated to be over 69,500 active FDACS pesticide licenses holders across the state. This presents the opportunity to educate a large audience looking to meet their training requirements by attending interesting classes on diverse topics related to pesticides and pest management. From September 2020 to September 2021, UF/IFAS Extension Seminole County offered 26 virtual pesticide CEU classes that included information on water resource topics to reach a total of 719 group learning participants. In a 3-6 month follow up survey, 94.3% (n=35) claimed that the training made them more aware of the importance of keeping pesticides out of waterbodies, 50.5% (n=107) said they adopted the practice of checking the environmental conditions (ie. chances of rain, wind, soil type etc.) prior to applying pesticides, and 48.6% (n=35) said that they now consider aspects of the location (ie. sunlight, water/irrigation requirements, etc.) prior to planting. Overall, pesticide CEU classes offer a platform that can be expanded in the future to educate professionals on water resource topics.

PRESENTER BIO: Dr. Pinkerton is a graduate of the UF Doctor of Plant Medicine program and has extensive interdisciplinary training on plants. In 2020, she joined extension as the Sustainable Agriculture and Food Systems agent. In many of her programs, she covers water quantity and quality as related to our food systems.

MORPHODYNAMICS OF OYSTER REEFS IN TIDAL FLATS UNDER VARIOUS SEA-LEVEL RISE AND WAVE SCENARIOS

***Daniele Pinton*[1]**, *Alberto Canestrelli*[1], *Simeon Yurek*[2] *and Julien Martin*[2]
[1]University of Florida, Department of Civil and Coastal Engineering Gainesville, FL, USA
[2]United States Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL USA

Oyster reefs are self-organized structures, that establish and grow through feedbacks between internal population dynamics and external factors. Reef self-organization depends on the balance of production and occupancy of the local substrate. The physical environment and mortality constrain reefs spatially by reducing production but expose substrate for recruits, which depend on spat deposition and growth. In estuarine environments, spat deposition is modulated by hydrodynamic and topographic parameters, such as waves, tides, and water depth. Here we couple an oyster population model with a simple wave model to take into account the feedback between hydrodynamics and reef evolution. In the model, spats deposition is modulated by the shear stress acting on the reef surface. Simulations are run for different combinations of tidal-flat geometries and hydrodynamic forcings. Model results show that reefs preferentially survive and reach a morphodynamic equilibrium for lower tidal-flat depths, narrower tidal flats, and lower wind intensities. Given the wind climate, lower water depths prevent the formation of high waves, even with high wind intensities, thus limiting the value of the shear stress, and facilitating spats deposition. Wider tidal flats allow for longer fetches and larger shear stresses, thus favoring reef collapse. With higher rates of sea-level rise, the parameter space that guarantees oyster growth drastically reduces. To our knowledge, this is the first attempt to couple hydrodynamics and population dynamics to predict the evolution of oyster reefs in intertidal environments at different climates. Our model results can be used by local managers to maximize the likelihood of success of oyster-reef restoration.

PRESENTER BIO: Daniele is a Ph.D. student at the Department of Civil and Coastal Engineering at the University of Florida. He got his bachelor’s and master’s degrees in Civil and Hydraulic Engineering at the University of Padova. In Spring 2019, Daniele joined Dr. Canestrelli’s lab, to improve numerical models in coastal environments.

UPDATE OF THE STORMWATER MASTER PLAN OF MIAMI-DADE COUNTY FOR CURRENT AND FUTURE CONDITIONS

Marina Blanco-Pape[1], P.E., Georgio Tachiev[2], PE, PHD, Elius Nortelus[1], P.E., ***Alberto Pisani****, P.E. and Amy Cook[1]*

[1]RER, DERM Miami-Dade County, FL, USA
[2]GIT CONSULTING LLC, Miami, FL USA

For more than 25 years, Miami-Dade County has developed and provided continuous updates of the SWMP. Since the initial numerical hydraulic and hydrologic stormwater modeling in 1993, the SWMP underwent modifications and improvements completed in 2005, 2009 and 2020. The improvements incorporated mitigation and redevelopment projects that have addressed historical surface water drainage challenges, hydraulic, hydrologic, and regulatory changes within the county. The most recent update completed in 2020 includes eleven watershed H&H models which cover approximately 780 square miles of inland and coastal land within and adjacent to Miami-Dade County. The updated watershed models incorporate the hydrologic and hydraulic factors impacting the urban areas of Miami-Dade County for the current conditions and for potential future Sea Level Changes. The watershed numerical models were used to analyze the most current and forecasted data available for population growth, topography, SLR scenarios, land use, groundwater levels, and rainfall volume and intensity. In addition to the hydraulic and hydrologic analysis completed to determine runoff rates and drainage system performance, peak flood geospatial mapping was applied to determine the maximum flood depths. A series of alternative model simulations were developed in sequential manner to analyze strategies for stormwater improvements, mitigation of remaining repetitive losses, and addressing climate change potential impacts. The models were additionally used to update the County Flood Criteria and the Water Control Maps which establish minimum canal bank, road and parcel elevation. This update is critical for the long-term sustainability and resiliency of Miami-Dade County's civil infrastructure.

PRESENTER BIO:

TURNING DOWN THE PUMPS: VARIABLE HYDROLOGIC RESPONSE TO PASSIVE RESTORATION AMONG WETLAND TYPES

***Renee Price**[1,2] and David Kaplan[2]*
[1]Atkins North America, Tampa, FL, USA
[2]University of Florida, Gainesville, FL, USA

Water supplies throughout Florida are highly dependent on withdrawals from groundwater aquifers. In Tampa Bay and surrounding counties, historically high levels of aquifer pumping have been associated with the desiccation of geographically isolated wetlands. Prior to 2000, pumping volumes had increased substantially to meet development and urbanization. Pumping management after 2000 greatly reduced groundwater abstraction rates, potentially acting as a "passive" hydrologic restoration. To test whether pumping management was sufficient to restore altered wetland hydrology, pre- and post-2000 water level data were compared for riverine, forested, and marsh wetlands in the Morris Bridge wellfield; Morris Bridge had historically been pumped at up to nearly 20 MGD annual average production, but this rate was reduced to 11 MGD or lower after 2000. Hydrologic response to pumping management was highly varied both within and between wetland types. Comparisons of median water depth pre- and post 2000 revealed both increased and decreased water levels for riverine, forested, and marsh wetlands. In general, median water depths and duration of inundation in forested wetlands appeared to improve more than in riverine and marsh wetlands after pumping management was implemented. While average wet season water depth increased for a majority of all wetlands (across wetland types), only about 30% of wetlands saw an increase in dry season water depth. Critically, reference (unimpacted) wetlands in the same region showed consistent hydrologic regimes when comparing the pre- and post-2000 periods. These results suggest that wetland hydrologic regimes may not respond uniformly to withdrawal reductions, either within or across wetland types, despite management efforts at the entire-wellfield scale. Ongoing work seeks to determine the major drivers of vulnerability, resiliency, and recovery for specific wetland types in response to withdrawals and passive restoration.

PRESENTER BIO: Renee Price is a senior scientist with Atkins North America and doctoral student the University of Florida focused on wetland hydrologic and vegetation responses to potable water withdrawals and passive restoration.

IMPACT OF SEASONALITY ON HYDROLOGICAL CONNECTIVITY IN LOW-LYING CARBONATE ISLANDS

Amy Pritt *and Patricia Spellman*
University of South Florida, Tampa, FL, USA

In island landscapes, hydrological connectivity between water bodies of different biogeochemical characteristics facilitates the transfer of energy, matter, and organisms which can significantly alter individual aquatic ecosystems. On low-lying carbonate islands, hydrological connectivity is enhanced between lakes and the adjacent aquifer due to high permeability pathways such as conduits which facilitate the exchange of water between the two systems. However, the exchange of water between the aquifer and lakes is also governed by the hydraulic head differences between them, which is ultimately controlled by the amount of precipitation which regulates aquifer and lake levels. We investigate the seasonal hydrological connectivity between lakes and the underlying aquifer on San Salvador Island, Bahamas, which would regulate the seasonal exchange of energy and matter, ultimately impacting lake ecosystem dynamics. We quantified monthly hydrological connectivity in individual lakes in 2019 using hydraulic head in both lakes and the aquifer and precipitation and controlling for evapotranspiration and tidal fluctuations. We used previously acquired geological data around each lake to complement the analysis of geological heterogeneity on the observed hydrological connectivity. We found significant changes in the degree of hydrological connectivity in many Holocene strandplain lakes, but not across lakes found in Pre-MIS 5 sediments. Our work aims to explore how these changes in hydrological connectivity affect overall lake ecosystem dynamics and how changes in connectivity to these fragile ecosystems may be at risk under climate change. Future work to include how seasonal changes in hydrological connectivity impact ecosystem biodiversity through environmental DNA work.

PRESENTER BIO: Amy Pritt is a Geology Doctoral Candidate at the University of South Florida. She has worked in both the private and public sector in hydrology and hydrogeology.

IMPROVED SENSOR-ANALYTICAL POINT SOLUTIONS (SNAPS) FOR E. COLI IN IRRIGATION WATER BY INTEGRATION OF STATISTICAL MACHINE LEARNING

Hanyu Qian[1]*, Nikolay A Bliznyuk*[1]*, Eric S McLamore*[2]
[1]University of Florida, Gainesville, FL, USA
[2]Clemson University, Clemson, SC USA

Reuse of alternative water sources (AWS) for irrigation has potential to reduce agricultural water shortage gaps. However, use of AWS, particularly for fresh produce, has increased risk of bacterial contamination. Thus, rapid and accurate identification of *Escherichia coli* in AWS (a classic biomarker for contamination) is crucial for resource management. Impedimetric biosensors are one of the most common tools for rapid pathogen detection but suffer from poor selectivity in complex media (where signal-to-noise ratios are low). We applied a laser-inscribed graphene (LIG) biosensor for measuring *E. coli* in AWS. Equivalent circuit model, which is one of the most powerful method to analyze the impedimetric data, may have limitation for complex examples. We developed a statistical machine learning framework to predict the *E. coli* concentration in AWS. The results show that using statistical machine learning algorithms to fit the biosensor data can reduce the prediction error 20% to 70%, compared with standard equivalent circuit models (ECM; Randles-Ershler). Furthermore, we find that the ECM prediction ability can be improved when it is coupled with some SML algorithms. Our research will nicely bridge SML with biosensor and ECM, and this tool could enable growers who lack access to analytical lab services to meet regulatory requirements with high confidence.

<u>PRESENTER BIO</u>: Mr Qian is a Ph.D. student of agricultural and biological engineering at the University of Florida Agricultural and Biological Engineering department. Much of his work focus on applying machine learning methods to analyze biosensor data. His study area, much like his research interests, is split between Statistics and Machine learning.

FORENSIC MAPPING OF THE STUNNING TRANSFORMATION OF FLORIDA'S COASTAL WATERSHEDS OVER 150+ YEARS

***Kai Rains**, Mark Rains, Stephanie Lawlor, Kurt Schmidt, and Shawn Landry*
University of South Florida, Tampa, FL, USA

Though land use-land cover (LULC) change has been widely implicated in the degradation of coastal water quality, we continue to lack a nuanced understanding of how LULC change has varied in space and time because so much occurred before the advent of modern mapping standards. We have overcome this challenge using forensic mapping techniques of LULC change over the past 150+ years in the Indian River Lagoon (IRL) and Tampa Bay Watersheds (TBW), Florida. Both watersheds contribute to estuaries of national significance which have received international media attention as degraded water quality has been implicated in harmful algal blooms, seagrass loss, and marine life mortality. Our techniques comprise benchmarking historical mapping products to modern mapping standards, with historical mapping products including maps and notes from the Public Land Survey System and military campaigns from throughout the 19th century, and aerial imagery, geologic maps and soil surveys, and LULC maps from throughout the 20th and 21st centuries. Results illustrate the stunning transformation of these watersheds. In portions of the IRL, the loss of wetlands has exceeded 85% and the increase in drainage density has exceeded 300%, mostly due to agricultural conversion. Interestingly, these occurred over different time intervals, with most of the loss of wetlands occurring between the 1950s-2000s but most of the increase in drainage density occurring earlier between the 1850s-1950s. Results are similar in the TBW, where the loss of wetlands exceeded 33% between the 1950s-2000s, mostly to a mix of urban and agricultural conversion, which has been incompletely mitigated by a smaller 11% increase in artificial waterbodies between the 1950s-2000s, including stormwater ponds. These more nuanced understandings of LULC change are facilitating ongoing efforts to restore wetlands and drainage networks, including an ongoing effort to more intentionally plan water-quality restoration projects in the IRL.

PRESENTER BIO: Dr. K. Rains is an Associate Research Professor who studies ecosystem response to environmental stress, including nutrient limitation and global change. She works at both the organismal level, including root-mycorrhizal associations, and the landscape level, including the application of geospatial tools, with a focus on waters and wetlands.

IMPACT OF SEA LEVEL RISE ON FLOODING AND WAVE LOAD: THE CASE OF THE GLASS WINDOW BRIDGE, BAHAMAS

***Edwin Rajeev*[1]**, *Alberto Canestrelli*[1], *Leonard Barrera Allen*[2] *and Haochen Li*[1]
[1]University of Florida, Gainesville, FL, USA
[2]Cummins Cederberg Inc, Miami, FL USA

The Glass Window Bridge (GWB) located in Eleuthera, The Bahamas, is the only bridge connecting Eleuthera's northern and southern mainland, facing the Atlantic Ocean to the east and the Great Bahama Bank to the west. This bridge is under constant threat from hurricanes and large swells in the Atlantic Ocean. The existing bridge has been subjected to severe damage arising from wave impact forces since its construction. The Perfect Storm of 1991 displaced the GWB by twelve feet westward toppling a lane of traffic. Although the damaged section of the bridge has been fixed, its complete reconstruction is being currently planned. However, as the global climate warms and sea level rises (SLR), the GWB will be subject to more extreme intense hurricanes and likely more intense overtopping. Therefore, there has been an urgent need to assess the impact of potential SLR on the GWB to guide the GWB redesign and reconstruction, in particular the bridge elevation and its distance from the coastline. This study bridges the influence of the current trends in SLR and climate change on communities and the infrastructure connecting them. The findings from this research will aid in understanding climate variability and risk in current and future decision-making for road infrastructure plans. One of the primary considerations for the redesign is to quantify the maximum horizontal and vertical reach of the spray generated by storm waves. We meet this need by developing a multiphase computational fluid dynamics (CFD) model that estimates spray generation for three major historical storm events, as well as for three different estimates of SLR. Our results suggest that, due to SLR, the islands will be subjected to increased overtopping, which will occur even during normal wave conditions. Notably, a nonlinear increase in the horizontal and vertical reach of the spray is observed with SLR.

PRESENTER BIO: Edwin Rajeev is Ph.D. student working under the guidance of Dr. Alberto Canestrelli with the Civil and Coastal Engineering Department at UF. He has experience in numerical modeling for riverine and coastal flows. He has a background in instrumentation and robotics for environmental flows.

ENVIRONMENTAL AND ECONOMIC TRADEOFFS OF LAND USE AND MANAGEMENT IN THE FLORIDAN AQUIFER REGION

***Nathan Reaver*[1]**, *Dogil Lee*[2], *Sagarika Rath*[2], *Unmesh Koirala*[3], *Fei He*[4], *Henrique Haas*[5], *Rob de Rooij*[1], *Tatiana Borisova*[4], *Damian Adams*[3,4], *Latif Kalin*[5], *Amanda Smith*[6], *David Kaplan*[7,8], *and Wendy Graham*[1,2]

[1]Water Institute, University of Florida, Gainesville, Florida, USA
[2]Department of Agricultural and Biological Engineering, University of Florida, Gainesville, Florida, USA
[3]School of Forest, Fisheries, and Geomatics Sciences, University of Florida, Gainesville, Florida, USA
[4]Food and Resource Economics Department, University of Florida, Gainesville, Florida, USA
[5]School of Forestry and Wildlife Sciences, Auburn University, Auburn, Alabama, USA
[6]Department of Agricultural and Applied Economics, University of Georgia, Athens, Georgia, USA
[7]Environmental Engineering Sciences Department, University of Florida, Gainesville, Florida, USA
[8]Engineering School of Sustainable Infrastructure and Environment (ESSIE), University of Florida, Gainesville, Florida, USA

Agriculture and silviculture are economically and culturally important to the region overlaying the Floridan Aquifer. However, these systems consume water and can be nonpoint sources of nitrate, affecting water quantity and quality in the Floridan Aquifer and associated ecosystems. Specific management practices (MP) applied at the farm- and forest-scale substantially influence aquifer recharge and nitrate leaching, and improved MP can reduce environmental impacts of production while also potentially improving yields. However, such MP typically require new equipment/technologies, often with high costs, potentially prohibiting adoption by producers or reducing economic viability. Quantifying the environmental and economic tradeoffs of MP is important for supporting their adoption and incentivizing environmentally favorable, but potentially economically unattractive, practices. In this study, we engaged with stakeholders in a participatory modeling process to develop and assess a range of MP and enterprise budgets for corn, peanut, carrot, hay, pasture-raised cattle, loblolly pine, slash pine, and longleaf pine in the Floridan Aquifer region. We used the Soil and Water Assessment Tool (SWAT) to simulate groundwater recharge, nitrate leaching load, and crop/forest yields. Economic analyses used enterprise budgets informed by SWAT outputs to compute net returns to the producer. Results were compared within a 3-dimensional tradeoff space (recharge-nitrate load-net returns). Results indicated clear tradeoffs between production systems, with row crops having the highest economic benefit and largest environmental impacts, while forest and forage had smaller economic benefit and lower environmental impacts. Importantly, improved MP dramatically reduced environmental impacts while maintaining similar or higher net returns. These observations suggest that improved MP can improve both the environmental and economic sustainability of agricultural and silvicultural production in the Floridan Aquifer region.

PRESENTER BIO: Dr. Reaver is a Research Assistant Scientist with the UF Water Institute. At the Water Institute, he currently applies his multi-disciplinary experience to the understanding of hydrological, ecological, and social dynamics in karst-dominated watersheds.

IMPROVING MODELING OF EARTH SYSTEM AND INTERSECTORAL DYNAMICS AT LOCAL SCALES: HURRICANE STORYLINES

Kevin A. Reed
Stony Brook University, Stony Brook, NY, USA

The production of actionable climate science relies on effective communication of regional climate information and its associated uncertainties across sectors. To be of value beyond academic circles, climate data must be sufficiently credible (i.e., physically grounded), understandable (communicated in the vocabulary of the decision-makers), and useful for the particular decisions that need to be made. Comprehensive assessment of both dynamical and statistical climate models adds substantial value to their outputs, particularly when the evaluation criteria are the product of a two-way dialogue between scientists and end-users. In this work, we provide an example of such efforts through the use of hurricane storylines. In particular, 7-day ensemble atmospheric model simulations are initialized in advance of Hurricane Irma's landfall in 2017 to explore characteristics of the storm's hazards. Additional simulations under future warming levels are completed to estimate the impact of global climate change on Hurricane Irma's hazards, particularly rainfall extremes. The work demonstrates the usefulness of storyline approaches, informed by interactions with water resource managers, to communicate climate risk at regional scales.

<u>PRESENTER BIO</u>: Dr. Reed is the Associate Dean for Research and an Associate Professor in the School of Marine and Atmospheric Sciences. Dr. Reed leads the Climate Extremes Modeling Group, which focuses on investigating how extreme events may change in the coming decades to better translate state-of-the-art science for climate adaptation applications.

PONGAMIA: AN ENVIRONMENTALLY FRIENDLY ALTERNATIVE CROP FOR CITRUS GROWERS

Amir Rezazadeh[1], *Sandra Guzmán*[2], *Lorenzo Rossi*[3], *Liliana M. Cano*[4], *and Alan Wright*[5]

[1]UF/IFAS Extension St Lucie County

[2]UF/IFAS Agricultural and Biological Engineering Department, Indian River Research and Education Center, Fort Pierce FL, USA

[3]UF/IFAS Horticultural Sciences Department, Indian River Research and Education Center, Fort Pierce FL, USA

[4]UF/IFAS Department of Plant Pathology, Indian River Research and Education Center, Fort Pierce FL, USA

[5]UF/IFAS Soil and Water Sciences Department, Indian River Research and Education Center, Fort Pierce FL, USA

Citrus growers in Southeast Florida are looking for alternative crops that could be planted in their current fallow lands and overcome economic losses from the citrus greening disease. Besides maintaining the Ag community's wellbeing, these alternative crops should require low water and nutrient inputs in order to promote environmental sustainability. Pongamia is a new alternative crop for citrus in the Indian River region that is adapted to the climate and conditions of the region. This crop can be planted in previous citrus lands without additional infrastructure or rigorous pest management investment. Pongamia is commonly known to be "lower maintenance crop" compared to citrus. However, there is no field-based scientific evidence that proves this in Florida. In this presentation, we show the preliminary findings of a Pongamia field trial at the Indian River Research and Education Center (IRREC) supported by SEEDIT UF IFAS that looks to provide a first draft of field management guidelines. The experiment evaluated three Pongamia varieties from Terviva and three irrigation scheduling techniques including soil moisture sensor-based, evapotranspiration based, and citrus growing calendar schedule. The water management practices were evaluated based on the plant and root physiological development, pathogens, and soil/water quality. The preliminary data obtained from this field trial will be used to inform existing and new Pongamia growers on the management practices required to maintain sustainable crops and will extend our understanding of Pongamia responses to the soil, water, climatic and potential biotic stresses in the region.

PRESENTER BIO: Fruit and Field Crops Multicounty Agent II. Working directly with Indian River and St. Lucie County commercial fruit crops producers as well as assisting Horticulture and Agriculture Agents. Dr. Rezazadeh's doctoral focus was on the influence of environmental factors and cultural practices on the physiology and development of greenhouse crops.

SOIL DENITRIFICATION DYNAMICS IN URBAN IMPACTED RIPARIAN ZONES THROUGHOUT TAMPA, FL

***John W. Roberts*[1], *Michael Andreu*[2], *Kanika Inglett*[3], *Matthew Cohen*[2], *and Wayne Zipperer*[4]**

[1]University of Florida IFAS – Palm Beach County Extension, Palm Beach County, FL, USA
[2]University of Florida – School of Forest, Fisheries, and Geomatic Sciences, Gainesville, FL, USA
[3]University of Florida – Soil and Water Science Department, Gainesville, FL, USA
[4]USDA– Forest Service – Southern Research Station, Gainesville, FL, USA

Denitrification is the anaerobic, microbial transformation of nitrate (NO_3^-) into inert, atmospheric nitrogen (N) under ideal conditions. It is a critical process in the management of anthropogenic NO_3^- and has been shown to respond to elevated N concentrations within the soil of urban riparian zones. We investigated the relationship between land use / land cover (LULC)classifications on soil denitrification and associated biogeochemistry within coastal, sub-tropical riparian zones. Soil samples were collected from low-order streams throughout Tampa, FL at distances of 0 m, 5 m, and 10 m from the streambank. Results from factorial analysis indicate that LULC classification ($p = 0.005$, $F = 4.406$) was significant in predicting denitrification enzyme activity (DEA) potential, with high density residential sites showing the greatest average DEA potential at 2.439 mg N $kg^{-1}h^{-1}$. Variables showing significant difference based on LULC classifications were pH and soil carbon to N ratio and showing that these factors likely had the most influence over riparian zone soil DEA potential based on LULC classification. These findings suggest that urban riparian zones are responding to elevated soil nitrogen; however, high residential areas showed lower carbon to nitrogen ratios than other sites, suggesting that some of the most urbanized areas could be improved to act as better NO_3^- sinks.

PRESENTER BIO: Dr. Roberts is a commercial horticulture agent and educator for UF-IFAS Palm Beach County Extension. He has worked on various research and educational projects related to urban forestry, ecosystem services, and landscape management.

SYSTEMATIC REVIEW AND STAKEHOLDER ROADMAP FOR FRESHWATER POLICIES IN THE PERUVIAN AMAZON

*Elizabeth Anderson, **Tania Romero Bautista***
Florida International University, Miami, FL, USA

Andean-Amazonian watersheds play an important role in biodiversity conservation and human wellbeing. They provide an important source of food and freshwater, perform critical ecosystem services, and create corridors for local wildlife and endangered species. Similarly, riparian communities living along these watersheds depend on the resources they provide for their livelihoods, making them vulnerable to negative impacts from gold mining and the encroachment of human development, such as the construction of hydroelectric dams. These ecosystems and river species, in turn, depend on their human inhabitants to adopt practices that will ensure their long-term health and functioning. Conservationists have long struggled to make their recommendations practicable for the actual communities they target. When met with the economic, social, and cultural realities on the ground, the pathway from theory to practice often fails to materialize. Such failures generate antagonism between initiatives aimed at conservation goals, like reducing deforestation, and social goals, such as ending poverty for local communities.

In Perú, this antagonism manifests itself in the effort to align freshwater management practices and policies with the social and economic realities of riparian communities. One strategy for resolving this tension is to conduct more integrative empirical research using evidence-based and participatory methodologies to analyze current freshwater policies and obtain more accurate data about the factors driving communities' decisions regarding the use of freshwater resources.

To achieve this, I propose to evaluate the evidential basis and justification for the current freshwater policies within the Marañon watershed by conducting a meta-analysis of literature, stakeholder analysis, and key informant interviews. I aim for my research to increase the effectiveness of these freshwater policies and improve outcomes for both people and ecosystems.

PRESENTER BIO: Tania Romero Bautista is a PhD student at Florida International University and Dr. Anderson's student in Tropical Rivers Lab. Tania earned her master's degree in Sustainable Development Practice from the University of Florida (2018) and her bachelor's degree in Ecotourism from the National Amazonian University of Madre de Dios (2012).

IDENTIFYING HYDROLOGIC CHANGES AND TRENDS USING AUTOMATED STATISTICAL ANALYSES

Tara L. Root
U.S. Geological Survey, Caribbean-Florida Water Science Center, Davie, FL USA

Climate change, sea-level rise, and human activities can result in changes in surface-water salinity, flow and stage, as well as groundwater levels and salinity. These changes can adversely affect ecosystem health and the sustainability of water resources for human use. Water managers need the big picture that can be provided by combining results of temporal, spatial, and statistical analyses of groundwater, surface water, and salinity data into one website that shows trends and current hydrologic conditions. Several existing USGS websites provide water managers with data and analyses; however, these existing websites are limited in data types, data sources, spatial extent, or statistical capabilities. Therefore, to aid coastal water managers, the U.S. Geological Survey is developing a prototype website, the Coastal Data and Analysis Tool for Water Resources Management (CDAT-WRM) by expanding on two existing U.S. Geological Survey websites, the Water Level and Salinity Analysis Mapper (WLSAM) and the Coastal Salinity Index (CSI). This new prototype builds on the framework of the WLSAM and CSI to: (1) incorporate additional types of data, (2) add data from non-USGS sources, (3) update and add new statistical analyses, and (4) include sites from a broader geographic area. R scripts are run daily to generate the tables, plots, and map symbols that will be displayed on the CDAT-WRM. The scripts automatically compute basic statistical summaries and rolling means, perform frequency and trend analyses, and generate graphical and tabular output for hundreds of hydrologic and water-quality monitoring sites. The CDAT-WRM website focuses on water level, flow, salinity, chloride, and specific conductance data from coastal monitoring sites. However, the R scripts and underlying automated statistical analyses from this prototype can be applied to a wide variety of data types in any geographic region as a tool for evaluating temporal trends, including those caused by climate change.

PRESENTER BIO: Dr. Root is a hydrologist with the U.S. Geological Survey Caribbean-Florida Water Science Center. She has extensive experience working on groundwater chemistry and groundwater-surface water interaction projects. She has 15-years of prior experience in academia where she taught hydrogeology and water resources courses and supervised graduate student research.

DOES MORE VARIETY MEAN HIGHER STABILITY? EXPLORING HOW SEAGRASS SPECIES DIVERSITY IMPACTS RESILIENCE

***Jamila Roth*[1]** *and Laura K. Reynolds*[2]

[1]School of Natural Resources and Environment, University of Florida, Gainesville, FL, USA

[2]Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA

Anthropogenic climate change is altering seawater temperature and chemistry. As a result of warming temperatures, tropical species are migrating away from the equator (i.e. tropicalization), and tropical herbivores are subsequently overgrazing subtropical seagrasses and macroalgae, resulting in the loss of these foundation species and the functions they provide. Since seagrasses reduce erosion, improve water quality and clarity, sequester carbon, and support diverse fish and invertebrate species (including endangered species and fishery species), loss of seagrasses has direct economic, cultural, and ecological consequences. The response of plant communities to increased grazing pressure depends on their diversity, both in terms of species diversity and genetic diversity. For seagrasses, the role of genetic diversity is well established, but fewer studies have investigated the role of species diversity. In this study, we used seagrasses in the northern Gulf of Mexico as a model system to understand the role of species diversity in ecosystem resilience.

Seagrass meadows along the Gulf Coast of Florida often contain multiple seagrass species, making this an ideal location to investigate the effects of seagrass species diversity. Warming temperatures will indirectly impact Gulf of Mexico seagrasses through tropicalization, with growing populations of herbivorous emerald parrotfish, green turtles, and manatees resulting in greater grazing pressure on seagrasses. To investigate how seagrass species diversity influences seagrass resilience to increased grazing pressure, we conducted a manipulative field experiment in Crystal River, FL where we simulated green turtle grazing in plots containing one, two, three, and four different seagrass species. Through this experiment, we aimed to improve our understanding of how seagrass species diversity impacts ecosystem services, functions, and stability, as this knowledge is important for designing effective seagrass management and restoration strategies.

PRESENTER BIO: Jamila Roth is a Ph.D. student in the School of Natural Resources and Environment, advised by Dr. Laura Reynolds in the Soil and Water Sciences Department. For her dissertation, she is researching the effects of environmental change and species diversity on seagrass resilience and seagrass-herbivore interactions.

USE OF SNOOK THERMAL REFUGE CRITERIA FOR MINIMUM FLOWS DEVELOPMENT IN COASTAL SPRINGS

Kym Rouse Holzwart *and Gabe Herrick*
Southwest Florida Water Management District, Brooksville, FL, USA

The Southwest Florida Water Management District (District) is required by state law to establish minimum flows for flowing waters within its boundary, which is from Charlotte County to southern Levy County along the Florida Gulf Coast and includes notable coastal springs systems, such as the Weeki Wachee River, Chassahowitzka River, Homosassa River, and Kings Bay/Crystal River Systems. Minimum flows are defined by Florida Statutes as "the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area" and are used for water supply planning and water use permitting.

The District's approach for developing minimum flows is habitat based. For the minimum flows re-evaluations for the Chassahowitzka River and Homosassa River Systems, the protection of thermal refuge habitat for Common Snook (*Centropomus undecimalis*) was identified as a key ecological resource to consider; this was the first time this criterion was used for minimum flows development or re-evaluation. Changes in temperature-based habitat as a result of flow reductions were evaluated using a hydrodynamic model and were considered specifically to avoid Common Snook stress, which was defined as temperatures dropping below 15° C for ≥24 hours. The current minimum flows for both systems are based on protecting snook thermal refuge habitat, defined as no more than a 15% reduction in area of suitable habitat (>15° C) compared to unimpacted flows during the coldest 24 hours.

Using acoustic telemetry, the District recently began a collaborative project to collect detailed Common Snook movement data in the Kings Bay/Crystal River System. The results will provide important information in support of protecting snook thermal refuge habitat when the Kings Bay/Crystal River System minimum flows are re-evaluated. The continued availability of winter thermal refugia in the District's coastal springs systems is an important factor affecting the sustainability of area snook populations.

PRESENTER BIO: Ms. Rouse Holzwart is a senior environmental scientist with more than 35 years of experience as an aquatic ecologist designing, managing, and participating in an extensive variety of projects in both the regulatory and research arenas. The majority of her project work has been on aquatic ecosystems in Florida.

MACROALGAE DECAY RATES AND DIVERSITY EFFECTS ON SEDIMENT BIOGEOCHEMISTRY IN A FLORIDA ESTUARY

Patrick H. Saldaña[1], *Eric C. Milbrandt[2], Ashley R. Smyth[3], Andrew H. Altieri[1]*
[1]Department of Environmental Engineering Sciences, University of Florida, Gainesville, FL, USA
[2]Marine Laboratory, Sanibel-Captiva Conservation Foundation, Sanibel, FL, USA
[3]Department of Soil and Water Sciences, University of Florida Tropical Research and Education Center, Homestead, FL, USA

When macroalgae blooms form from eutrophic conditions, their microbial decomposition can have negative impacts on seagrass beds and water through hypoxic conditions, nitrogen retention, and the smothering of benthic communities. Macroalgae are natural and diverse components of soft-bottom marine benthic ecosystems that can display a wide variety of traits such as morphological structure, nutrient uptake kinetics, lability, and decay rates. For example, some macroalgae grow quickly and assimilate and store nitrogen in excess of their growth requirements, generally undergoing fast decay rates when they die. However, our ability to predict the effects of macroalgae blooms is hindered by a poor understanding of how these algal traits affect bloom dynamics. In Matlacha Pass, Charlotte Harbor, FL a newly prevalent green alga, *Caulerpa fastigiata*, has recently smothered the benthos and driven unprecedented die-offs of seagrass beds. The legacy effects of this alga on benthic communities are largely unknown because *Caulerpa* spp., unlike other macroalgae, can uptake nutrients directly from the sediment, and as invasive ecological engineers, they can alter sediment properties in ways that prevent the recovery of otherwise competitively dominant species such as seagrasses. Here, we compared the traits of *Caulerpa* with two native macroalgal species, and correlated differences in ecological functions, including net N_2 flux and sediment nutrient content, with those traits to examine how different algae may reengineer soft sediment habitats following blooms. Specifically, we conducted field experiments and sediment core incubations in the summer of 2021 to (1) compare the decay rates and elemental ratios (carbon: nitrogen) of three algae (*Caulerpa, Acanthophora*, and *Gracilaria*) independently and in a mixed algae treatment, and (2) examine differences in dissolved gas, and nitrogen and phosphorous fluxes among different species of decomposing algae within *Caulerpa* fields and experimental *Caulerpa* removal plots. Our study provides insight on how the traits of different macroalgae may relate to their legacy effects on the biogeochemistry of soft-sediment ecosystems, with implications for seagrass recovery potential following harmful algae blooms.

<u>PRESENTER BIO</u>: Patrick Saldaña is a PhD candidate at the University of Florida and is advised by Dr. Andrew Altieri. He has conducted research on the marine ecology of kelp forests, coral reefs, and seagrass beds with specific interests on the legacy effects of habitat-forming species on ecosystem phase shifts.

PUBLIC PREFERENCES FOR MANAGEMENT OF AQUATIC INVASIVE SPECIES IN FLORIDA WATERS

***Olesya M. Savchenko**, Candice Prince, James Leary and Shelby Thomas*
University of Florida, FL, USA

There is a growing public debate among Florida residents over the use of aquatic herbicides to manage hydrilla*,* one of the most widely spread and aggressive invasive aquatic plants found in Florida. If left unmanaged, hydrilla can displace native plants, impede recreational activities, and block water flow in canals vital for flood-control during severe weather events. Between 2005 and 2015, $66 million was spent on hydrilla management in Florida. The primary method of control hydrilla is through aquatic herbicides applications. Although non-chemical methods of hydrilla management, such as mechanical harvesting exist, they tend to either be very expensive or less effective relative to chemical control.

Increasing stakeholder concerns about the potential environmental impacts of herbicide use in Florida waters has led to a temporary statewide moratorium on aquatic herbicide use. A series of public meetings revealed a strong preference for mechanical harvesting over herbicide use by the stakeholders in attendance. However, it remains unclear if the opinions expressed in these public meetings align with the general preferences of the rest of Florida residents. Given that aquatic plant management is largely driven by stakeholder needs, it is important to understand the extent of these concerns throughout the state.

Using a choice experiment study design, we surveyed 2,000 Florida residents to evaluate their awareness and preferences regarding hydrilla management methods. We assessed how preferences for hydrilla management methods vary with demographic and socio-economic characteristics, and other attributes, such as knowledge of hydrilla, recreational use of water bodies, spatial proximity to a water body, among others. Given the importance of public engagement on issues pertaining to lake management, we also tested how information about hydrilla management options provided by different sources impacts preferences. Results of the survey provide important and policy relevant insights for management of Florida public waters.

PRESENTER BIO: Dr. Savchenko is an Assistant Professor in Food and Resource Economics Department. Her research uses experimental economics and non-market valuation techniques to quantify the impact of human behavioral changes on natural systems. She is particularly interested in studying policy-relevant issues related to the management of water resources. Dr. Savchenko's research has been published in the top journals in the field of agricultural and applied economics.

SPATIAL DISTRIBUTION OF SEDIEMNT AND POREWATER BIOGEOCHEMICAL CHARACTERISTICS IN LAKE OKEECHOBEE

***Tracey Schafer*[1,2]**, *Paul Julian*[3], *and Todd Z. Osborne*[1,2]
[1]University of Florida, Gainesville, FL, USA
[2]Whitney Laboratory for Marine Biosciences, St. Augustine, FL USA
[3]Sanibel-Captiva Conservation Foundation, Sanibel, FL, USA

The benthic substrate of Lake Okeechobee is highly variable in both physical and biogeochemical attributes across its 460,000 acres. These attributes play a large role in the way nutrients are cycled between sediments and porewater. In order to map the changes in sediment and porewater chemistry over the last 15 years, approximately 180 sediment cores were collected using a piston corer. Additionally, a visual estimation of algal concentration and approximate water and sediment depth were collected at every site. After collection, sediments and associated porewater were extracted under an oxygen free environment and analyzed for nutrients and metals. Geostatistical analyses were conducted in ArcGIS to determine spatial patterns across the lake. The geostatistical models were then compared to previous mapping efforts conducted in 1998 and 2006 to determine system wide changes in sediment and porewater chemistry. This study found differences in spatial distribution of benthic substrates and their biogeochemical attributes. In addition, proximity to inlets and outlets have created a unique pattern of porewater chemistry throughout the lake that has changed over time. These unique patterns in sediment and porewater have the potential to further impact surface water quality and clarity across the lake.

<u>PRESENTER BIO</u>: Dr. Schafer is a postdoctoral researcher at the University of Florida Whitney Laboratory for Marine Biosciences. She studies biogeochemical cycling in a variety of aquatic systems, including restored wetlands, estuaries, and rivers.

COMBINED PROBABILITY OF COASTAL AND RIVERINE FLOODING

***Angela Schedel**, Ph.D, P.E.*
Taylor Engineering, Jacksonville, FL, USA

As part of our FEMA flood risk analysis and mapping efforts, Taylor Engineering created a streamlined calculation method to determine the combined probability of coastal and riverine flooding. The Combined Rate of Return (CROR) analysis tool works in conjunction with ArcMap and allows the user to visualize the flooding levels associated with each recurrence interval at chosen locations. The extreme water levels associated with these two different types of flooding processes are assumed to be physically independent and not concurrent. This simple assumption may not account for every storm-induced case; however, it allows for simple development of the compound flooding curves and is a method approved by FEMA.

To develop the curves, the flood elevation for each flood source is calculated at four different recurrence intervals. The rate of occurrence is equal to the inverse of the recurrence interval, such that the 100-year flood has a 1% annual chance of occurrence. The compound flooding curves show the 10%, 2%, 1%, and 0.2% annual chance water levels for both riverine runoff and coastal surge at a single point. These curves are created for numerous points along a longitudinal transect to find the combined water level at a given rate of occurrence. It is possible that a flood elevation is not present in the dataset for every recurrence interval, thus interpolation is used to fill in any missing information. The riverine and coastal flooding elevations associated with each recurrence interval at a given point are combined and smoothed to create the compound flooding curve. Determining the point where coastal flooding outweighs riverine flooding or vice-versa is a key component of the compound flooding analysis, and Taylor's CROR Tool eliminates the guesswork. This presentation will summarize the tool's use and how it can be applied within Florida to further flood adaptation planning.

PRESENTER BIO: Dr. Angela Schedel is a Vice President at Taylor Engineering in Jacksonville, Florida and leads the Coastal Planning group. She oversees a variety of projects conducting vulnerability assessments, creating adaptation strategies, and advocating for long-term resilience planning for local municipalities, the state of Florida, and federal clients.

FLORIDA KEYS RESIDENTIAL CANAL DEVELOPMENT IMPACTS ON NEARSHORE WATER QUALITY & BENTHIC DIVERSITY

***Kathleen Sullivan Sealey**, Jacob Patus and Zoi Thanopoulou*
University of Miami, Coral Gables, FL, USA

Small islands allow nutrients and sediment to enter near shore waters through groundwater seepage and surface storm run-off. Tropical carbonate islands such as the Florida Keys once relied on dense broadleaf forests and mangrove wetlands to restrict nutrient input to marine environments, supporting clear turquoise waters indicative of oligotrophic conditions. The Florida Keys now has about 500 dredged canals of varying depths, lengths, and orientations. Canals can trap organic material, including seaweed and seagrass, which accumulates and contributes to poor water quality with the accumulation of nutrients. Poor design and circulation in canals have been addressed in the past through a series of demonstration projects to remediate this problem through back-filling, adding culverts, or adding seaweed curtains. Universal wastewater treatment has been implemented throughout the Florida Keys, removing cesspits and septic systems as a source of land-based sources of nutrients. However, the legacy of the past rests at the bottom of dredged canals.

This research addressed is, "*Do canals in the Florida Keys contribute to nearshore water quality degradation?"* The research examined 13 sites in the Florida Keys, 9 residential canal sites and 4 state parks with undeveloped shorelines. Water samples were collected quarterly over two years from 2019 to 2021. A grid sampling design was developed with a 200 m by 500-meter areas running from the shoreline offshore (to 500 m). Random blocks within the grid were sampled for 8 water quality parameters, and benthic surveys were conducted to document benthic community classification, SAV and epifauna occurrences and abundance. The challenge was to design an efficient plan to understand any "halo" effect of nutrients from canals moving into adjacent nearshore environments. Results showed patterns of ecological degradation close to shore and changes in water quality related to orientation of the canals and the presence of dredged navigation channels outside of the canals.

PRESENTER BIO: Dr. Sealey is a professor in the Department of Biology and heads the Coastal Ecology Laboratory. She has over 35 years of experience in benthic ecology and coastal restoration. She has worked on the original inventory of Florida Keys residential canals in the early 2000's.

GRU GROUNDWATER RECHARGE WETLANDS – PAST, PRESENT AND FUTURE

Kristen Sealey *and Rick Hutton*
Gainesville Regional Utilities, Gainesville, FL, USA

Gainesville Regional Utilities (GRU) is constructing a groundwater recharge wetland park in western Alachua County in order increase aquifer recharge and support flows to the Santa Fe and Ichetucknee Rivers. The project will provide a public park and wildlife habitat in addition to beneficially using reclaimed water to recharge the Floridan aquifer with high quality, low nutrient water. A groundwater recharge wetland is a man-made wetland built on sandy soils. Reclaimed water is continuously fed to the wetland to sustain a healthy ecosystem. Natural wetland processes reduce nutrients in the water to low levels as it percolates into the ground and recharges the aquifer. GRU began operating its first demonstration recharge wetland at the Kanapaha Middle School (KMS) in 2008 and currently operates three recharge wetlands in addition to the Sweetwater Wetlands Park. The new recharge wetland will be located on a 75-acre site and will provide 3 million gallons per day (MGD) of recharge initially, with plans to expand up to 5 MGD. This project is part of the North Florida Regional Water Supply Plan and is a centerpiece in GRU's water reuse program that will allow GRU to continue to provide 100 percent beneficial reuse of reclaimed water. The performance and water quality data collected from these systems demonstrates the ability to attain a high water quality with nitrate levels below 1 mg/L. Alachua County plans to partner with GRU to manage public access and provide enhanced public park facilities. GRU will present an overview of its experience with groundwater recharge wetlands and summarize performance and water quality data, and will describe the wetland project that is currently underway.

PRESENTER BIO: Kristen Sealey is a utility engineer with 15 years of experience in the water resources industry. She has planned, designed, implemented and managed groundwater recharge wetlands throughout her career. She was the task manager for GRU's first demonstration wetland and is the project manager for the large wetland GRU is creating.

FLORIDA AGRICULTURAL SOIL MOISTURE SENSOR NETWORK

Vivek Sharma, *Charles Barrett, Yvette Goodiel, Lisa Hickey, Wendy Mussoline, Ajia Paolillo, Shawn Steed, Craig Frey*

Increasing competition for freshwater resources from urban development, tourism, energy, and agricultural sectors combined with climatic variability, have raised the water quantity and quality issues in the southeastern US. This is a particular concern for the state of Florida, which is a major region for high-value crops grown on sandy soils with low water-holding capacities and is heavily dependent on irrigation. These water quantity and quality challenges have led to scrutiny of groundwater by the state and local governments, leading to new regulatory approaches, best management practices (BMPs), and ground and surface water policies. Soil moisture is an important factor used in irrigated agriculture to make decisions regarding irrigation scheduling. With accurate monitoring of soil moisture, producers can avoid both excessive and insufficient irrigation that leads to reduced yield quantity and quality, increased runoff, erosion, leaching of nutrients, and other problems. To this end, the Florida Agricultural Soil Moisture Sensor Network was formed in 2018 from an interdisciplinary team of partners. The main goal of this network is to educate producers, extension agents and to work with state agencies to increase producer adoption of soil moisture sensors through a series of demonstration projects in producers' fields throughout the state to conserve water. The project facilitates in-depth, one-on-one educational opportunities between agents and growers about this beneficial and cost-saving technology. Currently, approximately 63 soil moisture sensors (SMS) are installed in 18 Florida Counties in different crop production systems. The network is bringing cultural and behavioral changes in technology implementation as a result of improving irrigation management. In addition, the project demonstrates effective irrigation management strategies by monitoring irrigation water supply, and soil moisture, which will conserve water and enhance crop water and nutrient use efficiencies.

PRESENTER BIO: Dr. Vivek Sharma is an Assistant Professor in the Agricultural and Biological Engineering Department at the University of Florida. His research and extension program addresses the application and development of precision agricultural water management technologies and strategies to enhance water-use efficiency while reducing the impacts of agricultural management practices on water quality.

ADAPTATION OF COASTAL COMMUNITIES AND NATURAL ECOSYSTEMS IN A CHANGING CLIMATE

***Y. Peter Sheng**, Vladimir A. Paramygin, Adail Rivera-Nieves, et al.*
University of Florida, Gainesville, FL, USA

Coastal communities in many parts of the world are subject to increasing coastal inundation risk due to compound impacts of intensifying tropical cyclones, accelerating sea level rise, extreme precipitation, and changing land use features. Here we present a dynamic process-based approach to assess the compound coastal flooding risk in two coastal regions in the U.S. – one along the New Jersey and New York coasts where Superstorm Sandy caused catastrophic flood damage, and another in southwest Florida (SWFL) where Hurricanes Irma and Wilma caused disastrous flood damage. Both regions have extensive coastal wetlands with tidal marshes in NJNY region and mangroves in SWFL.

Here we assess the current and future coastal flood risk in these regions by using a three-dimensional vegetation-resolving surge-wave model, a loss model with extensive field data and the Joint Probability with Optimal Sampling (JPM-OS) statistical method. We found the future probabilistic coastal flood hazards in both regions are expected to more than double by 2100. While coastal wetlands are found to have reduced flood-induce structural loss during past storms, their values are highly dependent on the storms and local topographic, wetland, and property conditions (*Sheng et al., Scientific Reports, 2021*). The flood protection value of coastal wetland will change over time but is likely to be retained by 2100.

For adaptation of coastal communities and natural ecosystems and communities, it is essential to consider the impact of changing climate on the 1% flood in coastal regions instead of a single tropical cyclone. We present a novel approach to incorporate the joint probability density functions of the five characteristic of tropical cyclones and the sea level rise. (*Yang et al., Natural Hazards, 2019; Sheng et al., Submitted, 2021).*

PRESENTER BIO: Dr. Sheng is a Professor Emeritus and Adjunct Research Professor in the Civil and Coastal Engineering Department of the Engineering School of Sustainable Infrastructure and Environment, University of Florida. He has been the PI of the Piermont Marsh project funded by the NERR Science Collaborative and the ACUNE project funded by NOAA. Dr. Paramygin is a Research Assistant Scientist in the same department with extensive experience in coastal modeling. Adail Rivera-Nieves is a Ph.D. candidate in the same department at University of Florida. We have too many contributors to list their names here.

CLIMATE CHANGE IMPACTS ON STREAMFLOW AND NUTRIENT LOADING IN THE NORTHERN LAKE OKEECHOBEE BASIN

*Jung-Hun Song[1], Yogesh Khare[2], **Satbyeol Shin[1]**, and Younggu Her[1]*

[1]Department of Agricultural and Biological Engineering & Tropical Research and Education Center, University of Florida, Homestead, FL, USA

[2]The Everglades Foundation, Palmetto Bay, USA

The projection of streamflow and nutrient loads is essential for future water resource management plans under varying climate and environmental conditions. This study investigated how climate change may affect streamflow and nutrient loading to Lake Okeechobee from its drainage watersheds, including the Kissimmee River Basin. Future precipitation and air temperature projections were made using 29 Global Climate Models (GCMs) for the two future periods (near 2043–2053 and far 2073–2083) under Representative Concentration Pathway (RCP) 4.5 and 8.5 scenarios. For hydrological projections, the climate projections were then incorporated into Watershed Assessment Tool (WAM) that was prepared to simulate water and nutrient transport processes in the drainage watersheds. Results showed that streamflow and nutrient loadings might change significantly for the future periods. However, climate and hydrological projections substantially varied depending on the selections of GCMs and RCPs, which suggests the need for a careful interpretation and comprehensive evaluation of future projections. This study is expected to provide information that helps develop climate adaptation plans and opportunities to understand the influence of global-scale changes on local watersheds for improved sustainability of the Northern Everglades system.

PRESENTER BIO: Satbyeol Shin is a Ph.D. student. Her doctoral research investigates optimal water management in a watershed-lake system. She is developing a spatially integrated tool to provide a holistic view of the connection between the upstream watershed and downstream waterbody.

ABIOTIC CAUSALITY OF METABOLIC PROCESSES IN RIVERS

***Yuseung Shin*[1]**, *Matthew J. Cohen*[2]
[1]School of Natural Resources and Environment, University of Florida, Gainesville, FL, USA
[2]School of Forest, Fisheries and Geomatics Sciences, University of Florida, Gainesville, FL USA

While ecosystem metabolism, gross primary production (GPP) and ecosystem respiration (ER), is typically strongly coupled with hydroclimatic variations in terrestrial ecosystems, less is known about the controls on metabolism in flowing waters. Temporal patterns of river metabolism are not solely determined by seasonality of climatic conditions but also by local environmental conditions (e.g., microclimate, watershed size, proximal land cover) that cause fine-scale variability and complex interactions of abiotic drivers, such as light, temperature, and flow dynamics. Consequently, riverine metabolic responses on the drivers show strong spatial heterogeneity. To enable dynamic predictions of river metabolism, it is crucial to disentangle individual effects of the drivers from their collective force. In this study, we analyzed the individual effects of three abiotic factors, open-sky light availability, water temperature, and discharge, on river metabolism by applying convergent cross mapping (CCM), a causality detection technique, on long-term metabolism data of 39 US rivers. We specifically tested a systems-level hypothesis about causes of GPP and ER variation at a range of time scales. CCM results support systematic controls of the drivers on metabolic variations in rivers but with varying magnitude and time scales of abiotic causality among sites. Several notable findings included that 1) light did not or weakly caused GPP variation under dense canopy cover, 2) discharge was not causally related with both GPP and ER in rivers with dynamic flow, and 3) there were substantial differences in the time scales of causality for the three abiotic drivers. Predictions of metabolic rates were more accurate with CCM results than by regression models, suggesting that accounting for local environmental conditions and the relevant time scales of causality is crucial for effective forecasting. Our study implies that the causal interactions can be a key structure to explain site-specific controls on ecosystem metabolism in rivers.

PRESENTER BIO: Yuseung Shin is a PhD student studying river ecosystem. He received a master degree on biogeochemistry by studying carbon dynamics between streams and soils. His current works focus on temporal patterns and controls of ecosystem-level photosynthesis and respiration in flowing waters.

INTEGRATING STAKEHOLDER RELEVENT ECONOMIC, RISK, AND HEALTH FACTORS IMPROVES WATER SUSTAINABILITY

Vijay Santikari[1], Kira Hansen[1], ***Sanjay Shukla[1]****, Gregory Hendricks[1], Johan Desaeger[2], Fadi Fathallah[4], Pamela Roberts[1], Kurtis Gurley[3], and Sarah Strauss[1]*

[1]SWFREC, Agricultural and Biological Engineering, Plant Pathology, and Soil and Water Science, UF/IFAS, Immokalee, FL, USA
[2]GCREC, Entomology and Nematology, UF/IFAS, Wimauma, FL, USA
[3]UF Civil and Coastal Engineering, UF, Gainesville, FL, USA
[4]Agricultural and Biological Engineering Department, UC Davis, CA, USA

We describe an innovative production system that is being adopted on farms across North America to reduce water and environmental footprints and production costs and risks. Most fresh produce is grown using raised bed plasticulture (RBP) on short and wide conventional beds (15-20 cm tall, 76-91 cm to wide), causing a perception that use of long irrigation cycles is necessary for proper wetted coverage. The RBP was redesigned to improve wetted coverage by using taller and narrower compact beds (CB; 23-30 cm tall and 66-41 cm wide). Large scale adoption of CB was possible by showing that factors beyond water, that are relevant to stakeholders, can be important drivers in achieving change. These factors included inputs, costs, production risks (pests/diseases, wind/flooding damages), labor health and productivity, and climate change adaptation.

Evaluation of CB began in 2013 and is continuing with co-investment from the industry and agencies on tomato, pepper, eggplant, and watermelon. Results show that CB maintained/increased yields and reduced: 1) production costs by up to $600/ha; 2) water usage by up to 50%; 3) runoff by up to 50%; 4) plastics by up to 25%; 5) pesticide by up to 50%; 6) carbon footprint by up to 10%; 7) nutrient leaching losses by up to 10%; 8) root-knot nematode (*Meloidogyne* spp.) count; and 9) incidences of diseases (Fusarium wilt, Phytophthora blight). Preliminary evidence suggest that CB can improve worker productivity and reduce musculoskeletal stress. CB also showed no physical damage from hurricane Irma compared to complete damage for conventional beds. As growers are adopting CB, they have begun to change fertilizer management. Lessons learnt so far indicate that pursuing a win-win solution to increase both profits and environmental sustainability can achieve large scale changes which otherwise would not have been possible by focusing on water conservation and quality alone.

PRESENTER BIO: Sanjay Shukla is a Professor of Water Resources in the Agricultural and Biological Engineering Department at UF. He specializes in hydrology and water quality with focus on developing sustainable solutions. Recent recognitions include UF Foundation Professorship, Water Institute Distinguished Fellow, and 2020 ASABE Netafim and Virginia Tech Distinguished Alumni Awards.

EFFECTS OF WILDFIRES ON ANNUAL STREAMFLOW RESPONSE IN THE SOUTHEASTERN AMAZON

Sharmin F. Siddiqui *and David A. Kaplan*
University of Florida, Gainesville, FL, USA

Amazon rainforests are an integral component of global atmospheric evaporation and precipitation processes and are increasingly threatened by accelerating fire regimes driven by large-scale deforestation and climate change. Forest disturbance can alter river hydrology, with changes in streamflow magnitude, baseflows, and peak flows. This study uses a multi-tiered analytical approach to relate the landscape-level disturbances of deforestation and fire to hydrologic change in the southeastern Amazon and assesses the spatial and temporal scales over which deforestation and fire alter riverine hydrology. First, a before after control impact (BACI) approach was applied to control (no fire) and experimental (fire-affected) catchments in the Araguaia-Tocantins basin. Across a range of catchments, we found no significant differences in slope between control and treatment catchment flows in the period before and after large fires. However, water years with higher burn proportions were more associated with higher mean recession constant, lower baseflows, and lower runoff rainfall ratio (Q:P) in the following year compared to nearby reference catchments, with increased flow variability in dry-season months. These results highlight a variable catchment response to landscape-scale disturbance and contradict our expectation that larger burns would be associated with higher Q:P ratio. Next, random forest and multiple linear regression models were applied to all study catchments (n=99) to determine the most influential variables on annual hydrologic response. In addition to precipitation, cumulative burn area, deforested area, and temperature were important for predicting catchment hydrology in a region with an accelerating fire regime. The results from this study contextualize the effects of fire and deforestation (relatively low) versus climate (high) on hydrologic response at the catchment scale, especially for catchments with low to moderate (<20%) treatment effects.

PRESENTER BIO: Sharmin Siddiqui is a PhD candidate in the Watershed Ecology Lab and Department of Environmental Engineering Sciences at the University of Florida, advised by Dr. Kaplan. Sharmin's research is focused on the effects of shifting fire and flooding regimes on the stability of Amazonian forests and river networks.

ASSESSING THE EFFECTS OF FLORIDA MANATEES AND HUMANS ON NUTRIENT UPTAKE RATES IN KINGS BAY, FL

***Adam C. Siders**, Alexander J. Reisinger, Matt R. Whiles*
Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA

Animals can play key roles in nutrient cycling in aquatic ecosystems via excretion and egestion of nutrients, sequestering limiting nutrients, foraging activities, and bioturbation of sediments. Florida manatees are an example of an animal with the potential to have large effects on nutrient cycling. Despite significant efforts to learn about and protect manatees and their critical habitat, we know little about how manatees affect and interact with the ecosystems they inhabit, especially in wintering locations where they aggregate in high abundances while seeking thermal refuge. To better understand manatee effects on nutrient cycling, we assessed the effects of Florida manatees and humans on nutrient uptake at Hunters and Three Sisters Springs in Kings Bay, FL during October, January, and April. Manatee abundances at Hunters Springs are low during the winter when manatees migrate into Kings Bay, but manatees aggregate in high abundances at Three Sisters Springs. Manatees are largely absent from Kings Bay by March, but human presence is high throughout Kings Bay during spring. We found three overall patterns: (1) Nutrient uptake rates (NO_3^-, NH_4^+, PO_4^{3-}) were generally highest in October, when human presence was low and manatees were absent; (2) At both sites, uptake rates were similar between January and April; (3) Uptake rates of all nutrients and periphyton biomass decreased between October and January at Hunters Springs despite our expectation that uptake rates would be similar due to stable conditions in springs. Results suggest that manatees may have large effects on nutrient uptake across all of Kings Bay despite their highly localized abundances. This pattern is potentially driven by the hydrology of Kings Bay and tidal influences.

PRESENTER BIO: Adam Siders is a PhD student in the Soil and Water Science Department studying the effects of manatees on freshwater food webs and nutrient cycling.

WATER WEDNESDAY PROGRAM EDUCATES URBAN RESIDENTS ABOUT ACTIONABLE WATER CONSERVATION PRACTICES

Tiare Silvasy[1], *Yilin Zhuang*[2], *Tina McIntyre*[3], *Morgan Pinkerton*[3], *Krista Stump*[4], *Brooke Moffis*[5]
[1]UF/IFAS Extension Orange County, Orlando, FL, USA
[2]Mid-Florida Research and Education Center, Apopka, FL, USA
[3]UF/IFAS Extension Seminole County, Sanford, FL, USA
[4]UF/IFAS Extension Osceola County, Kissimmee, FL, USA
[5]UF/IFAS Extension Lake County, Tavares, FL, USA

Water Wednesday is a collaborative, multi-county extension program that addresses water quality, quantity, and conservation practices. In this program, an agent or specialist from University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) virtually delivered a weekly, fun and fact-based, 45-minute talk on issues pertaining to Florida's water resources. Topics in this water series have ranged from creating your own rain barrel to calibrating your irrigation system and managing your septic system. From May 2019 to June 2021, we conducted46 webinars with 965 group participants from Zoom and Facebook Live. A retrospective post survey was administered to assess knowledge gain and intent to change behavior. As a result of attending Water Wednesday, respondents (n=179) indicated: 100% improved their understanding of the importance of protecting Florida's water resources, 91% gained knowledge on residential water conservation practices, and 83% improved their awareness of residential water quality protection practices. Respondents also indicated the intent to adopt new practices including: 83% indicated they would reduce the water use in their yard and garden, 75% intended to reduce plastic use, and 100% indicated they would tell others of the importance of protecting water resources. Participant comments included "This was extremely helpful for new Floridians" and "I learned not to overwater my lawn". In a follow-up survey sent in July 2021, 40% of respondents (n=45) indicated they understand better the challenges facing water and 60% claimed they increased their knowledge of water policy. Most participants attended multiple webinars with 60% attending more than one, and almost 10% attending more than 10 webinars. In conclusion, Central Florida residents improved their knowledge of Florida's water issues and actions they can take to benefit water quantity and quality.

PRESENTER BIO: Tia Silvasy in a Florida-Friendly Landscaping™ Extension Agent with UF/IFAS Extension. She works on a collaborative team with the Regional Water Specialist and other agents to bring education to Central Florida residents and commercial entities. Collaboratively the team conducts events that address water quality, quantity, and conservation practices.

ESTIMATING HISTORICAL IRRIGATED PRODUCTION OF MAJOR US ROW CROPS

***Samuel J. Smidt*[1]**, *Susan E. Lamb*[1], *Anthony D. Kendall*[2], *David W. Hyndman*[3]
[1]University of Florida, Gainesville, FL USA
[2]Michigan State University, East Lansing, MI USA
[3]University of Texas at Dallas, Richardson, TX USA

Agricultural irrigation patterns are evolving across the contiguous United States (CONUS) due to changes in irrigation technology, water availability, targeted crop demand, and expansion onto traditionally dryland areas. This evolving landscape introduces many sustainable watershed management challenges for both new and historically irrigated areas such water allocation, drought mitigation, and soil health. Despite the importance of irrigated agriculture, historical crop production data have largely been reported as a merged averages between rainfed and irrigated practices. As a result, little remains known about the use or impacts of irrigated production within historical data records. The purpose of this study is to backfill missing agricultural data using a machine learning technique to estimate irrigated row crop production for major US row crops from 1945-2017. The result of this study is a county-level dataset that estimates yields and areas for the irrigated and rainfed production of corn, hay, soybeans, and wheat. Results from this study will be used to (1) quantify the migration of irrigated production across the CONUS, (2) assess the impact of environmental policies on irrigation use and adoption, and (3) develop proactive land and water management recommendations for irrigation use beyond heavily stressed aquifer regions.

PRESENTER BIO: Sam Smidt is an Assistant Professor of watershed sciences in the Soil and Water Sciences Department. He is the PI of the Land and Water Lab, which serves as a research and education space focused on coupled human and natural systems within the broad field of environmental geoscience.

SEA LEVEL RISE AND SALTWATER INTRUSION INTO AQUIFERS ALONG THE SOUTHEAST FLORIDA COAST

***Karin A. Smith**, P.G.*
South Florida Water Management District, West Palm Beach, FL, USA

In southeast Florida, the primary source of fresh groundwater for human needs is the Surficial Aquifer System (SAS). The Biscayne aquifer, part of the SAS in this area, is among the most productive aquifers in the world, and on average, provides more than one billion gallons of water per day for potable and irrigation needs in Palm Beach, Broward, and Miami-Dade counties combined. Because the SAS is an essential part of the region's water supply, protecting the groundwater system from saltwater intrusion is important. The low-lying southeast coast of Florida is particularly susceptible to lateral saltwater intrusion due to multiple factors, including rising sea levels. Slowing the movement of the interface results in a more resilient system.

The South Florida Water Management District (SFWMD) and United States Geological Survey are actively monitoring and mapping the location of the underground saltwater interface within freshwater aquifers. The historical and projected movement of saltwater inland, together with current water use data and future water use projections, helps identify existing users of ground water that are vulnerable to sea level rise. Monitoring programs are used to guide operations and regulatory programs and to provide early warning of threats to water supply.

The SFWMD is implementing a set of science-based water and climate resilience metrics to track and document shifts and trends in District-managed water and climate observed data. Saltwater intrusion is a metric impacted by the climate drivers of sea level rise and potential changes in rainfall. As part of the District's communication and public engagement priorities, the resilience metrics products inform stakeholders, the general public, and partner agencies about the District's resilience efforts, while supporting local resiliency strategies.

PRESENTER BIO: Karin Smith is a Principal Hydrogeologist with over 30 years of experience in water supply regulation, research, modeling and planning. As a Water Supply Plan manager, her team determines future south Florida water needs, both human and environmental, and identifies sources, constraints and projects to meet those needs.

THE ROLE OF SPONGES IN MODULATING NITROGEN CYCLING IN THE FLORIDA KEYS

***Ashley R. Smyth*[1] *and Shelly Krueger*[2]**
[1]University of Florida, Homestead, FL, USA
[2]Florida Sea Grant UF IFAS Extension, Key West, FL USA

Sponges dramatically alter ecosystem water quality by combining extraordinary pumping rates and rapid, dynamic biogeochemical transformations. Large-scale sponge die-offs in the nearshore waters of the Florida Keys have led to a deficit in water filtration capacity, affecting water clarity. Rapid rates of organic matter remineralization by some sponge species can make them critical sources of dissolved inorganic nitrogen (DIN) in tropical ecosystems. Given the importance of nitrogen (N) for controlling primary production, there is a need to understand the influence sponges have on N in the surrounding water column. The overarching goal of this research is to establish the rates and mechanisms of sponge-mediated N cycling processes in Florida Bay by quantifying DIN transformations for 3 sponge species. Specifically, we measured net fluxes of N_2, ammonium, and nitrite+nitrate associated with glove (*Spongia cheiris*), loggerhead (*Spheciospongia vesparium*), and sheepswool (*Hippospongia lachne*) sponges found in the Florida Keys. Preliminary results suggest that all 3 species of sponges are net nitrogen-fixing, as indicated by a negative N_2 flux. Additionally, all 3 sponge species were a source of DIN as signified by positive fluxes for ammonium and nitrite+nitrate. Nitrogen fixation rates were higher for sheepswool and loggerhead sponges compared to the glove sponges. DIN production was highest for the sheepswool sponge. Regardless of species, nitrogen fixation was more substantial than the DIN flux to the water column. The newly fixed nitrogen may be retained by the sponge or the associated microbial community, while the DIN flux is associated with nitrification and remineralization of organic matter. Our results reinforce previous findings that sponges, and their associated microbial community, are essential to the productivity and nutrient cycling in tropical ecosystems.

PRESENTER BIO: Dr. Smyth is an assistant professor in the Soil and Water Sciences at The Topical Research and Education Center. Her research focuses on understanding how anthropogenic activities impact nutrient cycling in coastal and aquatic ecosystems. She has previously measured denitrification rates associated with seagrass meadows, oyster reefs and shellfish aquaculture.

TIDAL AND SUBTIDAL NUTRIENT FLUX FORCED BY LAKE OKEECHOBEE DRAWDOWN

***Sangdon So**, PhD and Jeffrey N. King, PhD, PE*
Applied Technology and Management, Gainesville, FL, USA

This study presents a novel method to estimate seasonal nutrient flux to the Indian River Lagoon, forced by tide and Lake Okeechobee drawdown. The US Army Corps of Engineers release water from Lake Okeechobee to draw the lake surface down and protect communities near the lake from dangerous floods that may occur during hurricane season. However, nutrients in Lake Okeechobee may cause harmful algal blooms in downstream estuaries. Complex interactions between tide and canal flow govern the partitioning of nutrient mass flux to the lagoon and ocean. Applied Technology and Management presents a method to measure nutrient flux to the lagoon and ocean forced by tide and seasonal canal flow, thereby accurately quantifying parts of nutrient flux to the lagoon from parts to the ocean.

A vessel-mounted Acoustic Doppler Current Profiler measures vertical velocity profiles along a transect during a tidal cycle. Vertical nutrient profiles are concurrently measured with Sondes along the transect. Nutrient flux during a tidal cycle is the product of velocity and nutrient concentration. Least-squares analysis quantifies residual nutrient flux, which describes both tidal and subtidal nutrient mass flux to the lagoon and to the ocean. Residual nutrient flux quantifies the spatial distribution of nutrient flux to the lagoon or the ocean during a tidal cycle. Measurements during episodic release events, or during wet and dry seasons allow for differentiation between seasonal fluxes. Long-term measurements may permit the prediction of nutrient flux to the lagoon and ocean as a function of selected nutrient concentrations in the lake.

Long-term monitoring of nutrient flux is important in characterizing water quality in the lagoon and ocean. The dynamics of nutrient flux are critical in protecting and preserving estuarine and coastal ecosystems.

PRESENTER BIO: Dr. So is a Professional at Applied Technology and Management, a Geosyntec company. He received master's and PhD degrees in Civil and Coastal Engineering from University of Florida. He specializes in statistical and time-series analyses; field data collection; and storm surge, sediment transport, and water quality modeling.

PERFORMANCE OF CLIMATE MODELS IN REPRODUCING THE HYDROLOGICAL CHARACTERISTICS OF RAINFALL EVENTS IN FLORIDA

Jung-Hun Song *and Younggu Her*
Tropical Research and Education Center, University of Florida, Homestead, Florida, USA

Rainfall events largely control hydrological processes occurring on and in the ground, and their characteristics determine the severity and frequency of extreme hydrological events including flood and drought. However, climate models' performance in reproducing rainfall events has not been investigated enough to guide selection among the models when making hydrological projections. We proposed to compare the durations, intensities, and pause periods as well as depths of rainfall events when assessing the accuracy of general circulation models (GCMs) in reproducing the hydrological characteristics of observed rainfall. In this study, rainfall projections made from outputs of 29 Coupled Model Intercomparison Project 5 (CMIP5) GCMs were investigated, and the proposed GCM evaluation method were applied to 78 weather stations located in Florida. This study also compared the sizes of design storm events and the frequency and severity of drought to demonstrate the consequences of GCM selection. Results showed that rainfall and extreme hydrological event projections could significantly vary depending on climate model selection and weather stations, suggesting the need for careful and comprehensive evaluation of GCM in the hydrological analysis of climate change. The proposed GCM evaluation methods are expected to help to select GCMs that can reproduce the rainfall characteristics of local areas and thus improve the accuracy of future hydrological projections for water resources planning.

PRESENTER BIO: Dr. Song is a Post-Doctoral Research Scholar at the Tropical Research and Education Center (TREC), University of Florida (UF). His research interests mainly focus on improving representation of process dynamics in hydrological models by integrating hydrological models, new technology, and new data.

QUANTIFYING VADOSE STORAGE AND RELEASE IN A YOUNG, UPLIFTED KARST AQUIFER USING SPECTRAL ANALYSIS

Patricia Spellman *and Jason Gulley*
University of South Florida, Tampa, FL, USA

Karst vadose zone heterogeneity creates complex transmission and storage dynamics that affect the timing and magnitude of aquifer recharge. Young, high-matrix permeability karst aquifers would likely have appreciable storage in the vadose zone. In vulnerable and water-limited karst regions, the timescales of vadose storage would be important for seasonal and sub-seasonal recharge, and thus quantifying storage dynamics in the vadose zone is critical for effective water resource allocation. We create a framework to quantify storage and release in a young, high matrix permeability karst aquifer vadose zone using high-resolution precipitation and groundwater levels from the Northern Guam Lens Aquifer (NGLA) in the US territory of Guam. We estimate recharge using the Water Table Fluctuation (WTF) method and develop transfer functions between precipitation and recharge to quantify vadose zone storage timescales. The transfer functions are partitioned into different flow pathways including conduit, combined matrix/conduit and slowly draining matrix. Probability distributions are fit to each pathway to determine average travel times of infiltrated waters. Results show that aquifer recharge through secondary porosity features typically occurs within a few hours of a rainfall event, and this rapid recharge accounts for 12-28% of total recharge over a 5-year period. The majority of aquifer recharge occurs, on average, within a month after a contributing storm event. A small fraction of recharge (<10%) took longer than 2 months to reach the water table. The established framework can be applied to other karst aquifers to improve our understanding of water storage in the vadose zone and subsequent recharge dynamics.

<u>**PRESENTER BIO**</u>: Dr. Spellman is an Assistant Professor at the University of South Florida. Her work involves constraining water budgets on small island nations to inform water resource management. She also focuses on problems related to karst aquifer flow and solute transport, and how changing climate and land use impact these dynamics.

THE WEATHER RESEARCH AND FORECASTING MODEL (WRF) DEVELOPMENT FOR THE UNITED STATES AND FLORIDA

John F. Stamm[1], *Jason Bellino*[1], *John Mecikalski*[2], *and Roland Viger*[3]
[1]U.S. Geological Survey, Caribbean-Florida Water Science Center, Lutz, FL, USA
[2]University of Alabama in Huntsville, Huntsville, AL, USA
[3]U.S. Geological Survey, Water Resources Mission Area, Boulder, CO, USA

High-resolution estimates of climatic and hydrologic variables are of value to water-resource managers. The Weather Research and Forecasting Model (WRF) is a dynamical model used for operational weather forecasts and regional climate simulations. It requires initial and boundary conditions which are supplied by global- or regional-scale climate models. Output is typically at an hourly timestep with a spatial resolution from kilometers to tens of kilometers. Computational timesteps are much shorter. WRF incorporates a land-atmosphere model that simulates the hydrologic cycle, including runoff, infiltration, evapotranspiration, and groundwater recharge. The U.S. Geological Survey (USGS) Water Resources Mission Area is using WRF to run a reanalysis for water years 1980–2021 at a 4-kilometer (km) spatial resolution for a rectangular domain that includes the conterminous U.S. (CONUS). The model is referred to as CONUS404 (40 year, 4-km). Model output is at a 1-hour timestep with precipitation at a 15-minute timestep. The reanalysis is currently underway and is expected to be completed in early 2022. This will be followed by a projected climate simulation, possibly using the pseudo-global-warming method. Boundary conditions for the reanalysis are from the European Centre for Medium-Range Weather Forecasts (ECMWF) Reanalysis v5 (ERA5, 30-km resolution). The CONUS404 model uses the Noah-Multiparameterization Land-Surface Model (Noah-MP LSM) to simulate surface hydrology. In collaboration with the University of Alabama in Huntsville, the USGS Caribbean-Florida Water Science Center is also using WRF to simulate the weather of Florida at a 2-km spatial and hourly temporal resolution. Reanalysis runs for Florida started in 2016 and are updated daily. Boundary conditions are taken from the NOAA Rapid Refresh Model (RAP). Output from the CONUS404 and Florida models could provide an alternative to the common practice of interpolation of weather station observations to compute high-resolution grids of meteorological and hydrologic data for Florida.

PRESENTER BIO: Dr. John Stamm is a Supervisory Hydrologist with the U.S. Geological Survey Caribbean-Florida Water Science Center. His expertise includes statistical and dynamical downscaling of climate, stream hydrology, geomorphology, hydrogeology and geostatistics.

KEY ELEMENTS OF RED TIDE MESSAGING AND MODES OF COMMUNICATION GLEANED FROM MULTIPLE FOCUS GROUPS

***Elizabeth Staugler*[1]**, *Chris Simoniello[2] and Paul Monaghan[3]*
[1]Florida Sea Grant, University of Florida, Gainesville, FL USA
[2]Texas A&M University and Gulf of Mexico Coastal Ocean Observing System, St. Petersburg, FL USA
[3]Department of Agricultural Education and Communication, UF/IFAS, Gainesville, FL USA

Red tide in Florida, caused by the dinoflagellate *Karenia brevis*, occurs almost annually in the eastern Gulf of Mexico and challenges both public health and the economy. Public health issues arise from the suite of neurotoxic brevetoxins which when aerosolized can cause acute respiratory irritation, and when ingested in seafood, can poison consumers. Economic challenges arise from both real and perceived health and quality-of-life impacts. On the recommendation of the Florida Harmful Algal Bloom Task Force, the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute funded a study to develop a state-wide red tide communication strategy aimed at empowering the public to protect their health and quality of life. Led by Florida Sea Grant, and in partnership with the Gulf of Mexico Coastal Ocean Observing System (GCOOS), the project team solicited input from more than 1,100 people to inform best communication practices and enable the use of actionable, science-based information in decision-making during Florida red tide events. One element of the research was conducting 11 focus groups to better understand the human dimensions influencing decision-making. In-depth focus group conversations were divided into three audiences: 1) natural resource and human health professionals; 2) public information officers, and media, tourism, small business and hospitality industry professionals; and 3) the general public. These conversations provided better understanding of the emotions, values, thoughts and opinions driving personal behaviour, and enabled the team to develop a Red Tide Communications Plan for Florida that aligns practitioner (i.e., agency) needs with end-user (i.e., resident and visitor) content, format and delivery mode wants. This presentation will highlight both the process used to develop and implement the focus groups and key findings of the research analysis.

<u>PRESENTER BIO</u>: Elizabeth Staugler is NOAA Harmful Algal Bloom Liaison with Florida Sea Grant where she coordinates HAB forecasting input, feedback and training opportunities between NOAA and Sea Grant programs across the nation. She has more than 20 years of experience planning, designing, and implementing comprehensive stakeholder engaged coastal ecosystem related projects.

INFLUENCE OF HYDROLOGIC CONNECTIVITY ON THE NATURAL FLOW REGIME OF ARCHETYPAL WETLAND COMPLEXES

Leanne M. Stepchinski*, Patricia Spellman, Mark Rains, and Kai Rains*

School of Geosciences, University of South Florida, FL, USA

Headwater wetlands and streams are connected by dynamic hydrologic flowpaths, and function as integrated hydrologic networks at the watershed scale. Headwater wetlands perform a variety of hydrologic lag, sink, and source functions, the latter including flow generation and thereby contributing to the natural flow regimes of downstream waters. These wetlandscapes have typical physical configurations, including the number, size, and spatial configuration of the headwater wetlands and flowpaths. Modifications to this physical configuration likely alters flow generation and therefore the natural flow regime and the related integrity of downstream waters. We investigated this within wetlandscapes in which depressional wetlands and streams are connected to one another and thereafter to downstream waters. We specifically investigated whether and to what degree changes to physical configuration affects flow to downstream waters. We adapted a one-dimensional flow routing model to simulate flow within an archetypal wetlandscape, using surface water dominated vernal pool wetlandscapes to characterize and parameterize the model. We varied the physical configuration in the model by adjusting the number and spatial arrangement of wetlands and flowpaths. Downstream hydrograph evaluation showed that altering the physical configurations in the archetypal wetlandscape strongly affected flow generation, and therefore the natural flow regimes of downstream waters. Moving wetlands downstream in the watershed increased magnitude of flows, and decreased frequency and duration of flows. Clustering wetlands closer together increased magnitude of flows produced relative to non-clustered wetlands. Combining individual wetland volumes into a singular larger wetland increased magnitude of flows produced relative to both clustered and non-clustered wetlands. The frequency and magnitude of flows to downstream waters were highly sensitive to changes in the model catchment area and amount of runoff entering the individual wetlands and flowpaths. These results have implications for the study and management of hydrologic flows and associated ecological functions within headwater wetland settings.

PRESENTER BIO: Leanne Stepchinski is a Ph.D. candidate in Ecohydrology at the University of South Florida. Ms. Stepchinski's research focuses on investigating the presence, nature, and influence of hydrological connectivity between headwater wetlands and the surrounding hydrological landscapes, including downgradient wetlands, streams, and other waters.

IDENTIFYING FRESHWATER INFLOW NEEDS FOR ESTUARINE FISHES: A STATEWIDE PERSPECTIVE

Philip W. Stevens
Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St Petersburg, FL USA

One of the most important challenges facing estuarine scientists and managers is to determine the necessary magnitude and timing of freshwater delivery to the estuary while maintaining sufficient supply for human populations. The Florida Fish and Wildlife Conservation Commission has been conducting research to aid the state's water management districts in the establishment of minimum flows and levels for Florida's rivers. Electrofishing, fisheries-independent monitoring (i.e., seining), acoustic telemetry, and biological metrics (e.g., condition, growth) are being used to determine how estuarine fishes respond to changes in freshwater inflow. Through this research, benchmarks have been provided on the duration of floodplain inundation needed to improve the condition of marine fish using large river systems (e.g., common snook), habitat requirements have been identified for species indicative of oligohaline conditions (e.g., opossum pipefish, fat snook, sleepers), and species distributions have been modeled along salinity gradients that reach the open estuary (e.g., red drum). Further, freshwater-inflow related research has helped to designate critical habitat for an endangered species (i.e., smalltooth sawfish), determine the area of thermal refuge needed to support overwintering subtropical species in northern Florida (e.g., common snook, gray snapper), and assess species responses to drought conditions and storm-induced inflow events in southern Florida (e.g., spotted seatrout, goliath grouper). In addition to providing information useful for establishing freshwater-inflow law, this work is also informing habitat conservation and restoration initiatives.

<u>PRESENTER BIO</u>: Dr. Stevens is an estuarine fish ecologist with more than 25 years of experience most of which has occurred at Florida's fish and wildlife agency. He specializes in fish biology, fisheries-independent monitoring, fish movements, and habitat restoration.

RESILIENCE TO FUTURE FLOODING IN THE GULF OF MEXICO

***Carrie T. Stevenson*[1]**, *Mikaela Heming*[2], *and Renee Collini*[2]
[1]University of Florida IFAS Extension, Escambia County, FL, USA
[2]Program for Local Adaptation to Climate Effects: Sea-Level Rise (PLACE-SLR), Mississippi-Alabama Sea Grant, Biloxi, MS, USA

The Gulf of Mexico is an area of rich culture and beautiful coastlines, but coastal living comes with ever-increasing risk. Sea-level rise (SLR) is a ubiquitous issue directly affecting coastal communities. While it is crucial that coastal decision-makers understand SLR and its potential impacts, SLR science is complicated and advancing rapidly. Additionally, practical solutions for small coastal communities to address SLR impacts are not well described or shared. Stakeholders have expressed that these conditions make it difficult to understand their vulnerabilities and the best way to respond. To reduce communication barriers around SLR science and encourage actions to address risks, we developed two video series (https://vimeo.com/channels/gulfslr/) in collaboration with coastal decision-makers. Meeting monthly, our team provided guidance and expertise for the implementation of the project including scripting, filming, editing, distribution, and discussion of video case studies addressing important needs or gaps in the northern Gulf of Mexico. The first series communicates the science around SLR, how it may impact the northern Gulf of Mexico, and potential solutions to address or avoid these impacts. The second series highlights case studies of communities have taken in five different Gulf states to reduce their vulnerability to sea-level rise and flooding. A 30-minute “news” segment to be aired on public television stations knits these videos together to help residents better understand the risks and ways to respond. Altogether, this collaborative, multi-state project aims to help communities across the northern Gulf of Mexico prepare for this pressing issue. The team has won multiple state and national awards for our work over the past few years. Objectives for participants during this session include improved understanding of SLR science; appreciation for the efforts of small Gulf Coast communities have taken towards coastal resilience; a source of education, and contacts from which other communities can learn.

PRESENTER BIO: Carrie Stevenson has been a Coastal Sustainability Agent with UF/IFAS Extension for 18 years. Her educational outreach programs focus on living sustainability in coastal ecosystems. Her goal is to help residents protect and preserve local ecosystems, water resources, and prepare and mitigate for flooding, coastal storms, and climate impacts.

STORMWATER BAFFLE BOX PERFORMANCE: A CASE STUDY OF BAFFLE BOXES IN THE CITY OF TAMPA

Cody J. Stewart *and Mauricio E. Arias*
University of South Florida, Tampa, FL, USA

Tampa, similarly to other coastal metropolitan areas, is continuing to rapidly urbanize. The Tampa Metropolitan Area (TMA) has a population of 3,275,200 and has consisting increased between 1 and 3% each year since 2012. Urbanization results in the increased transformation of vegetative surfaces to impervious ones. These conditions in urban environments have caused increased volumes and flows of runoff following storm events. These increased volumes and flows have resulted in the transportation of larger quantities of contaminants (sediments, trash, oil/grease, nutrients, metal, and etc.) into natural waterways. Several best management practices (BMPs) are available to manage stormwater for both quality; this study focuses on one, baffle boxes. Baffle boxes have been a common solution to treat stormwater as they do not require additional undeveloped land for their implementation. Baffle boxes are precast structures typically made from either concrete or fiberglass with the primary function of removing suspended solids from stormwater. More recently baffles boxes are being marketed as BMPs that offer trash and nutrient removal. Baffle boxes are designed to remove suspended solids by forcing stormwater over a series baffles causing sediments to settle in the chambers below. Some baffle boxes also feature a skimmer or trash screen designed to capture larger organic waste and trash. Newer units have media within the them to aid in additional nutrient removal. This study evaluates the removal efficiency of TSS, TN, and TP across select baffle boxes within the City of Tampa.

PRESENTER BIO: Mr. Stewart is a Ph.D. student in the Civil and Environmental Engineering Department at the University of South Florida. His research focuses on broaden the understanding of the performance and functionality of stormwater sediment traps.

ASSESSING ANTHROPOGENIC STRESSORS TO GLOBAL FRESHWATER HABITATS AND INLAND FISHERIES

Gretchen L. Stokes[1]*, Abigail J. Lynch*[2]*, Daniel Wieferich*[3]*, Simon Funge-Smith*[4]*, John Valbo-Jørgensen*[5]*, T. Douglas Beard*[2]*, Jr. and Samuel J. Smidt*[1]

[1]University of Florida, Gainesville, FL, USA

[2]U.S. Geological Survey, National Climate Adaptation Science Center, Reston VA, USA

[3]U.S. Geological Survey, Science Analytics and Synthesis Program, Denver CO, USA

[4]Food and Agriculture Organization of the United Nations Organization, Regional Office for Asia and the Pacific, Bangkok, Thailand

[5]Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture Department, Rome, Italy

Freshwater ecosystems are experiencing some of the most rapid and severe declines in biodiversity and habitat alteration on the planet from competing demands for water in agriculture, industry, irrigation, recreation, and human consumption. Freshwater biodiversity conservation and water resource management require replicable, adaptive, efficient, and science-based assessment tools to track rapid changes from human influences, inform management decisions, and prioritize conservation efforts. Yet, many freshwater taxa remain widely data deficient. Inland fisheries, for example, contribute to global food security and poverty alleviation for millions worldwide, yet fish harvest and biodiversity data remain largely disparate and severely deficient in many areas, which makes assessment and management difficult. Such cases with species or extraction data limitations require the creative integration of additional and proxy data sources, including habitat indicators, expert input, and machine learning. The goal of this work was to address those needs by developing a systematic, nested, replicable method to assess the distribution, intensity, and relative influence of human influences and potential threats to inland fisheries and their freshwater habitats. The results of this study contribute three advances in freshwater conservation: (1) provide a baseline assessment, which shows that nearly half of the global inland fisheries catch is under an intermediate level of threat, over one-third is moderately threatened, and nearly 10% is severely threatened; (2) composite threat indices provide a quantifiable indication of the relative level of threats to inland fisheries, useful immediately for tracking progress toward global targets for sustainability and biodiversity conservation (e.g., Sustainable Development Goals, Aichi Biodiversity Targets); and (3) tiered relative importance comparisons provide evidence and decision support for improving the efficiency of future assessments, and the approach enables a more objective narrative around the management of aquatic ecosystems.

PRESENTER BIO: Gretchen Stokes is a Ph.D. candidate at the University of Florida and NSF Graduate Research Fellow at the USGS National Climate Adaptation Science Center. She holds Master's and Bachelor's degrees in fisheries and wildlife biology (Virginia Tech, NC State). Her research interests include international conservation, geospatial analysis, and movement ecology.

A HOUSEHOLD COST-BENEFIT ANALYSIS OF IMPACTS FROM FOG WATER ACCESS IN SOUTHWEST MOROCCO

Sarah Strohminger
University of Florida, Gainesville, FL, USA

Morocco is quickly advancing the ways in which its population accesses water in order to meet growing demand and the changing climate. One important method of providing water is the process of fog harvesting. In the rural southwest region of Ait Baamrane is the world's largest fog harvesting infrastructure. This infrastructure has reduced the burden on the population – especially women – who, on average, spent three hours each day fetching water from wells. Using thirty-eight semi-structured household interviews, changes in daily household activities as well as in human capital and social capital were identified. Human capital improvements were considered to be the practical means in which life has changed since access to fog water has been given, i.e. improved access to education, health improvements from access to clean water, health improvements related to losing the physical burden of carrying water, social structures et cetera. These changes are a result of the obsolete opportunity cost of collecting water with traditional methods and the financial burden of buying water from private sellers. Social capital improvements relate to reduced outward migration and greater community cohesion--working-age males have been obliged to migrate to cities when their families cannot afford water. This research emphasizes empowerment and whether access to this water resource has an effect on the longevity of these indigenous Amazigh communities. Morocco's investments in water access have been primarily focused on desalination and dam construction, but geographically remote communities lack the infrastructure to connect to these methods. Ensuring access is the only way to make sure that rural Amazigh communities continue to thrive in the desert as they have for thousands of years in spite of reduced rainfall and declining ground and surface water levels. Key findings include increased sleep, reduced burden on mental health, increased house construction, and reduction in outward migration.

PRESENTER BIO: Sarah Strohminger is a graduate student in the Masters of Sustainable Development Practice (MDP) program with a diverse background in food security, environmental education, and research. As a graduate student, she spent three months researching community impacts as a result of fog water access as her MDP field practicum.

ENZYMATIC HYDROLYSIS OF DISSOLVED ORGANIC PHOSPHORUS IN THE EVERGLADES STA SOURCE WATERS

Praveen Subedi, *Patrick W. Inglett, Ashton T. Woods, Kanika Sharma Inglett*
Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA

Characterizing dissolved P fractions in source waters is critical to addressing questions about variabilities in the P retention performance of Everglades STAs. We compared and contrasted enzymatically hydrolysable dissolved organic P fractions in <0.2 µm using surface water samples collected from four sites [outflow from Lake Okeechobee (S354), inflow to STA-2 (S6), inflow to STA 3/4 (G370), and inflow to L8 FEB (G538)]. Water samples were incubated at 37°C with alkaline phosphatase, phosphodiesterase, or phytase for 16 hours in the dark to estimate hydrolysis of DOP and generation of soluble reactive phosphorus (SRP). Alkaline phosphatase additions hydrolyzed little (G370, S354) to no P (S6, G538). Phytase hydrolysable SRP did not differ between sites and was equivalent to about 9 to 46% of total dissolved P, with the highest phytase hydrolyzed SRP at G370, and the lowest phytase hydrolyzed SRP at S6 site. However, for the S6 site, the net SRP increase from phosphodiesterase hydrolysis of DOP was significantly larger than the other three sites. Phosphodiester hydrolysable SRP for S6 (24.1 µg L^{-1}) was almost 3-, 2.9-, and 2- folds higher than in the G538, G370, and S354 sites, respectively. As such, phosphodiesterase could hydrolyze around 78% of total dissolved P in S6, 89% in S354, 95% in G538, and 97% in G370 site. It is, however, important to note that the 0.2 µm filtered water samples used in our study had significantly lower dissolved P relative to 0.45 µm filtered samples for these same sites (e.g., 0.2 µm: range 5.4-39.7 µg L^{-1} vs. 0.45 µm range: 27-78 µg L^{-1}). Nevertheless, these results show that a significant portion of DOP in <0.2 µm fraction of STA source waters is predominantly phosphodiester hydrolysable fraction.

<u>PRESENTER BIO</u>: Dr. Subedi is a post-doctoral associate in Wetland Biogeochemistry Laboratory at the Soil and Water Sciences Department, University of Florida.

ENVIRONMENTAL FLOWS AND LEVELS: DETERMINING IMPACT THRESHOLDS AND ALLOWABLE CHANGE

Andrew B. Sutherland
St. Johns River Water Management District, Palatka, FL, USA

Florida water management districts are required to establish environmental flows and levels, to define minimum hydrologic regimes that protect priority water bodies from significant harm due to water withdrawals. Many approaches have been developed in Florida and elsewhere with the goal of balancing the water supply needs of humans with water supplies needed to protect aquatic ecosystems. Environmental flows and levels are developed for many reasons, including the protection of biodiversity and ecosystem services, as well as the maintenance of recreational values and other human beneficial uses. A challenging part of establishing environmental flows and levels involves determining appropriate metrics and impact thresholds that are both protective and scientifically defensible. Uncertainty in impact analyses may be due to environmental (hydrological and ecological) variability, data availability, the ability to simulate a reference condition or other long-term hydrological patterns, among others. In an effort to establish science-based impact thresholds, the St. Johns River Water Management District (SJRWMD) has developed a quantitative approach for estimating allowable change to ecologically critical hydrological events. This data-driven method helps to determine allowable change to water level or flow regimes through a comparison of hydrological signatures that exist across similar water body types. These signatures define a natural range of flooding or drying frequencies for key ecological events (elevation and duration combinations), providing a quantitative method for determining a minimum hydrologic regime necessary to maintain natural wetland communities and other key ecological features. In the SJRWMD these critical features are typically organic soils, wetland plant communities or key indicator species, but could include any features that are a function system hydrology. Species-specific signatures typically exhibit a smaller range of flooding or drying frequencies, when compared to community boundaries or other features. Evaluation of sources of variability and ways to reduce uncertainty and improve this approach are ongoing.

PRESENTER BIO: Dr. Sutherland has worked in the St. Johns River Water Management District's Minimum Flows and Levels program for 8 years. He has 23 years of experience in the study of freshwater ecosystem ecology, fish ecology and macroinvertebrate ecology.

TESTING PERFORMANCE EFFICIENCY OF INNOVATIVE NUTRIENT REDUCTION TECHNOLOGIES WITH IN-SITU MESOCOSMS

Mary L. Szafraniec[1], *Francesca M. Lauterman*[1], *Lance Lumbard*[1], *and Laurie Smith*[2]
[1]Wood Environment and Infrastructure, Tampa, FL, USA
[2]City of Lakeland Lakes Management Program, FL USA

There are limited data tracking the improvements gained from sediment nutrient management. Prior to conducting a large scale and costly restoration project that may include sediment removal or chemical inactivation to improve water quality in a waterbody, it is important to understand how the action may affect the overlying water column and downstream water bodies after implementation and long-term. We have conducted numerous laboratory bench scale assessments to evaluate treatment alternatives such as sediment capping by applying chemical, physical or biological treatments to in-tact sediment cores to assess the performance efficiency of innovative nutrient reduction technologies. We have since scaled up from the laboratory and have deployed in-situ mesocosms within two lakes in Central Florida to assess the performance and cost effectiveness of two sediment inactivation treatment alternatives. The mesocosms (limnocorrals) enclose a portion of the lake and benthic sediments. Ongoing water quality and sediment sampling to assess changes in pre/post application conditions is currently underway. The experimental design includes multiple levels of replication and will span both the wet and dry seasons to assess temporal effects on product performance. The research objective is to demonstrate the performance and cost-effectiveness of the two treatment alternatives at the mesocosm scale in-situ prior to applying the product at full scale. The results obtained from this project can be broadly used to assist with watershed restoration planning as sediment nutrient removal or chemical/biological amendments can be compared against other aquatic system restoration BMPs along with costs to develop long-term plans. More specifically, the results can be used in the prioritization of removal or chemical inactivation of various sediment types, and to quantify the potential beneficial impacts of sediment nutrient management on water quality.

PRESENTER BIO: Dr. Szafraniec is a Principal Scientist at Wood with over 18 years of experience conducting ecological and water quality assessments and designing restoration projects. She has recently been focusing her research to advance concepts in biogeochemistry with the goal of tracking pollutant sources and optimizing ecosystem restoration project performance.

FLOOD PROTECTION LEVEL OF SERVICE FOR MIAMI-DADE COUNTY CURRENT AND FUTURE SEA LEVEL RISE CONDITIONS

Justin Tagle[1], *Stephanie Long-Marquez[2], and Brent Whitfield[2]*
[1]Florida Atlantic University, Boca Raton, FL USA
[2]Chen Moore and Associates, West Palm Beach, FL, USA

The South Florida Water Management District (SFWMD) is conducting a system-wide review of the regional water management infrastructure to determine the flood protection level of service (FPLOS) being provided by existing infrastructure under current and future conditions. The FPLOS describes the amount of protection provided by the water management facilities within a watershed considering sea level rise (SLR), future development, and known water management issues in each watershed. Notably, the SLR scenarios will also consider associated changes in groundwater levels and land-use changes.

This project involves preparing FPLOS analysis for the C2, C3W, C5 and C6 watersheds in central Miami-Dade County. This effort involves developing a calibrated and validated hydrologic and hydraulic (H&H) model of the subject watersheds. This region includes a significant extent of flood protection infrastructure including an extensive primary canal network with District owned and operated control structures throughout the highly managed system. Although the District canals and structures represent the primary infrastructure for providing flood protection in the area, the secondary drainage system is a significant component. In particular there are large canals, culverts and pumps in the project area that are owned and operated by Miami-Dade County and the municipalities of Belen, Sweetwater and West Miami.

Post calibration for this roughly 200 square mile area, simulations of design storm events for existing conditions and for future conditions were prepared. The future conditions simulation incorporated SLR, projected land use, and projected groundwater levels. The results of these scenarios were utilized to evaluate the FPLOS for existing infrastructure in the studied watersheds. Assessment was completed for a suite of performance measures under existing and future SLR conditions, and a narrative describing preliminary recommendations for potential flood mitigation projects was provided for the C-2, C-3W, C-5 and C-6 watersheds.

PRESENTER BIO: Justin Tagle graduated from University of Florida with his Bachelors in Science and Masters in Engineering in Civil Engineering. He is currently pursuing his PhD in Civil Engineering at Florida Atlantic University while working as a Project Engineer at Chen Moore and Associates.

EFFECTS OF LAKE OKEECHOBEE OPERATION SCHEMES ON PHOSPHOROUS EXPORTS

Osama M. Tarabih*, and Mauricio E. Arias*
Dept. of Civil and Environmental Engineering, University of South Florida, Tampa, FL USA

Lake Okeechobee is the largest reservoir by surface area in the United States and a crucial water source in South Florida, supplying water for human consumption, irrigation, and surrounding wetland ecosystems. Though of natural origin, the lake is now bounded by the Herbert Hoover Dike, and it is strictly operated for flood control, water supply, and environmental flows. Lake Okeechobee, however, is a major source of nutrients to surrounding distributaries and estuaries, with lake operations being a key driver of contemporary trends in water quality. This study aims at evaluating impacts of Lake Okeechobee operations on phosphorous loadings into the main distributaries and in the lake proper. Thus, a comprehensive modeling tool for Lake Okeechobee hydrology and water quality was developed that simulates different historical and even proposed operation schedules of Lake Okeechobee. The model determines the regulated discharges into the main distributaries of the lake given the Lake's net inflows. The model also simulates the phosphorus mass balance as a function of hydrology, operations, and incorporating internal loadings from the surficial layer of bottom sediments. The model was calibrated and validated for both hydrological and phosphorous conditions for the period (1991-2018) simulating three different Lake Okeechobee operation schedules. The model's outputs incorporate regulated water discharges and phosphorous loadings into the main distributaries, water levels and associated water volumes in the lake, and phosphorous concentrations in the lake water body. Various operation scenarios were simulated and their impacts on phosphorous loadings in the lake and the distributaries were evaluated where it was found that phosphorous in Lake Okeechobee were mainly driven with flow patterns. In the near future, this model will be used to design Okeechobee discharges that minimize phosphorous loadings into the distributaries and estuaries.

<u>PRESENTER BIO</u>: Osama is a Ph.D. candidate in USF with Master's degree on water resources engineering. His doctoral dissertation aims at mitigating Lake Okeechobee's phosphorous loadings into the surrounding water bodies while benefiting associated human communities. His research interests include ecohydrology, water resources, designer flows, and hydrological modeling.

ALTERATIONS OF DISSOLVED ORGANIC MATERIAL COMPOSITION AND ITS INFLUENCE ON ECOSYSTEM RESPIRATION

Emily Taylor[1]*, Jacob Hosen* [2]*, and Alexander J. Reisinger*[1]
[1]University of Florida, Gainesville, FL, USA
[2]Purdue University, West Lafayette, IN USA

Dissolved organic material (DOM) in urban streams can have increased lability, decreased aromaticity, and be of more autochthonous origin than in reference streams. Changes in DOM composition are important to understand as increasing labile DOM in reference streams can increase metabolic activity and alter nutrient dynamics. While more labile DOM in urban streams may be expected to increase metabolic activity, previous studies (and preliminary data from this study) have found lower respiration (R) rates in more urbanized sites. While DOM is known to contribute to ecosystem energetics, the relationship between substrate composition and its availability for aquatic organisms remains unclear and is further complicated by the multitude of anthropogenic stressors common to urban streams. We measured DOM composition and whole-stream metabolism of seven subtropical streams across an urbanization gradient over 20-months using fluorescence excitation-emission matrices and parallel factor analysis. In contrast to previous studies, we did not find urbanization as the strongest factor controlling DOM composition across sites. Instead, geomorphology, point sources, and in-stream processing were important factors. This suggests that controls on DOM composition of urbanized streams in subtropical environments may be different than temperate climates, where previous studies have been conducted.

PRESENTER BIO: Emily Taylor is a PhD student in the Soil and Water Sciences Department working in the Urban Systems Ecology Lab working with Dr. AJ Reisinger. She is researching the impacts of urbanization on stream ecosystem metabolism, dissolved organic material, and nutrient cycling.

MEASURING SUBMERGED AQUATIC VEGETATION MOTION USING DIGITAL VIDEO ANALYSIS

***Robert L. Taylor**, David Kaplan, Xiao Yu*
Engineering School of Sustainable Infrastructure & Environment, University of Florida, Gainesville, FL, USA

Submerged aquatic vegetation (SAV) plays an essential role in Florida's aquatic ecosystems. When paired with flowing water, the interactions between SAV and flow impact primary producer community structure in Florida springs. While these interactions have been studied in the laboratory setting, quantitative field observations are limited. Here, methods are developed and implemented to measure the motion of SAV in Florida springs by recording digital video footage underwater, followed by multiple steps of image processing to extract blade displacement and velocity data. Field methodology included deploying submersible cameras in a Florida spring run, measuring a vertical velocity profile, collecting high-frequency velocity data at two points along the vegetation patch, and sampling of vegetation to measure stem density, blade density, and blade length. Results from one sample site are presented here. Blade velocities were successfully extracted from the images using particle image velocimetry (PIV). A periodic, coherent waving motion (called "*monami*") would be expected above a critical velocity threshold, however we did not identify this signal from analysis of these data. Ongoing work will characterize the periodicity and correlation between high-frequency velocity data measured in the SAV patch. The data and methods gathered through this research will then be used as validation for a coupled vegetation-hydrodynamics model focused on the role of flow-vegetation interactions in driving patterns of flow and material transport in rivers and estuaries.

PRESENTER BIO: Rob Taylor is an undergraduate researcher at the University of Florida as a member of the Watershed Ecology Lab led by Dr. David Kaplan. Having grown up in Gainesville and the Florida Keys, he is focused on protecting and understanding Florida's waters and natural ecosystems through quantitative field observations and analyses.

MINIMUM FLOWS DEVELOPMENT IN A SPRING SYSTEM DISPLAYING INCREASED FLOWS

Paul E. Thurman *and Kathleen Coates*
Northwest Florida Water Management District, Havana, FL, USA

Wakulla Spring is one of the largest karst springs in the world, discharging an average 575 cfs between 2004 and 2019. Combined with the second magnitude Sally Ward Spring, the Wakulla and Sally Ward Springs System discharged an average of 598 cfs between 2004 and 2019. Unlike most springs in Florida, flows at Wakulla and Sally Ward Springs have increased dramatically during the past two decades. The increased flows are thought to be a result of several factors including lower river stages and changes in aquifer head gradients. These increased flows have resulted in increased water velocity, increased scouring of sediment, and decreased submerged aquatic vegetation.

Water management districts are required to set minimum flows and/or minimum water levels for Outstanding Florida Springs under Section 373.042(1), Florida Statutes. The minimum flow for a given water body is defined as the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. Most metrics utilized for determining minimum flows along the Wakulla River were shown to be relatively insensitive to spring flow reduction. One metric, safe manatee passage, was found to be limiting resulting in a 9.9 percent allowable flow reduction from the long-term average discharge for the combined Wakulla and Sally Ward Springs System. This is particularly interesting since manatee use of the spring system was minimal prior to 2007. Increased water depths associated with sediment scouring and vegetation loss are thought to have allowed manatee to regularly access the spring post 2007.

PRESENTER BIO: Dr. Thurman manages the Minimum Flows and Levels Program for the NWFWMD. In addition, he serves as the NWFWMD's senior ecologist with more than 25 years of experience in aquatic ecology. Prior to working at the NWFWMD he spent many years in the fields of wetland restoration and fisheries.

THE “SIPPER” DRONE-BASED WATER SAMPLING SYSTEM

***Henry Tingle**, Andrew Ortega, Tony Diaz, Jordan Bernstein, Chad Tripp, Peter Ifju*
Mechanical and Aerospace Engineering Department, University of Florida, Gainesville, FL, USA

A drone-based water collection system, called the “Sipper”, was developed at the University of Florida to sample for water borne pathogens such as K-brevis and HAB. The system is comprised of a drone (any drone capable of carrying the weight of the system) and a vessel that is lowered to draw water into sterile containers. Over the past two years, the system has gone through two prototypes. The initial version was tested in the inter-coastal waters surrounding the Whitney Lab. Water was collected from both land based launch locations and from a boat (skiff) based launch. It was found that the system could collect water as far away as ½ mile from the launch point. Set-up, collection, and breakdown at any location could be achieved on the order of 20 minutes. The system proved to be practical and water could be collected without a boat for many of the locations making the system convenient. In the original system a winch mechanism was built into the drone thus making it dependent on that specific platform. A second prototype was developed to make the system drone agnostic. The second version is self-contained, having the winch mechanism within the Sipper unit (instead of on the drone), along with the sterile containers, peristaltic pump, and electronic circuitry to control the sequence of lowering the Sipper to the water surface, pump water, and retrieving it back to the drone. During testing many attributes of the system were realized including its ease of use, versatility, and allowing water to be collected without exposing crew to air borne pathogens. The presentation will cover the development, design, and testing of the Sipper system.

<u>PRESENTER BIO</u>: Henry Tingle is a Ph.D. student in the Mechanical and Aerospace Engineering Department at the University of Florida. He is a member of the UF Unmanned Aircraft Systems Research Program and has been developing systems for drone-based water sampling, as well as survey and mapping.

DECADAL CHANGES IN NITROGEN AND PHOSPHORUS SPECIES ALONG THE LAKE WORTH LAGOON IN SOUTH FLORIDA

Mohsen Tootoonchi[1]*, Andres F. Rodriguez*[1]*, and Samira H. Daroub*[12]

[1]Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA

[2]Everglades Research and Education Center, University of Florida/IFAS, Belle Glade, FL, USA

The West Palm Beach-C51 canal (WPB-C51) connects Lake Okeechobee to the Lake Worth Lagoon estuary (LWL) in South Florida, U.S. The WPB-C51 canal receives discharges containing nitrogen (N) and phosphorus (P) from Lake Okeechobee, as well as agricultural and urbanized areas of Palm Beach. The objectives of this research were to determine trends of N and P species along the canal system from 2009 to 2019, and to determine spatial differences of N and P species along the WPB-C51 canal and LWL. Water quality, rainfall and flow data were obtained from the DBHYDRO database of the South Florida Water Management District. Average total P (TP) concentrations for the studied area ranged between 55 to 183 µg L^{-1}, and average total N (TN) concentrations ranged between 0.61 and 2.62 mg L^{-1}. At the LWL inflow, concentrations were higher than the estuaries numeric criteria (49 µg P L^{-1}; 0.66 mg N L^{-1}) established by the state of Florida. Temporal trends were detected using the seasonal Mann-Kendall analysis and showed predominantly increasing trends for P species' concentrations, but N species trends varied by location. Both TP and TN loads increased during the studied period. Increasing trends in P concentration can be due to legacy P and urbanization, and increases in TP and TN loads were mostly due to larger discharge volumes from Lake Okeechobee into WPB-C51 canal. Spatial differences along the WPB-C51 canal were detected using Steel-Dwass pairwise comparison which showed a progressive decline in both TP and TN concentrations from Lake Okeechobee to LWL. This decline could be due to nutrient assimilation by plants, agricultural best management practices, and P precipitation in sediments along the WPB-C51 canal. Our findings emphasize the need to continue implementing strategies to minimize nutrient input into LWL to meet its sediment and water quality goals.

PRESENTER BIO: Dr. Tootoonchi is a Post-Doctoral research associate at the Everglades Research and Education Center in South Florida. He conducts research on water quality with a focus on agricultural drainage water and phosphorus chemistry. He has extensive experience with aquatic and wetland plants as well as saltwater intrusion in estuaries.

WATER DEMAND AND SUPPLY IN FLORIDA: PAST, CURRENT, AND FUTURE TRENDS

***Dat Q. Tran*[1]**, *Tatiana Borisova*[2], *Kate Beggs*[3], *and Sorna Khakzad-Knight*[4]

[1]Economist at the Florida Legislative Office of Economic and Demographic Research and former postdoctoral scholar at the School of Public Policy, University of California, Riverside.

[2]Economist at the Economic Research Service, U.S. Department of Agriculture and former Associate Professor at the University of Florida, Gainesville, FL, USA.

[3]Economist at the Florida Legislative Office of Economic and Demographic Research.

[4]Economist at the Florida Legislative Office of Economic and Demographic Research and former Research Associate Faculty at University of West Florida

Sea-level rise, population growth, and changing land-use patterns will place additional pressure on Florida's already constrained groundwater and surface water supplies in the coming decades. Significant investments in water supply and water demand management are needed to ensure sufficient water availability for human and natural systems. Section 403.928(1)(b) of the Florida Statutes requires estimating the expenditures needed to meet the future water demand and avoid the adverse effects of competition for water supplies. This study considers the 2020-2040 planning period and forecasts (1) future water demands and supplies; and (2) the total expenditures necessary to meet the future water demand. Panel data and regression analysis techniques are used to analyze data from the U.S. Geological Survey, Florida's Water Management Districts, and the Florida Department of Environmental Protection. We show that the total water use is projected to increase by 981 million gallons per day (+15%) by 2040, driven primarily by urbanization. Cumulative expenditures for the additional water supplies are estimated at $852 million. However, the expenditures could be reduced to $129 million when the water conservation potential is considered. This study highlights the need for developing effective funding strategies on local, regional, and state levels to finance additional water supply infrastructure. We also show that consistent water demand and supply data available on a regional level can enhance the forecast development across a full range of spatial and temporal scales.

PRESENTER BIO: Dr. Dat Tran is an environmental economist. Before joining the Florida Legislative Office of Economic and Demographic Research, he was a postdoctoral scholar at the School of Public Policy, University of California, Riverside. He has extensive experience with the economics of land use and water management.

COFFEE PRODUCTION, WATER USE, AND WATERSHED PROTECTION IN HONDURAS: A COMMUNITY CASE STUDY

Catherine M. Tucker
University of Florida, Gainesville, FL, USA

Coffee production has been expanding in western Honduras over the past three decades. Today it is the major export commodity and source of income for the region. The expansion of coffee has involved clearing of montane forests, damage to fragile watersheds, and increasing demands for water to process coffee. The region is part of Central America's *corridor seco*, which experiences periodic, severe droughts. At the same time, the frequency of hurricanes and torrential rainfall appears to be increasing. In this context, water management and watershed protection pose critical challenges for human well-being and agricultural production. This study explores how one coffee-growing community has endeavored to protect its main watershed, reduce deforestation, and manage spring-fed water systems to meet human and agricultural demands. The steps taken by coffee producers and farmers have included creation of a community-based watershed reserve, adoption of low-water use coffee processing facilities, and retention ponds to capture waste water. Several cooperatives have also established tanks to supply water for washing coffee during the harvest, which falls in the dry season when water is scarcest. Despite success in transitioning to more conservative use of water, the combination of recent droughts interspersed with torrential rainfall events has strained community capacity to manage extremes of water shortage and excess. Precipitation from recent hurricanes Eta and Iota has caused landslides, damaged water system infrastructure, and destroyed roads and bridges. The situation is further complicated by precarious political contexts, economic stress, the current global pandemic and high rates of outmigration. The discussion examines the challenges faced by the community, especially coffee farmers, and their efforts to manage water, mitigate exposure and develop resilience.

PRESENTER BIO: Dr. Tucker is a Professor of Anthropology and Latin American Studies. Her work focuses on community-based approaches for natural resource management and adaptation to climate change. She is working with coffee farmers in Honduras to explore options for climate change adaptation and sustainable water and forest management.

BAY-FRIENDLY FERTILIZING TOOLS FOR RECLAIMED WATER USERS

Abbey Tyrna, *Jackie Lebouitz*
UF/IFAS Extension Sarasota County, Sarasota, FL, USA

When it comes to how much nitrogen-based fertilizer to apply, many do not consider their irrigation water source. Those with reclaimed water may be receiving significant amounts of nitrogen through regular irrigation applications, and therefore, may not require nitrogen-based fertilizer amendments for healthy turf grass growth. We calculated the amount of total nitrogen and nitrate in reclaimed water using data from three Sarasota County water reclamation facilities. During 2020 the cumulative amount of total nitrogen applied from weekly irrigation applications ranged from 1.5 to 3.3 pounds per 1000 square feet across the three facilities. On average, nitrate-nitrogen made up between 80 – 91 percent of the total nitrogen in reclaimed water. As a result, homeowners with Bahia, St. Augustine, and Zoysia grasses who receive reclaimed water from two of the three water reclamation facilities had ample amounts of nitrogen-based fertilizer and do not need to amend their soils. To communicate these findings to reclaimed water users, we developed two interactive tools. One tool is geared toward residential customers and the other for golf course superintendents. Both tools offer the most up-to-date information on nitrogen concentrations in reclaimed water produced by Sarasota County's three water reclamation facilities. Each tool has a built-in calculator to help users determine the cumulative amount of nitrogen applied to their landscape through weekly irrigation practices. The goal of these tools is to reduce the application of nitrogen-based fertilizer, curbing local nitrogen pollution, and improving water quality.

PRESENTER BIO: Dr. Tyrna is the Water Resources Agent for UF|IFAS Extension Sarasota County. She has worked in water resource education for nearly 20 years and is currently responsible for creating education programs and volunteer opportunities that result in improved water quality and a reduction in water use in Sarasota County.

The US Consumers' Willingness to Pay for Best Management Practice Labels

Md Azhar Uddin[1]; *Zhifeng Gao*[1]; *Derek Farnsworth*[1]; *Alejandro Bolques*[2]; *Tatiana Borisova*[3]

[1]University of Florida, Gainesville, FL, USA
[2]Florida Agricultural and Mechanical University, Tallahassee, FL USA
[3]U.S. Department of Agriculture (the work completed while at the University of Florida, Gainesville, FL, USA)

Best Management Practices (BMPs) are potential mitigation strategies to reduce nonpoint surface water and groundwater pollution associated with agriculture production. Besides existing government cost-share programs to induce BMP adoption, market incentives such as higher prices for BMP-labeled products may increase producers' net returns and, therefore, the BMP adoption levels, potentially improving environmental outcomes. This study estimates consumer willingness to pay (WTP) for three hypothetical BMP labels indicating the products are from farms adopting BMPs. The study also compares WTP for products with BMP labels *vs*. USDA organic and Good Agricultural Practices/ Good Handling Practices (GAP/GHP) labels. We further measure the effects of alternative informational messages about agricultural practices on the WTP. A "positive" information message emphasizes the importance of agricultural inputs; a "negative" message focuses on the potential adverse impacts of agricultural inputs on the environment; and a balanced message combines the positive and negative information. An online consumer survey of a nationally representative sample shows that consumers perceive "protection of soil, water, and air" (i.e., environmental sustainability) as the most important characteristic of sustainable agricultural practices. This is followed by the "product quality and safety" (economic sustainability) and "prohibition of child and forced labor" (social sustainability.) Consumers are willing to pay a higher premium for the environmental labels (BMPs, Organic) than food safety labels (GAP/GHP). Besides, information messages can significantly alter the WTP for BMP labels. Consumers facing balanced information have the highest WTP for the BMP labels, compared with the WTP for other informational messages or the control with no message. The findings suggest that the BMP labels have potential market value compared to existing popular eco-labels in the market. However, appropriate messages should be identified and used to promote the consumption of products with environmental labels such as BMP labels.

PRESENTER BIO: Uddin is a third-year Ph.D. student at Food and Resource Economics Department. He is interested in the non-market valuation of environmental resources and the marketing of environmental commodities. He is currently working to explore the marketability of the BMP label and the adoption of BMPs among small and medium specialty crop growers.

WATER, SANITATION, AND HEALTH IN URBAN DISADVANTAGED UNINCORPORATED COMMUNITIES

Abby Vidmar[1], *Madeleine Zheng*[2], *Nora Awad*[3] *and E. Christian Wells*[1]
[1]University of South Florida, Tampa, FL, USA
[2]Arizona State University, Tempe, AZ, USA
[3]Wheaton College, Wheaton, IL, USA

Water and sanitation (WatSan) challenges continue to escalate worldwide due to climate change, environmental degradation, and socio-political instability. While interventions are often aimed at low HDI countries, communities in the global north also experience high levels of WatSan insecurity, for example, those in rural and indigenous areas. Recent research in the United States has revealed that many urban disadvantaged unincorporated communities also lack consistent access to clean and safe water and adequate sanitation. In Florida, these environmental justice communities often originated as unregulated subdivisions of unincorporated land and, as such, lack adequate public investment in WatSan infrastructure. In these settings, some households have access to centralized water treatment and delivery systems, while others rely on private drinking water wells and on-site wastewater treatment such as septic systems. In both cases, water quality and wastewater infrastructure can be insufficient to protect human health. Our research draws on social science methods—including participant observation, rapid field assessments, and in-depth interviews—to examine local residents' perceptions and experiences with water and sanitation, focusing on the University Area Community located on the northern unincorporated edge of Tampa. We also explore the broader regulatory context of water and wastewater infrastructure at both the municipal (Tampa) and county (Hillsborough) levels through interviews with WatSan utilities administrative staff and engineers. We find contrasting perceptions of WatSan problems and notions of risk between these stakeholder groups, which have contributed to misunderstandings and miscommunications about problems and potential solutions to WatSan challenges. Our research also reveals potential interventions to these challenges in how interlocal agreements are negotiated between cities and counties regarding water and wastewater service provision. Finally, our research allowed us to develop a community-based, participatory rapid assessment tool for assessing household WatSan insecurity that helps us identify households in the community at greater risk for WatSan insecurity.

PRESENTER BIO: Abby Vidmar is a graduate student in Applied Anthropology at the University of South Florida researching the nexus of water and sanitation insecurity and environmental justice. She is currently the student representative to the governing council of the National Association for the Practice of Anthropology.

THE MOTHER MAP: RÍO GRANDE DE MANATÍ WATERSHED AND THE HUMAN IMPACT ON NATURAL RESORUCES

Jobel Y Villafane-Pagan
University of Puerto Rico, Mayaguez

The “Mapa Madre'' (Mother Map) is an environmental initiative and community project that promotes the importance and protection of rivers and forests across the Río Grande de Manatí drainage basin in Puerto Rico. The project was developed in the Toro Negro community (Ciales, Puerto Rico) through an interagency initiative called “Management Plan for Human Impact Areas of the Toro Negro River” (2015 - 2019). The Mapa Madre is currently composed of five diferent the comunity organizations across the north-central mountainous region of Puerto Rico: Acción Comunitaria Cialitos Inc., Bosque Cibales, Amigos del Bosque Toro Negro Inc., Comunidad Toro Negro Inc., and Para la Naturaleza. The project's primary goals have been to conserve, recover, and protect rivers and forests across the Río Grande de Manatí drainage basin by promoting educational activities and communicating about disseminating relevant local laws and regulations. Community engagement has been successful due to recruitment and collaboration with groups/individuals with hands-on activities: geology field trips, cleaning rivers and forests, reforestation, and monitoring water quality across the drainage basin. Science communication and education have been vital to the Mapa Madre environmental community project, helping the community develop a common goal: conserving, restoring, and protecting the island's natural resources from human impact.

PRESENTER BIO: Jobel Y. Villafane-Pagan is a senior undergraduate geology student from the University of Puerto Rico - Mayaguez. He has dedicated undergraduate research on groundwater elevation changes during the 2020 southwestern Puerto Rico seismic sequence and sedimentology and stratigraphy of Enriquillo Lake sediments for developing a framework for paleoclimatic studies.

ADVANCEMENTS OF A COUPLED OCEAN NEARSHORE FORECASTING SYSTEM

John C. Warner
U.S. Geological Survey, Woods Hole, MA, USA

Rising coastal populations, surging sea levels and strengthening coastal storms are increasing risk to coastal communities. Prediction of extreme storms and their local impacts on the coastal environment, habitat, and infrastructure is crucial for management decisions and to provide early warning for evacuations and minimize loss of life and property. Coastal management plans to reduce risk can be guided by the application of numerical models that account for the complex interactions between the atmosphere, watersheds, the ocean and coastal ecosystems. The application of these types of models to past and future events, can help understand the complex dynamics of the coastal region and the consequences associated to coastal erosion, water quality and landscape changes. The prediction of these impacts has advanced tremendously in the past 10 years, due in part to advances in computational capabilities and observational systems. In this talk I will describe the Coupled Ocean-Atmosphere-Waves-Sediment Transport modeling system which dynamically couples state of art earth system oceanic, atmospheric and watershed numerical models. This system can be applied to better understand the effects of different coastal hazards such as such as rip-currents, pollutant transport in the nearshore region, barrier island erosion and breaching, red-tide transport, from others. Accurate assessment of impacts to these realistic systems requires high resolution nearshore and coastal information of landcover, bathymetry, topography, and oceanographic observations for comparison to model predictions. In this talk I will show different applications and I will talk about the future development areas.

PRESENTER BIO: Dr. Warner is a research oceanographer with the U.S. Geological Survey with more than 20 years of experience developing and applying coupled numerical modeling systems for the prediction of storms on coastal systems. He has extensive experience with estuarine physics, nearshore processes, coastal inundation and erosion.

HUMAN DIMENSIONS OF WATER CONSERVATION: WHAT DRIVES RESIDENTS TO ELIMINATE IRRIGATION IN LANDSCAPES?

Laura A. Warner *and John M. Diaz*
University of Florida, Gainesville, FL, USA

People working in water conservation have been encouraged to focus on specific behaviors that have high technical impact potential and high likelihood of adoption. Eliminating irrigated areas in residential landscapes is among the top behaviors in terms of technical potential (i.e., water conservation), but likelihood of engaging in this practice is relatively low compared to other conservation strategies. The purpose of this research project was to evaluate residents' motivations for eliminating irrigated portions of the landscape to inform more impactful behavior change strategies targeting likelihood of adopting this specific behavior.

A quantitative researcher-designed survey was distributed to Floridians 18 years of age and older who had irrigation systems they personally controlled, and 315 complete responses were secured. More than half of the sample (f = 183; 58.1%) indicated they had eliminated a portion of irrigated landscape area in the past, and less than half (f =144; 45.7%) were likely or very likely to do so in the future. We used a series of ordinal models to determine the factors that predicted intent to reduce irrigated landscape. In the final model, personal norms, or internal feelings of obligation to reduce irrigated landscape area, was the most important predictor, followed by subjective norms, or perceptions of social pressure to reduce irrigated landscape area. These findings demonstrate the power of both internal and external motivation. Findings imply the need for water conservation professionals to work to develop internalized connections to water and personal obligations to conserve. Further, they should build social communities that support water conservation to improve behavioral outcomes. Interestingly, people who had reduced irrigated landscape areas in the past were more likely to do so again in the future, implying potential for previous program participants to play a role in the success of water conservation interventions.

PRESENTER BIO: Dr. Warner is an associate professor and extension specialist in the UF Department of Agricultural Education and Communication and Center for Land Use Efficiency. Dr. Diaz is an assistant professor and extension specialist in the UF Department of Agricultural Education and Communication and Gulf Coast Research and Education Center.

OXYGENTATION OF LONG TERM ANOXIC BY FJORD, SWEDEN: IMPLICATIONS FOR ORGANIC CARBON SOURCES AND DECAY

***Emily G. Watts*[1]**, *Thomas S. Bianchi*[1], *Per O. Hall*[2] *Astrid Hylén*[2] , *and Mikhail Kononets*[2]
[1]Department of Geological Sciences, University of Florida, USA
[2]Department of Marine Sciences, University of Gothenburg, Sweden

Anthropogenic activity has significantly altered our planet and exacerbated global climate change. In particular, increases in the abundance of atmospheric greenhouse gases (e.g., CH_4 and CO_2), largely responsible for global warming, has disrupted the balance (e.g., sources, sinks and exchange rates) of the global carbon cycle. Sediment in the coastal margin store over 80% of the total organic carbon (OC) in the global ocean, thus playing a vital role in the global carbon cycle. Recent research has identified fjords as estuarine sites with efficient organic OC burial rates, largely due to their stratification, burying 11% of oceanic OC though only covering 0.1% of the ocean area. Fjords receive and bury autochthonous marine and allochthonous OC, or marine OC (OC_{mar}) and terrestrial OC (OC_{terr}). Here, we present data on recent and historical changes of OC inputs and burial in the By fjord, a predominantly anoxic Swedish fjord. This fjord was also the site of a 2.5-year long engineering experiment (2010-2013) in which oxygenated surface waters were pumped into deep waters. Sediment cores collected from 2009 and 2012, when the fjord was naturally anoxic and forced oxic, respectively, were examined for bulk elemental (C, $\delta^{13}C$, N, $\delta^{15}N$), radionuclide (^{137}Cs), and lignin biomarker analyses. The OC burial rates for the By fjord ranged from 24-38 g OC m^{-2} yr^{-1}, which agrees with estimates for regional fjords in NW Europe. Bulk elemental analyses suggest OC_{terr} and OC_{mar} burial. Lignin concentrations characterizes the OC_{terr} as non-woody angiosperm material that is not degraded once delivered to the sediments, proving the efficient burial of OC_{terr}. Relative contributions of OC_{terr} and OC_{mar} will be determined using a stable isotope mixing model and will be included in the presentation. Additional sites above the sill will be analyzed for greater temporal and spatial changes in OC burial.

PRESENTER BIO: Emily Watts is a second year PhD student in Dr. Bianchi's biogeochemistry lab in the Department of Geological Sciences. Her research interest includes carbon burial and the processes that influence carbon burial, such as redox changes, carbon sources, and metal interactions.

USING EXPLAINABLE AI MODELS FOR PRECIPITATION RETRIEVALS TO BRIDGE NASA AND NOAA OBSERVATION SYSTEMS

***Yixin Wen**[1], Zhi Li[2], Mathias Schreier[3]*

[1]University of Florida, Gainesville, FL, USA

[2]University of Oklahoma, Norman, OK, USA

[3]NASA/Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

The Atmospheric Infrared Sounder (AIRS) and the Advanced Microwave Sounding Unit (AMSU), aboard NASA's Aqua satellite, are central for observing global water and energy cycles, representing thus far the most sophisticated atmospheric sounding systems. Precipitation estimates from two satellites help to not only improve the accuracy based upon their unique sounding natures but also contribute to creating a seamless mosaic of global precipitation observations. However, conventional retrieval algorithms seek empirical relations between atmospheric signatures and rainfall rates, which is shown to be problematic due to imperfect quantification algorithms and the inability to adapt to local environmental changes. Taking advantage of massive data volumes in recent years, this study demonstrates a data-driven approach (A Convolutional Neural Network-based precipitation segmentation plus decision tree-based precipitation mapping) to maximize the retrieval accuracy while more importantly, discover the "black-box model" interpretability for a better understanding of the underlying physical connections. The results suggest that Machine Learning (ML)-aided approach systematically reduces observational bias, compared with operational retrievals. Identifying precipitation pixels like segmentation tasks further reduce 130% of systematic errors. This study exemplifies the potential of using an ML-aided approach to improve precipitation estimation and provides means of interpreting the Artificial Intelligence models.

PRESENTER BIO: Dr. Wen has been working on development and evaluation of weather radar and satellite precipitation retrieval algorithms more than one decade. She is an expert on ground-based radar and satellite synergy research using physically-based approaches and AI methods.

TIDALLY-FORCED INDEX-VELOCITY RELATIONSHIPS IN THE WACCASASSA RIVER

***Eric Whiteside*[1]*,** *Robert L. Taylor[1], Sangdon So[2], David Christian[3]*

[1]The University of Florida and Applied Technology & Management, Gainesville, FL, USA
[2]Applied Technology & Management, Gainesville, FL, USA
[3]Office of Agriculture and Environmental Projects, Suwannee River Water Management District, Live Oak, FL, USA

Coastal ecosystems provide ecological services, including carbon sequestration, wave attenuation, erosion prevention, and habitat. High-quality data and an accurate understanding of the system inform policy decisions. The Suwannee River Water Management District (SRWMD) and Applied Technology & Management (ATM) measured critical hydrographic parameters in Waccasassa Bay, Waccasassa River, and Cow Creek to support decision making.

SRWMD and ATM measured salinity, temperature, water-surface elevation, and flow velocity at three stations in the Waccasassa River watershed and at one station in Waccasassa Bay, every 15 minutes from April 2020 through March 2021. Salinity and temperature were measured with a sonde. Water-surface elevation and flow velocity were measured with an Acoustic Doppler velocity meter. Transient flow rate was also measured eight times over full tidal cycles, with an Acoustic Doppler current profiler. Four stations were strategically placed to constantly record data and monitor tide. ATM checked and maintained stations to ensure that data were correctly recorded, and that the velocity meters remained unobstructed and operational. ATM established index relationships between velocity and flow rate at two sites to subsequently estimate flow rate from measured velocity over the year-long measurement period. SRWMD and ATM developed unique, novel, compound index-velocity relationships to satisfy specific indexing challenges in this tidally-forced system. Data and analyses will form the basis for a coastal model and inform water policy.

PRESENTER BIO: Eric Whiteside is an undergraduate student at the University of Florida studying wildlife ecology and working as an intern for Applied Technology & Management to understand Florida's precious waterway systems. Growing up in the Florida Keys made Eric realize the importance of preserving life and biodiversity within ecosystems.

INTERPRETING THE TRENDS OF EXTREME PRECIPITATION IN FLORIDA THROUGH PRESSURE CHANGE

*Chi Zhang[1], **Songzi Wu[1]**, Tiantian Li[2], Ziwen Yu[1] and Jiang Bian[1]*
[1]University of Florida, Gainesville, FL, USA
[2]Florida Atlantic University, Boca Raton, FL, USA

Precipitation is one of the many significant natural factors impacting agriculture and natural resource management. Although statistics and other data technologies have been applied to investigate the non-stationary trend and the unpredictable variances of these events under climate change, existing methods usually lack a sound physical basis that can be generally applied in any location and any time especially in tropical areas whose atmospheric systems are relatively unstable due to high solar radiation. In this paper, Pressure Change Events (PCE) will be used as a physical indicator for atmospheric systems stability to unfold the impact of temperature on precipitation in the tropical area of Florida. By using data from both national and regional weather observation networks, this study segments the continuous observation series into PCE sequences for further analysis divided by dry and wet seasons. The results reveal that the frequency and intensity of PCE are highly associated with the occurrences of weather events. The frequency of the alternating between Increasing Pressure Change Events (InPCEs) and Decreasing Pressure Change Events (DePCEs) is subject to the temperature of the season and climate. Affected by the seasonal fluctuations of weather characteristics, such as temperature, the dependence of extreme precipitation on these characteristics can be interpreted via PCE. A 7% increase rate of precipitation vs. temperature rise can be observed from extreme precipitation with variances on season and PCE types. Although indicated by other research, active vertical movement of air caused by phase change of water at frozen point is not pronounced in Florida, especially in South. In summary, PCE is a reliable physical evidence of precipitation formation and can better associate the occurrence and intensity of extreme weather with other characteristics. In turn, such associations embody the underlying physical concepts holding at any location in the world.

PRESENTER BIO: Mr. Songzi Wu is currently a Ph.D. student in Department of Agricultural and Biological Engineering at University of Florida, being advised by Dr. Ziwen Yu. Wu's research interests are big data, AI, machine learning and deep learning.

STOCHASTIC DOWNSCALING OF HOURLY PRECIPITATION SERIES FROM CLIMATE CHANGE PROJECTIONS

***Ziwen Yu*[1]**, *Franco Montalto*[2], *Stefan Jacobson* [3], *Upmanu Lall*[4], *Daniel Bader*[4], *Radley Horton*[4]

[1]University of Florida, Gainesville, FL, USA
[2]Drexel University, Philadelphia, PA USA
[3]Philadelphia Water Department, Philadelphia, PA USA
[4]Columbia University, New York City, NY USA

Stochastic precipitation generators (SPGs) are often used to produce synthetic precipitation series for water resource management. Typically, a SPG assumes a stationary climate. We present an hourly precipitation generation algorithm for non-stationary conditions that is informed by average monthly temperature (AMT) projected by Global Climate Models (GCMs) that have higher-confidence than precipitation in these models. The physical basis for precipitation formation is considered explicitly in the design of the algorithm using hourly Pressure Change Events (PCE) to define the relationship between hourly precipitation and AMT. The algorithm consists of a multi-variable Markov Chain and a moving window driven by time, temperature, and pressure change. We demonstrate the methodology by generating a 100-year, continuous, synthetic hourly precipitation series using GCM AMT projections for the Northeast US. The synthetic results, when compared with historical observations, suggest that future precipitation in this region will be more variable with more frequent mild events and fewer but intensified extremes especially in warm seasons. Summers are predicted to have less precipitation while winters will be wetter, generally agreeing with current research on climate change projections in the northeast US. The Clausius–Clapeyron (CC) relationship is represented in the results, but more so for high intensity PCE. The amplification of extreme precipitation events varies for a given temperature depending on the PCE type. For decreasing PCE, extreme precipitation intensification starts at AMT of 22°C and at 12°C for increasing PCE. Our approach may provide more physically plausible weather ensembles for numerous applications involving climate change.

PRESENTER BIO: Dr. Yu is an Assistant Professor in Big Data Analytics in ABE department at UF. He has more than 10 years of experience solving urban hydrology problems by applying data science methods and developing modelling tools. Dr. Yu has worked in the development of multiple smart water resource management systems that integrate hydrological modeling, historical climate data, weather forecasts, and public engagement, to support the management of future cities and other settlements. He believes that the accurate representation of physical relationships found in any system of interest is more important than the specification of a given method.

UNDERWATER INTENSITY-TO-HEIGHT DOMAIN TRANSLATION FOR SYNTHETIC APERTURE SONAR

Dylan Stewart and ***Alina Zare***
Machine Learning and Sensing Lab, Electrical & Computer Engineering, University of Florida, Gainesville, FL, USA

In remotely sensed synthetic aperture sonar surveys, the same location on the seafloor is often captured from multiple views. However, fusion and alignment of these different views is extremely challenging. For example, error in the coordinates from the INS can be on the order of several meters. Furthermore, properties of SAS imagery can also provide barriers to adequate co-registration. Sound returns are inherently aspect dependent. In this work, we explore the use of domain translation to improve multi-look SAS image alignment. Three types of models are applied to translate SAS intensity imagery to height estimates: a Gaussian Markov Random Field approach (GMRF), a conditional Generative Adversarial Network (cGAN), and UNet architectures. Methods are compared in reference to coregistered simulated datasets.

PRESENTER BIO: Alina Zare teaches and conducts research in the area of artificial intelligence and machine learning as a Professor in the Electrical and Computer Engineering Department at UF. Dr. Zare's research focuses on developing machine learning algorithms to autonomously understand sensor data. Her research has included plant root phenotyping, sub-pixel hyperspectral image analysis, and underwater scene understanding using synthetic aperture sonar.

HOW TO DEVELOP A MULTI-FACET QC PROCEDURE FOR A GROUND-BASED WEATHER MONITORING NETWORK

***Chi Zhang**, Morgan Gunter, Beck Peyton, Kevin Denis, Songzi Wu, Ziwen Yu, and William Lusher*
University of Florida, Gainesville, FL, USA

Ground-based monitoring is essential for collecting environment information (e.g., air temperature, soil moisture) and evaluating its effectiveness. However, environmental uncertainties may have various impacts impairing data quality (e.g., outliers, reading delay). To mitigate these impacts, a multi-facet Quality Control (QC) strategy is developed and tested using Florida Automated Weather Network (FAWN) as an experiment platform. A flagging system with multiple types of labels (e.g., pass, suspicious, warning, erroneous, etc.) is integrated with multi-facet QC methods, including missing and duplicate check, three-level range checks, step checks, internal consistency checks, and spatiotemporal variance checks, to classify data quality. Range checks detect the outliers according to three hierarchical geographical levels of global, state, and region. While the boundaries of global and state ranges are relatively static, regional ranges are determined statistically and dynamically using z-test updated by new observations. The step checks detect unusual drastic changes between consecutive time steps or of a designated interval. Due to the drastic local weather variations in FL, data changes of consecutive steps could be too sensitive to be benchmarked than the ones of longer intervals and with more consistency trends. Physical concepts, such as dew point is no greater than air temperature, are encoded into internal consistency checks for all types of measures to minimize physical violation of data. Moreover, a spatial-temporal variance check considering the dynamics of data across multiple locations is under development to study the weather events' behaviors in Fl focusing on the similarity of time series patterns from surrounding stations. All those algorithms above can be generally applied for other loT-based monitoring networks.

<u>PRESENTER BIO:</u> Chi Zhang received his bachelor's degree in mechanical engineering from the Beijing University of Technology in 2017 Summer. After that, he received his master's degree in mechanical engineering at the University of Florida in 2020. Now, he is a PhD student in ABE department at UF.

HYPOXIA FORECAST IN THE CHESAPEAKE BAY USING CNN AND LSTM

Guangming Zheng[1,2] *and Stephanie Schollaert Uz*[3]
[1]NOAA/NESDIS/Center for Satellite Applications and Research, College Park, MD USA
[2]Earth System Science Interdisciplinary Center, University of Maryland Research Park, College Park, MD USA
[3]Earth Science Division, NASA Goddard Space Flight Center, Greenbelt, MD USA

Seasonal hypoxia has been a persistent threat for ecosystems and fisheries in the Chesapeake Bay. Hypoxia forecast based on coupled hydrodynamic and biogeochemical models has proven useful for fisheries management. These models excel in accounting for the effects of physical forcings on oxygen supply, but are not as good at predicting oxygen demand associated with decay of organic matter. Therefore, the accuracy of hypoxia forecast can be potentially improved with satellite-derived water color data which may help constrain the surface concentration of organic matter. Owing to the optical complexity, however, it is not straightforward to extract organic matter information from water color data in a robust fashion. A promising approach to address this issue is to use deep learning which is great at building end-to-end applications. By training a deep neural network with data of all variables that could affect dissolved oxygen (DO) concentration in the water column, improvement of hypoxia forecast is possible. Here we attempt to predict dissolved oxygen concentration with input data that account for both physical and biogeochemical factors. The physical factors are characterized by the 3-D outputs of a hydrodynamic model, which include the current velocity, water temperature, and salinity, as well as wind velocity. The biogeochemical factors are characterized by satellite-derived spectral reflectance data. Both physical and biogeochemical data are sampled on a weekly basis up to 8 weeks before the observation date of each field measured DO, which is obtained from the Chesapeake Bay Program. In total, we obtained 150,656 training examples from 2002-2018, and used data from the period of 2019-2020 for testing. We adopted a model architecture of combined convolutional neural network (CNN) and long short-term memory (LSTM) with 8 time steps. At each time step, a set of CNNs are used to extract information from the input data. This architecture mimics the evolution process of DO in natural waters. Our approach represents an innovative application of deep learning to solving water quality problems.

PRESENTER BIO: Guangming Zheng's research focuses on developing and applying remote-sensing algorithms for monitoring and forecasting water quality in coastal and inland waters. He is interested in addressing major water quality issues that may threaten coastal ecosystems, fisheries, and human health such as coastal hypoxia and harmful algal blooms. He employs both traditional physics-based approaches as well as deep learning based artificial intelligence.

EVAPOTRANSPIRATION TREND IN SOUTH FLORIDA

Yibing Kevin Zhu
South Florida Water Management District, West Palm Beach, FL, USA

Studies have been reporting global climate changes in the past decades. The increased level of greenhouse gases and the subsequent warming have altered the hydrological cycle to different extents at locations around the Earth (IPCC 2021). To address the challenge, the SFWMD is implementing several water and climate resiliency metrics to identify the regional trends, using the District managed data. Along with rainfall and surface flow, evapotranspiration (ET) plays a critical role to the sustainable development of our infrastructure, e.g. in agriculture and water supply. A recent look at the observation data shows that South Florida has been experiencing an upward trend of ET over the past 30 to 60 years, with an averaged change ratio of +5 mm/year. The data come from different sources as manually measured pan evaporation, and calculated potential ET with input of insolation that was retrieved from satellite images of cloudage. These data of independent sources draw the same conclusion that was statistically testified with high confidence ($p < 0.05$). The trends of four influential variables were also examined, in which the increasing solar radiation and declining relative humidity contribute to the upward ET trend most, then the air temperature, while the wind speed shows a downward trend. In addition, evaporation and transpiration roughly share a 50/50 composition in the ET of South Florida, and they both have an upward trend. Due to the wet climate, actual ET shares the same trend with potential ET in South Florida, especially in wetlands or during the wet season.

PRESENTER BIO: Mr. Zhu is a professional engineer with more than 25 years of experience in design and construction of hydraulic structures, Hydraulic &Hydrological modeling, and environmental assessment for restoration. Most recently, he also got extensive experience with hydrological data QA/QC and investigation of monitoring issues.

CHALLENGES AND OPPORTUNITIES FACING THE FLORIDA WELL OWNER NETWORK

***Yilin Zhuang*[1]**, *Andrea Albertin*[2]
[1]UF/IFAS Central Extension District, Mid-Florida Research and Education Center, Apopka FL, USA
[2]UF/IFAS Northwest Extension District, North Florida Research and Education Center, Quincy FL, USA

The Florida Well Owner Network (FWON) is a drinking water quality and septic system education program for residents being developed by UF/IFAS Extension agents and state specialists. Our goals are to educate residents about well water quality and best management practices to ensure well and groundwater protection, and to facilitate water testing.

Approximately 2.5 million Floridians rely on private wells for home consumption. While public water systems are monitored under the federal Safe Drinking Water Act, private wells are not regulated. Well users control the management and protection of their wells, depending on education rather than regulation to ensure water quality standards are met. Limited public data exist on how many well users test their water or drink from contaminated wells. The state has identified septic systems as a potential source of both nitrogen and fecal coliform bacteria to impaired water bodies. Over 30% of Florida households use septic systems to treat household wastewater, and most private well users have septic systems. Raising awareness among residents about groundwater quality, pollutant sources and loads, and best practices to reduce loads is critical.

Since 2017, 1,231 residents have been educated about water quality and septic system maintenance through FWON and 421 people have had their well water tested for bacterial contamination. Due to COVID-19, we switched from in-person workshops to webinars, reaching approximately 500 well users in the last six months, but this has excluded rural audiences with poor internet connection. Major challenges also include funding and facilitating well water testing. Testing is expensive for residents and logistics to organize large sampling events and ship samples to labs for analysis is challenging. Moving forward, we are continuing to organize well education events both through webinars and in-person and are seeking funding and partnerships to facilitate and subsidize well water testing.

PRESENTER BIO: Dr. Zhuang is a Water Resources Regional Specialized Agent. Her Extension areas of specialization focus on integrated water resources management in agricultural and urban environments.

RETHINKING SEEPAGE IRRIGATION MANAGEMENT FOR HORTICULTURAL PRODUCTION IN FLORIDA

Lincoln Zotarelli[1], *Judyson M. Oliveira*[1], *Fernando Bortollozo*[1], *and Allan Bacon*[2]
[1]University of Florida, Horticultural Sciences Department, Gainesville, FL, USA
[2]University of Florida, Soil and Water Sciences Department, Gainesville, FL, USA

Best management practices across Florida reduce water and nutrient leaving agricultural fields while maintaining crop yield and competitiveness of farming operations. Seepage is the mainstay for several horticultural commodities produced in Florida; approximately 320,000 ha of cultivated land are irrigated via seepage. Due to a spodic layer, the naturally occurring perched water table is artificially raised to just below the root zone to irrigate the crop. Seepage is relatively low-cost and low-maintenance compared to other available irrigation methods despite its much-reduced efficiency. Excessive application of water and nutrient run-off is an environmental concern. Alternative methods to improve seepage irrigation by enhancing water usage and nutrient efficiency of horticultural crops are increasingly available to producers through statewide cost-share. In northeast Florida, approximately 4,700 acres of agricultural land have been converted from seepage to drain tile irrigation; 1,650 acres converted to sprinkler irrigation and about 600 acres converted to subsurface drip for the water table control, with estimated water conservation of 525 million gallons per year. The potential water conservation of these alternative irrigation methods, when properly operated, can reach up to 50% compared to traditional seepage without compromising yield. Regardless of the irrigation method utilized, the precise manipulation of the water table level year-round is critical for increasing water conservation and nutrient retention in the root zone while promoting adequate soil moisture and aeration. Modeling the soil water retention curves using pedotransfer functions by correlating particle size distribution, bulk density, and organic matter content are used to establish the relationship between upward soil water flux and water table level. Precision irrigation scheduling can be achieved by adjusting the water table level during the different crop stages by matching upward soil water flux and crop evapotranspiration demand, in addition to reducing yield variability, and thus increasing crop resilience to adverse weather events.

PRESENTER BIO: Lincoln Zotarelli is an associate professor and extension specialist in the Horticultural Sciences Department. His research program focuses on developing best management practices for irrigation and nutrient management of vegetable crops.

THANK YOU SPONSORS

FOUNDING SPONSOR

DUKE ENERGY

GOLD SPONSOR

UF | IFAS Research
UNIVERSITY of FLORIDA

SILVER SPONSORS

UF | College of Agricultural and Life Sciences
UNIVERSITY of FLORIDA

PHILLIPS & JORDAN
A Proven Solution

UF | IFAS
UNIVERSITY of FLORIDA

TAMPA BAY WATER
Supplying Water To The Region

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

sas

water & air
RESEARCH, INC.

BRONZE SPONSORS

ATM
A Geosyntec Company

DB Environmental

GRU
More than Energy

wood.

STUDENT POSTER AWARDS SPONSOR

AWRA florida SECTION
American Water Resources Association

STUDENT SPONSORS

UF/IFAS Agricultural & Biological Engineering · UF/IFAS Center for Land Use Efficiency · UF/IFAS Soil & Water Sciences
UF/IFAS Wildlife Ecology and Conservation · UF Center for Coastal Solutions · UF/IFAS School of Forest, Fisheries, & Geomatics Sciences
UF Department of Geological Sciences · St. Johns River Water Management District
UF/IFAS School of Natural Resources & Environment · UF ABE Center for Remote Sensing