BOOK OF ABSTRACTS 2016

5th UNIVERSITY OF FLORIDA WATER INSTITUTE SYMPOSIUM

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Emerging Perspectives Post-Deepwater Horizon Oil Spill: Gulf Seafood, and Environmental and Human Health

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Abdel-Mottaleb, Noha

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Session Title: Poster Session - Watershed & Wetland Management

Potential use of Japanese Sweetflag for Remediation of Contaminated Surface Water

Acetaminophen and carbamazepine are often found in high concentrations in wastewater treatment effluent and surface waters contaminated with wastewater and reclaimed water. Conventional remediation techniques are often impractical for non-point sources and for compounds without water quality regulations. One possible remediation technique under evaluation is the use of floating islands of ornamental wetland plants.
A mass balance study was conducted to characterize the uptake of 14C-labelled acetaminophen and carbamazepine by the ornamental wetland plant, Acorus gramenius (Japanese sweetflag). Over a 14 day exposure period, 100 % of acetaminophen present in the growing solution, was taken up by the plants, with the majority occurring in the roots. However, carbamazepine removal at the end of the 14 day period was approximately 50 %. Preliminary results suggest that A. gramenius grown in floating islands may be useful for removing acetaminophen from contaminated surface water. Future research will evaluate the uptake potential for other contaminants with differing hydrophobicity to try to identify optimal properties for uptake.

Acharya, Subodh

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Session Title: Groundwater Resource Evaluation

Estimating water yield from pine forests with different understory management strategies

Forests play an important role in maintaining proper water balance of an area by affecting different hydrologic components such as evapotranspiration (ET), runoff and storage. However, studies on how variations in forest management strategies affect overall water yield are generally lacking. In this study, we use soil water balance to estimate water yields under a range of understory management regimes in pine forests across Florida. Using the in-situ soil-moisture and groundwater level measurements combined with the forest-stand attributes (leaf area index and basal area), stand-scale ET are estimated for forests subject to different understory management, and burning strategies. These ET estimates, combined with the annual rainfall data are then used to derive regional water yields for each management type. The results from these analyses will enable the development of general, management-water yield relationships which could be key to devising ideal forest management scenarios for better surface and groundwater resource management in the southeastern US.

Adler, Jennifer

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Session Title: Poster Session - Springs & Rivers

Unprecedented aggregation of turtles in a Florida spring yields new insights into dietary preference and grazing rates

A historically unprecedented aggregation of Suwannee Cooters (Pseudemys concinna suwanniensis) prompted an investigation of turtle grazing habits in Blue Spring, a second magnitude spring in Gilchrist County, Florida. Soon after the onset of the aggregation, we counted turtles and sampled vegetation during two separate sampling events (September and October 2013). In September 2013, visual surveys indicated a peak density of 497 turtles ha-1, almost 28x higher than the highest ever recorded at Gilchrist Blue Spring. By the second sampling event (October 2013), turtle density was reduced to 167 turtles ha-1, a density 9x higher than the historical maximum. Mean wet weight (g) of the invasive macrophyte Hydrilla verticillata in the spring run significantly declined (p0.4). Calculated grazing rates ranged between 766.49 and 2178.65 g wet weight H. verticillata turtle-1 day-1 for the high and low densities of turtles, respectively. Per capita grazing pressure was estimated at 58-165 g dry weight H. verticillata turtle-1 d-1 with a mean value of 112 g dry weight H. verticillata turtle-1 d-1. This is the first documented case of P. c. suwanniensis selectively grazing invasive H. verticillata as well as the first estimation of P. c. suwanniensis grazing rates in the wild. Findings point to the important role of turtles in freshwater food webs and also highlight the potential importance of submersed vascular plants in springs as a food source for Suwannee Cooters. Many springs have recently shifted from systems dominated by rooted vascular plants to an algal-dominated state, potentially reducing foraging opportunities for Suwannee Cooters and other herbivorous turtles.

Alonso, Alice

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Session Title: Poster Session - Coastal Waters

Can Upstream Anthropogenic Activities Reshape the Tidal Influence on a Downstream Wetland? A case study in NW Costa Rica.

Alice Alonso; Rafael Muñoz-Carpena; Arnoldo Valle-Levinson; Carolina Murcia.
The Tempisque river surrounding the internationally recognized Palo Verde wetland in NW Costa Rica is influenced by tidal propagation from the Gulf of Nicoya. The discharge in this river has decreased as a consequence of an uncontrolled water withdrawal for irrigation purpose in the upper portion of the watershed. We hypothesized that this diminution in the freshwater flow led to a higher amplitude of the tidal signal in the lower river that outweighs the associated decrease in the subtidal water level. The river influences the wetland hydrology by lateral seepage and bank overflow during high tide events. Hence, an increase in the tidal amplitude would lead to a higher occurrence of flooding events of the wetland, redefining the hydrology of this fragile ecosystem.
We measured water level, temperature and conductivity at a 15-minute resolution in three locations along the low Tempisque river, as well as the surface and subsurface water in the wetland nearby to the river edge during 5 months to 2.5 years. We also measured currents, salinity and temperature profiles during a complete tidal cycles (12.5-hour periods) in three lower-river transects with an acoustic Doppler current profiler and a conductivity-temperature-depth profiler. We combined statistical signal processing tools in the temporal and frequency domains, harmonic analysis and existing analytical expressions to demonstrate and quantify the variation in tidal amplitude and of the subtidal component under different values of discharge. We used it to assess the change of occurrence and intensity of flooding events under different estimations of long-term river discharge diminution. Significant evidence has been drawn showing that the wetland hydrology has been significantly altered due to those changes. This could be a factor that caused the observed degradations in this unique system. In a more general way, the developed methodology can be used for other systems where tidal variations as a response to altered discharge needs to be assessed.

Amini, Adib

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Session Title: Poster Session - Policy & Behavior Change

A Tool for Optimization of the Environmental and Economic Sustainability of Ion Exchange Drinking Water Systems

Human population growth and economic development are increasing water demands across the globe while causing water resources to become increasingly scarce. This places increased responsibility on potable water systems to provide environmentally and economically sustainable water treatment. Often the implications of design choices on effects at full-scale implementation are poorly understood or evaluated. Furthermore, the means of evaluation must center at the nexus of holistic goals, such as technology improvement, energy usage, climate and environmental impact, costs, and water treatment efficacy.
Micro-economic and technical considerations have traditionally been paramount in the design of water treatment systems and the traditional approach involves use of design guides, practical experience, process modeling, and cost analysis. However, improved methods are needed to better consider environmental and economic considerations in water treatment design.
This study dynamically links a mathematical process model with both Life Cycle Assessment and Life Cycle Costing to provide for optimization of decision variables. Although process modeling results have been tied to environmental indicators to allow for optimization, there has never been a tight integration of process modeling with LCA and LCC. This allows for direct estimation or environmental impacts and costs based on design choices, instead of by proxy indicators. Furthermore, it allows for avoidance of the shifting of burdens and impacts across the life cycle.
The design improvement tool is then applied in a case study of ion exchange (IX) drinking water treatment for removal of organics. IX is a robust technology that can be used to remove various types of contaminants in drinking water and has shown increased adoption in Florida for applications such as disinfection byproduct precursor removal. This study also expands the knowledge base on the sustainability of IX technology, for which there are few previous studies.

Anderson, Nelson

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Session Title: Poster Session - Springs & Rivers

High Resolution Lotic Limitation Assessment Through the Use of In-Situ Mesocosms

The determination of limiting nutrients in a lotic system normally requires a reach scale or ex-situ assessment. A reach scale experiment can find limitation for the system as a whole, but fails to discern fine scale spatial heterogeneity present due to differing types and densities of photosynthetic benthic coverages. Ex-situ experiments do not include field conditions, potentially giving an inaccurate representation. By using an in-situ mesocosm, solutes can be experimentally altered over a small portion of river bottom. By measuring GPP and biomass accretion in optically clear mesocosms, limitation can be determined for different species of benthic life over varying locations and conditions. . Here we present GPP and biomass responses of Sagittaria, algae, and bare substrate in Rainbow River, a major Florida karst spring fed river. Limitation was assessed on the basis of nitrogen, phosphorus, and iron additions, including all co-limitation possibilities. Results are expected to show iron limitation due to near absent surface water concentrations. This high resolution limitation data can be used to manage targeted nuisance species.

Andreoli, Joseph

Authors: **Joseph Andreoli**, University of Florida Department of Geography

Session Title: Poster Session - Climate Change & Variability

Predicting the Geographic Ranges of Non-Native Cichlids in Florida with Climate Change

Invasive species and climate change are two of the most pressing issues facing Florida today. The state is a hotspot for non-native fish introductions, including cichlids. Cichlids are a popular group of fish in aquaculture, and among anglers and aquarists, with many species having established populations in Florida. These species cause various environmental and socioeconomic impacts to the state. This study correlates the georeferenced presence points of six different cichlid species in Florida and the current bioclimatic (BIOCLIM) and hydrologic (HYDRO1K) variables at those sites using maximum entropy modeling (MAXENT), in a species distribution modeling (SDM) framework. These relationships are then extrapolated to two different representative concentration pathways (RCPs) for the years 2050 and 2070. The resulting maps give us predictions to where in Florida suitable habitat for a given species exists at a fine resolution of 1 km2. The geographic ranges vary from species to species, with a general trend of expansion throughout the state in the future given climate change. As eradication is difficult once a species becomes established, these models have use in informing risk assessments for sister taxa. There is predictive power in uncovering what parameters drive non-native cichlid ranges in Florida. These findings can be expanded to what variables are important for aquatic non-native species establishment at global and regional scales. For regions supporting rich fish diversity and endemism like the Southeastern United States, managers may use these findings in prioritizing effort and limited resources in controlling those non-native species causing the most negative impacts.

Athayde, Simone

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Session Title: Collaborations and Partnerships

Indigenous Peoples, Social-environmental Governance and Hydroelectric Dam Development in the Amazon

Indigenous lands and freshwater systems in the Amazon are under threat by the development of several hydroelectric dams in main Amazonian rivers. In regards to social-environmental justice, some of the main problems associated with hydroelectric dam construction in the Amazon (but also globally) explored in this case-study are: a) lack of transparent, inclusive and participatory decision-making in the planning and execution of the construction itself, as well as on mitigation and compensation projects and actions; b) lack of access to information, adequate consultation and prior informed consent processes established before the construction is initiated. This presentation reports on a participatory monitoring program of fisheries among two indigenous groups affected by the Belo Monte dam. The project design has included defining and monitoring indicators of participation and community empowerment, in addition to the technical monitoring of fisheries. We report on the process of defining and evaluating the indicators, reflecting on lessons learned and prospects for “on the ground” implementation, monitoring and evaluation of targets related to the Sustainable Development Goal 16 – SDG16 (Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels).

Atkinson, Michelle

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Session Title: Water Use in Agriculture

Using Smart Irrigation Apps to Show the Value of Extension to Local Government

I am applying for an Extension Scholarship
Extension needs to show their value to local county government who often fund local extension services. One way that the UF/IFAS Manatee County Extension Service is showing its value is by helping Manatee County save irrigation water on county owned properties. Using the Urban Lawn SmartIrrigation App, property site managers with the help of Extension are setting up the SmartIrrigation App on smart phones and tablets. Using the app instead of a set time-based schedule for irrigation, county site managers can provide irrigation amounts to turf that more closely match water needs. In programing the soil type and unique zone characteristics like sprinkler type and number of sprinklers in the zone, an irrigation schedule is generated. Extension staff provide detailed zone information to the site managers for app set up as well as completing a full irrigation evaluation on the site to correct inefficiencies in the system. The Smartirrigation Turf app provides an easy way to determine your irrigation schedule for better management of turf. The irrigation schedule it generates is based on real-time ET data at a weather station near the system location. Using this app for irrigation is expected to reduce irrigation amounts annually by 25%–30% if the app-suggested schedules are followed. On sites that have been evaluated and Extension staff made recommendations that saved 30% overage usage.
Learning Objectives: As the Water Conservation Agent and supervisor of the Mobile Irrigation Lab in Manatee County, I hope to get ideas or gain knowledge of new water saving technology, water related messaging, successful programming, trends, and sustainable management of water resources. This knowledge gain would be carried into local programming for the residents and professional irrigation contractors in Manatee County. We are currently surveying our Mobile Irrigation Lab clients with Dr. Randell Cantrell's Decision-Ade questions (http://ascelibrary.org/doi/10.1061/%28ASCE%29AE.1943-5568.0000176) that may map areas to show where we have a greater influence for behavior change. It is through networking and listening to other successful programs that we discovered this tool.

Banger, Kamaljit

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Session Title: Coastal Water Resources

Interaction between land-use and climatic extremes in controlling nitrogen transport from watersheds

The transport of nitrogen (N) from land surface to waterbodies is controlled by complex interactions among land-use, climate, and soils. Various forms of N (such as organic vs inorganic) vary significantly in the loss pathways, which adds another complexity to predict the impact of climatic extremes on N transport from watersheds. In most coastal water bodies such as the Tampa Bay Estuary, N is the limiting nutrient that drives eutrophication. The key questions on how climate-driven extremes and land-use interactions control N transport in the Tampa Bay are yet unclear. We hypothesize that land-use in the watersheds can modify the effects of the climate-driven extremes (such as high vs low precipitation) in controlling N transport. Here, we present the on how climatic extremes have affected N transport across urban land-use gradient in watershed draining into the Tampa Bay Estuary, Florida. This presentation will include three aspects: 1) how total N transport varied in the wet and dry years in the watersheds, and 2) how land use and climatic-driven extremes control organic, inorganic, and total N transport? Finally, we will discuss uncertainties in the research framework (spatial scale of watershed and temporal resolution of N monitoring) used for studying climatic extremes effects on N loss. This research will provide directions to develop research framework on studying such complex phenomenon and will enhance our understanding on interactions between human activities, climatic extremes, and ecosystem services.

Barrett, Charles

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Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Converting from seepage to plasticulture for Florida grown cabbage

The uncertainties of future climate conditions call for more variable and unpredictable weather patterns. Regardless of the climate outcomes, there is already an urgent world wide need for more sustainable water resource management caused by the depletion of major aquifers and population growth.
In Florida, a high population cabbage production system was developed to address these shared issues. By integrating an increased plant population with more water efficient production practices, we were able to optimize cabbage production while reducing the potential for off-farm nutrient movement as compared to the standard seepage system. Cabbage was grown on 1.2 meter wide raised beds with black plastic mulch and drip irrigation. Through the use of plasticulture, yield was increased from 33.6 Mg/ha to 59.4 Mg/ha on average over the traditional bareground production system. Water savings from using plasticulture were estimated at 381 mm during a low rainfall year. High population vegetable crop production systems that maximize water use efficiency, like the system developed for Florida cabbage, have great potential to provide sustainable food production for the future.

Barry, Savanna

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Session Title: Poster Session - Coastal Waters

Seagrass resilience to shading driven by biomass allocation ratio

Seagrasses are unique marine plants with fully developed leaves, roots and rhizomes and a high degree of phenotypic plasticity in allocating tissue to these structures. Along Florida's Gulf coast, concentrations of chlorophyll-a in surface waters and the widths and lengths of leaves of the dominant seagrass, Thalassia testudinum, increased along a gradient of increasing phosphorus concentrations in the water column. Aboveground to belowground biomass ratios (AG:BG) for T. testudinum indicated that seagrasses allocated relatively more biomass to aboveground structure as phosphorus concentrations in the water column increased. Based on these results, we designed an 8-week shading-recovery experiment in T. testudinum meadows with three different AG:BG ratios (high, intermediate, and low) to determine if relative allocation of biomass influenced resilience to short-term shading. Seagrasses in all treatment plots persisted through the 5 weeks of shading, but responded negatively to shading by decreasing leaf growth rates or altering leaf morphology. A 3-week recovery period showed that T. testudinum with intermediate AG:BG ratios were more resilient to shading than T. testudinum with either high or low ratios, and seagrasses with high AG:BG ratios were the least resilient. Overall, these results suggested that long-term water quality conditions may exert a strong influence on allocation of biomass by T. testudinum, which potentially may affect their ability to recover from short-term disturbances. In turn, AG:BG ratios are important metrics to monitor in seagrass meadows because they indicate areas of high and low resilience to short-term disturbances.

Bauer, Mace

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Session Title: Impacts of Climate Variability and Change on Water Availability and Quality

Exploring Changes in Rainfall Intensity and Seasonal Variability

I am applying for an Extension Scholarship. The distribution of rainfall has major impacts in agriculture, affecting the soil, hydrology, and plant health in agricultural systems. The goal of this study was to test for recent changes in rainfall intensity and seasonal rainfall variability in the Southeastern U.S. by exploring the data collaboratively with agricultural stakeholders. During the last 30 years (1985-2014), there has been a significant change (53% increase) in the number of extreme rainfall days (≥152.4 mm/day) and there have been significant decreases in the number of moderate intensity (12.7-25.4 mm/day) and heavy (25.4-76.2 mm/day) rainfall days in the Southeastern U.S., when compared to the previous 30 year period (1955-1984). The variability in spring and summer rainfall increased during the last 30 years, but winter and fall showed less variability in seasonal totals in the last 30 years. In agricultural systems, rainfall is one of the leading factors affecting yield variability; so it can be expected that more variable rainfall and more intense rain events could bring new challenges to agricultural production. However, these changes can also present opportunities for producers who are taking measures to adjust management strategies to make their systems more resilient to increased rain intensity and variability. Extension programs held throughout the tri-state region (FL, GA, AL) have delivered adaptive management strategies to farmers and their advisors.

Benjamin, Joshua

Authors: **Joshua Benjamin**, University of Florida
David Kaplan, University of Florida

Session Title: Poster Session - Climate Change & Variability

Development of a Fine-Scale Laser-Based Water Level Sensor

Evapotranspiration (ET) is a critical, but difficult to estimate, part of the global water cycle. A variety of methods exist to measure ET, but each have their own advantages and drawbacks. In this work we focus on the potential for using diurnal water level variation to estimate ET, and propose a novel sensor to measure fine scale (sub millimeter) water table variation using a laser-based sensor. The sensor consists of a phase-shift based laser rangefinder controlled by a Raspberry Pi microcomputer, and is designed to work in a remote environment with the potential ability to be deployed for several months at a time. This approach has the potential to eliminate measurement error associated with pressure and temperature sensitivity apparent in most commonly used pressure transducers, expanding our ability to estimate this important hydrologic flux. Preliminary results indicate a high level of accuracy in comparison to a pressure based transducer, but without noise and errors associated with changing temperatures and barometric pressure. Future tests will determine the sensor's ability to be deployed in a remote environment, and will see how it fares in a complex natural system in comparison with current technologies.

Berg, Sanford

Authors: **Sanford Berg**, University of Florida, Public Utility Research Center

Session Title: Planning and Governance

Seven Elements Affecting Governance and Performance in the Water Sector

A number of studies have emphasized that governance involves many elements, including accountability, autonomy, role clarity, policy coherence (especially as related to objectives), stakeholder participation/engagement, professionalism (capacity), and transparency. The OECD has recently identified twelve elements characterizing sound systems of water sector governance, including those already noted. Ultimately, governance affects the (1) effectiveness of institutions in implementing and achieving targets (as quantified objectives), (2) the efficiency of institutions as reflected in the benefits obtained at least cost, and (3) the trust and engagement of the citizenry—as governance promotes public confidence and inclusiveness of stakeholders (achieving legitimacy and a sense of fairness among affected parties). Sound governance affects conflict resolution among participants, promoting general acceptance of outcomes; poor governance exacerbates problems. Getting governance structures right is central to improving cost containment, service quality, and network expansion. This study identifies seven elements affecting infrastructure performance: institutions, interests (stakeholders), information, incentives, ideas, ideals (priorities placed on objectives), and individuals (leadership). It describes how these seven interrelated elements determine how effectively a regulatory system responds to challenges.

Berry, Michael

Authors: **Michael Berry**, Florida Department of Health

Session Title: Emerging Diseases and Contaminants in Florida Waters - 2

Florida's Well Surveillance Program

The State of Florida Department of Health (DOH) Well Surveillance Program locates and samples drinking water wells around areas of known or suspected anthropogenic chemical contamination. This contamination may be from several sources, such as petroleum, drycleaners, industrial, or agricultural sites. This program is jointly administered by the Florida Department of Environmental Protection (DEP) and the DOH. It is a program that helps to protect both public health and the environment.
The work done in this program helps the DEP to manage and prioritize the cleanup of contaminated sites. Sites that pose the greatest risk to both drinking water and the environment are the first to be handled. This program also protects public health by monitoring and identifying threats to the drinking water supply. Furthermore, private and other small wells with chemical concentrations greater than federal or state standards are either provided with a filter or connected to a central water source at no cost to the property owner. This prevents long-term public consumption of contaminated drinking water. Since 2005, the Well Surveillance program has searched over 19,000 sites and sampled nearly 48,000 wells. Over 4,400 of those wells had chemical concentrations greater than state and federal drinking water limits.

Biscaia R. da Silva, Andre Luiz

Authors: **Andre Luiz Biscaia Ribeiro da Silva**, University of Florida
Lincoln Zotarelli, University of Florida
Heraldo Hashiguti, Maringa State University
Michael Dukes, University of Florida

Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Response of Potato Yield to Irrigation Systems and Nitrogen Management in Flatwood Soils

Some agricultural areas of northeast Florida have converted from seepage irrigation to tile drainage, subsurface drip irrigation for water table control or overhead sprinkler irrigation. Growers are converting to these alternative irrigation systems to increase irrigation water savings. However, because of the low nitrogen use efficiency of potatoes and the susceptibility of N losses in the sandy soils of the region, high N fertilizer rates may still be required to maintain potato yields. The objective of this study was to evaluate irrigation water and N requirements, soil water dynamics of alternative irrigation systems compared to seepage irrigation. A field experiment was conducted at the University of Florida, Hastings Research and Extension Center using seepage, tile, subsurface drip, and overhead irrigation. Treatments combining N fertilizer rates of 0, 56, 112 kg/ha were applied at planting and 56 or 112 kg/ha were applied at both the emergence and side dress application within each irrigation system in a factorial randomized complete block design with four replicates. The average potato yield was 35.8, 37.4, 40.6 and 39.1 t/ha for seepage, tile, subsurface drip and overhead irrigation, and irrigation water use efficiency of 11.8, 25.3, 31.6 and 36.3 kg/m3, respectively. Irrigation water savings were 51%; 58% and 68% with tile, subsurface drip and overhead irrigation, respectively, compared to seepage irrigation. The application of 56 and 112 kg/ha N fertilizer at potato planting resulted in significantly higher tuber yield compared to the 0 kg/ha N treatment in all irrigation systems. The highest potato yield was achieved with the total N-fertilizer treatment rates above 224 kg/ha. There were no significant differences in tuber yield for total N rates between 224 and 336 kg/ha. Alternative irrigation systems produced similar or higher tuber yield with low irrigation water requirements, while N application timing rates played important role in potato tuber yields.

Bottcher, Del

Authors: **Del Bottcher**, Soil and Water Engineering Technology, Inc.
Andrew James, Soil and Water Engineering Technology, Inc.

Session Title: Springs IV - Temporal Dynamics

Crop Coefficients and Rainfall Distributions Influence on Silver Springs Flow

Over the past ten to fifteen years, the flows from the Silver Springs have been significantly lower than the previous three decades. This has raised concerns over the future of the spring and triggered significant debate over what has caused these reduced flows and what action can be taken to protect the spring. To help answer these questions, a springs flow model was developed that integrates the critical processes that control spring flow including recharge processes as influenced by temporal evapotranspiration (ET) relationships, ET crop coefficients by land use, groundwater pumping, and temporal and spatial rainfall distributions. Anthropogenic impacts on ET were primarily found to be impacted by irrigation practices and the amount of impervious surfaces from urban development. With the inclusion of the major water processes and using spatial rainfall data within the springshed, the Silver Springs model has closely predicted the observed flows over the past eighty two years, including the recent extreme low flow condition in June, 2012. The results indicate that temporal variations of rainfall and storm size distributions and anthropogenic land use changes are the dominant factors controlling the observed flows from Silver Springs.

Boyer, Mackenzie

Authors: **Mackenzie Boyer**, University of Florida

Session Title: Poster Session - Water & Nutrients in Managed Landscapes

A tale of two regions: How residential irrigation differs between Tampa Bay and Orange County and what that means for conservation

Florida is a hotbed for residential irrigation, but not all regions irrigate equally. The seven member-governments of Tampa Bay Water, located in southwest Florida, have developed a culture of conservation as a result of regional water scarcity. In contrast, Orange County Utilities in central Florida has not encountered the same scarcity. Although geographically close, customers of Tampa Bay Water member-governments and customers of Orange County Utilities differ greatly in their irrigation habits.
Analysis is based on monthly billing records for single-family residential customers without access to reclaimed water in Tampa Bay Water member-governments (1 million customers) and Orange County Utilities (140,000 customers). Monthly irrigation demand was calculated from billing data, estimated indoor water use, and estimated irrigated area. Estimated theoretical irrigation required was calculated using soil-water balances.
Based on the estimated irrigation demand and theoretical irrigation required, 7% of Tampa Bay Water customers over-irrigate as compared to 60% of Orange County customers. The differing irrigation behavior directly impacts which conservation measures would be most effective in each region. Several previous studies have reported the effectiveness of tools such as smart controllers (i.e., soil-moisture sensors and evapotranspiration controls) and landscape modifications (i.e., Florida-Friendly Landscapes), but these results have not yet been used to project region-wide conservation benefits. This study seeks compare historical irrigation habits and to estimate the potential impact of water conservation tools in southwest and central Florida.

Breder, Eliza

Authors: **Eliza Breder**, University of Florida
Michael Dukes, Professor, P.E.

Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Landscape Irrigation Patterns as Influenced by Smart Irrigation Controllers

Two types of smart irrigation controllers, soil moisture sensors (SMS) and evapotranspiration controllers (ET) have been installed on single family homes in Orange County Florida with irrigation history that exceeds the gross irrigation requirement. Along with the smart controllers group an additional control group were fitted with irrigation meters collecting data hourly. Data has been collected for three years to determine water conservation potential of these smart controllers under two implementation strategies, with University of Florida Institute of Food and Agricultural Sciences (UF-IFAS) recommendations and with contractor installs. Throughout those three years, water savings compared to the control group ranges from 12% to 45%. Standard water restrictions in the Orange County area vary from 1 to 2 times a week by season. SMS and ET specific treatments are known to irrigate three days a week by a pre-programmed setting while conserving water. To analyze the water conserving potential of the treatments at a higher irrigation frequency the weekly irrigation patterns of the smart irrigation technology treatments and the control group were compared.

Bushey, Randall

Authors: **Randall Bushey**, CH2M
D. Edward Davis, CH2M

Session Title: Impacts of Climate Variability and Change on Water Availability and Quality

Sustainability in Water Resources – Offstream Reservoirs to Manage Extreme Rainfall Events

Sustainability in water supply in Florida relates directly to the prediction of rainfall trends and technology solutions to provide adequate water supply in droughts and flooding. Florida is recognized as one of 10 hot spots in the lower 48 states by 2025 to have significant water supply issues (USACE, 2012) based on water availability and population growth. The 2015-16 Super El Nino forecasts extreme winter rainfall similar to 1997 and the Atlantic Multidecadal Oscillation (AMO) trends are predicting a cooler Atlantic resulting in fewer hurricanes and tropical storms – which could mean less rainfall over the summer wet season. El Nino events are usually followed by droughts. Water supply in Florida, particularly peninsular Florida, is at a cross roads and new tools will have to be employed in the future to accommodate increased water supply demand due to projected population growth, particularly in the face of extreme seasonal events.

Groundwater pumping in Florida is becoming under increased permitting constraints supporting no increase in groundwater production and in some areas, such as central-southwest Florida, a planned reduction in groundwater pumping. Tampa Bay Water, a west-central Florida water supply agency created in the 1990's to settle regional water "wars", utilizes reservoir storage, groundwater pumping, desalination, and surface water sources to meet the demand of 2,300,000 people in the bay area. The Agency was required to reduce its groundwater pumping based on environmental impacts to contiguous wetlands and lake systems. As a result of this reduction of a relatively "cheap" source of water supply, the agency diversified its sources by investing in a desalination plant, promoting water conservation within its member governments, in both public and agricultural usage, encouraging implementation of reclaimed water for irrigation and aquifer recharge by its member governments, and constructing an offstream regional reservoir.

Chang, Seungwoo

Authors: **Seungwoo Chang**, University of Florida, Agricultural and Biological Engineering
Wendy Graham, University of Florida

Session Title: Poster Session - Climate Change & Variability

Comparison of joint variable bias correction to uni-variate bias correction for use of Global Climate Model

For assessing future climate change impact, bias correction of GCMs is necessary to reduce the gaps between modeling results and reality. Many bias correction methods have been developed for implementing GCMs in hydrologic modeling. Recently, joint variable bias correction is introduced and this method is not fully reviewed before, in this study we assessed joint variable bias correction method comparing to CDF mapping, one of most common bias correction methods, as a uni-variate bias correction. Precipitation and evapotranspiration estimated by Penman-Monteith method from NLDAS-2 (the forcing data for Phase 2 of the North American Land Data Assimilation System) were used as references and nine GCMs of CMIP5 (Coupled Model Intercomparison Phase 5) were bias corrected with CDF mapping (uni-variate bias correction) and joint variable bias correction. Joint variable bias correction was conducted with four different ways: (1) matching probability of wet-day of simulation data (GCMs) to probability of wet-day of reference data (NLDAS-2) in probability space, (2) matching probability of wet-day in physical space, (3) without consideration of matching probability of wet-day in probability space, and (4) without consideration of matching probability of wet-day in physical space. Matching probability of wet-day and bias correction in probability space reduce biases of precipitation and evapotranspiration the most among four different ways, however CDF mapping reduced biases better than joint variable bias correction. In addition, CDF mapping reproduced joint CDF of precipitation and evapotranspiration better than joint variable bias correction did.

Chutcharavan, Peter

Authors: **Peter Chutcharavan**, University of Florida - Department of Geological Sciences
Andrea Dutton, University of Florida - Geological Sciences
Michael Ellwood, Australian National University - Research School of Earth Sciences

Session Title: Sea Level Rise: Projections and impacts

Uranium Isotopic Variability in Seawater and its Implications for Coral-based Sea Level Reconstructions

Understanding past rates of sea-level rise under different climatic conditions allows us to better project the nature of future sea-level rise that will affect coastal water resources. Uranium-thorium dating is a valuable technique that provides robust age constraints on fossil coral-based sea level reconstructions. Unfortunately, coral skeletal material is prone to alteration and must be carefully screened to ensure that the coral's primary chemistry has been preserved. One commonly used screening method involves the initial 234U/238U activity ratio from when the coral was alive, which is representative of seawater 234U/238U in the waters where the coral grew. Due to the relatively long residence time of uranium in the ocean (~400,000) years, seawater 234U/238U is often assumed to be constant since the late Pleistocene, and coral U-Th ages whose initial 234U/238U varies significantly from the composition of modern seawater are considered altered and, therefore, rejected. Several recent studies, however, have demonstrated that 234U/238U may vary on glacial-interglacial timescales. Various hypotheses have been proposed, from changes in physical weathering rates to oxidation of excess 234U in coastal sediments during sea-level lowstands. Nevertheless, the cause of this variability is subject to debate.
Our study draws upon a compilation of coral U-series data to better constrain observed variability in coral initial 234U/238U. Observations from the coral record will be evaluated using a two-box model of ocean circulation to determine if changes to the ocean's uranium isotope budget can explain changes to seawater 234U/238U over the last glacial cycle. It is essential that researchers constrain any natural variability in seawater uranium chemistry. If seawater 234U/238U does, in fact, vary over thousands of years then existing screening criteria may be rejecting unaltered corals. Such interpretations of U-series ages are needed to produce robust chronologies of past sea-level change.

Clark, Abigail

Authors: **Abigail S. Clark**, University of Florida
Donald C. Behringer, School of Forest Resources and Conservation, Program in Fisheries and Aquatic Sciences, University of Florida; Emerging Pathogens Institute, University of Florida

Session Title: Emerging Diseases and Contaminants in Florida Waters - 1

An introduction and overview of the lobster virus PaV1

An introduction and overview of the lobster virus PaV1 1-Line Text
Abstract Body From algae and invertebrates to fishes and mammals, pathogens affect every type of marine life. Viruses, in particular, have received increased attention in recent years, as their abundance in the water column and impact on host populations are much greater than previously thought. Panulirus argus Virus 1 (PaV1), the only naturally occurring virus to infect any species of lobster worldwide, was first reported in 2000 from the Florida Keys. Found only in the Caribbean spiny lobster Panulirus argus, PaV1 has since been identified throughout the Caribbean region. The Caribbean spiny lobster is the highest valued fishery in the Caribbean where annual landings exceed $1 billion and $35 million in Florida alone. While the direct impact of PaV1 on Florida fishery landings is currently under investigation, we will present recent research on the ecological effects of disease, ecological implications for the fishery, geographic distribution and connectivity of PaV1, and disease pathobiology.

Cohen, Matthew

Authors: **Matt Cohen**, University of Florida, School of Forest Resources and Conservation

Session Title: Sensors and Technologies

The National Nutrient Sensor Challenge: Stimulating Technology to Accelerate the High Frequency Wave of the Future

The impacts of nutrient enrichment are one of the grand environmental challenges facing society, affecting both the health of aquatic ecosystems and the societies and economies that depend on them. In the last decade, new in situ technologies capable of high frequency measurements of nutrient concentrations have emerged, and have transformed our understanding of nutrient loading, sources, ecosystem responses, and management effectiveness. Recognizing the intrinsic value of these measurements for monitoring progress towards remediation, and the stark cost constraints placed on their widespread adoption, the Office of Technology Policy commissioned the National Nutrient Sensor Challenge. The goal is to push the limits of measurement accuracy, cost, and deployment logistics (e.g., biofouling, telemetry). This talk will describe the origins, motivation and early results of the National Challenge, and orient the audience to emerging technologies that will transform our ability to assess trends, cycles and extreme events in watershed nutrient export and aquatic ecosystem responses.

Copeland, Rick

Authors: **Rick Copeland**, AquiferWatch, Inc.

Session Title: Groundwater Resource Evaluation

Development of a Basin-wide Groundwater Quantity Index for Long-term Sustainability

The proper management of groundwater resources is essential for their long-term sustainability. In order to properly manage our aquifer, not only scientists and water managers, but also the public, need to be involved in the management process. One way to include all parties is to periodically report on the overall conditions of groundwater basins that are easily understood by all. Indices have the potential to accomplish this objective, but unfortunately, are not currently available. To assist in this deficiency, two indices are proposed that can tract the overall quantitative conditions of groundwater basins. One is for a sub-basin, while the other is for an entire basin. They are based on two components of a groundwater budget: groundwater withdrawals and recharge. Using the proposed indices, seven examples from the three major aquifers of Florida are presented. They demonstrate that Florida's aquifer conditions currently vary from very good to stressed. The indices have the potential to be periodically reported to the citizens of Florida. A more informed public will be better able to manage its groundwater resources over the long term.

Crouch, Trey

Authors: **Trey Crouch**, University of Florida
Sergio Marconi, University of Florida
David Kaplan, University of Florida

Session Title: Poster Session - Watershed & Wetland Management

Examining the effects of dam-induced agriculture land use change on the hydrologic cycle

The construction of large dams and the continued development of new roads, agribusiness and mining on the Tapajos River has become the new focus of the Amazon frontier. These large dams are expected to have a wide range of effects on riverine ecosystems and communities. Consequently, significant land use change is also expected. We will explore the freely available, remotely sensed and ground-based data from the NASA-supported Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) to examine the possible local hydrological effects of land use change from forest to pasture and pasture to crops due to dam-related urban expansion.

Cunningham, Mark

Authors: **Mark Cunningham**, Florida Fish and Wildlife Conservation Commission
Dan Wolf, Florida Fish and Wildlife Conservation Commission

Session Title: Emerging Diseases and Contaminants in Florida Waters - 1

Emerging Diseases Of Aquatic Birds In Florida

Over 150 species of aquatic birds use the marine and freshwater ecosystems of Florida. Some reside in Florida year-round while migratory birds utilize the Atlantic and Mississippi flyways to winter in Florida or travel through the state to wintering areas further south. Anthropogenic changes to the environment are having an increasing impact on aquatic species and this is especially apparent in Florida. Direct and indirect effects of humans on bird populations include exploitation, physical hazards, habitat loss, alteration, fragmentation, exotic species, pollution and environmental contaminants, artificial feeding, resource depletion, artificial contact among wildlife, exotic, and/or domestic species, and climate change. The impact of these stressors can range from direct mortality to additive or synergistic effects on reproduction and fitness. Significant avian emerging disease threats in Florida include avian botulism, avian vacuolar myelinopathy, and eustrongylidosis.

Dain, Jonathan

Authors: **Jonathan Dain**, Florida Natural Resources Leadership Institute, UF/IFAS
Jessica Ireland, Program Coordinator, Florida Natural Resources Leadership Institute, School of Forest Resources and Conservation, University of Florida

Session Title: Collaborations and Partnerships

Building Capacity in Collaboration and Conflict Management for a State Facing Accelerating Change: The Florida Natural Resources Leadership Institute

In 2014, Florida surpassed New York to become the nation's third most populous state with close to 20 million people (U.S. Census Bureau, 2014). Projections suggest that by 2030 this number could reach 24 million (UF BEBR, 2015). Growing population implies increased pressure on water resources and increased numbers of stakeholders with competing interests in water and water management decisions – an estimated 7.7 bgd of fresh water will be required to support 24 million Floridians. A shifting landscape increasingly impacted by climate variability and sea level rise has already led to expensive and time consuming disputes over water quality and quantity issues as well as conflict over endangered species, land use and coastal and marine resources. Such disputes will only increase in the coming years and sustainable, innovative solutions will require more than just better data. The answers will also require heightened attention to collaborative governance approaches, effective communication, and workable conflict management strategies. Collaboration is not a given when competing interests are involved yet natural resource managers and scientists are rarely trained in the specialized set of skills and approaches it requires to work effectively across sectors and with diverse groups of stakeholders. To address the need for collaborative problem solving related to water and other natural resource issues, a UF Extension program called the Florida Natural Resources Leadership Institute (NRLI) has developed a model designed to help natural resource professionals from both the public and private sectors develop the skills and contacts needed to work together to address the complex challenges faced by the State of Florida. In this presentation, the approach will be described and examples will be provided. The NRLI program is not the answer to sustainable water resource challenges, but does offer one successful model for helping Florida manage competing interests in times of increasing complexity.

De Leon, Conrado

Authors: **Conrado De Leon**, University of Florida
Kati Migliaccio, Professor, Agricultural and Biological Engineering
Michael Dukes, Professor, Agricultural and Biological Engineering
Kelly Morgan, Department of Soil & Water Science, University of Florida
Hartwig Hochmair, Geomatics Program, University of Florida

Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Comparison of Irrigation Allocation Models for Estimating Agricultural Water Requirements in Florida Considering the Influence of Precipitation Data Type

Irrigation models in Florida use different climate data to estimate the amount of water needed by plants to satisfy crop water requirements. Crop water requirements refer to the amount of water needed to satisfy the loss of water due to evapotranspiration, considering precipitation and irrigated water required for an optimal crop yield and an efficient use of water resources. Hence, rainfall variability and quality of rainfall data are influential factors to be considered in the estimation of irrigation requirements in Florida. An evaluation of different rainfall data sets and their effects on irrigation requirements will be performed with two models used by the Florida Water Management Districts. We will use the Agricultural Field Scale Irrigation Requirement Simulation (AFSIRS) model, and the Agricultural Water Use Model (AGMOD) to estimate crop water requirements in agricultural farms in Florida. Water requirements in AFSIRS are calculated with the Penman-Monteith evapotranspiration method, while climate input data are historical rainfall records from nine stations in and near the state of Florida. AGMOD uses a modification of the Blaney-Criddle equation to estimate potential evapotranspiration and historical rainfall data are obtained from the Southwest Florida Water Management District weather network, or from monthly rainfall estimations defined by the user. We will modify model input rainfall data sets with historical data of the Florida Automated Weather Network and with multi-sensor radar and rain gauge estimates from the National Weather Service and the National Oceanic and Atmospheric Administration to compare output estimations of water requirements from the two models. The results of this study will evaluate the effects of rainfall distribution and source of rainfall data and the potential differences on irrigation requirements and water allocation according to the two different models.

De Paula, Henrique

Authors: **Henrique de Paula**, Utah State University

Session Title: Poster Session - Policy & Behavior Change

Optimizing dam siting in hydropower systems using a multi-objective optimization approach

Hydropower systems can provide two di erent electricity services: base load and peak load generation or peak load generation only (Egré and Milewski, 2002). The former is often found in regions where hydropower is abundant, while the latter is found where hydropower complements other energy sources. In a region where hydropower o ers base load and peak load generation, the increase in generation capacity can be readily seen as bene cial in terms of energy reliability. On the other hand, hydropower plants are always associated with reservoirs, one of the main causes of social and environmental impacts. In the last years, hydropower projects have been facing many challenges around the world, frequently related to public expectations regarding social and environmental performances (Klimpt et al., 2002). Decision-makers often choose the best set of hydropower plants to be built in a given river or watershed based on optimization models. These models can be an important tool not only to decide what might be the best policy, but also to communicate the main stakeholders why a given policy was chosen and what were the main variables that lead to that decision. In addition, by using a multi-objective model that considers social-environmental aspects as a goal, and not as a constraint, it might be possible to better assess the trade-o s that hydropower expansion presents.
The main goal of this research is to develop a multi-objective decision-support model that may be used by policy makers to decide where to build new hydopower plants, considering social-environmental aspects explicitly as an objective function.
Another desired goal is to identify the main aspects that might represent a barrier in this process, in order to try to overcome them or indicate that increase in energy/storage might not be possible, showing the main reasons and consequences of this outcome.

Decker, Paul

Authors: **Paul Decker**, University of Florida
Matthew Cohen, University of Florida
Daniel McLaughlin, Virginia Tech

Session Title: Sensors and Technologies

Monitoring BMP Effectiveness with Emerging Sensors in Two Fertilized Forested Watersheds

This paired-watershed study aims to isolate natural variations in stream water quality from those potentially associated with forest fertilization, and in doing so, assess Florida best management practices (BMPs) for fertilization. Using novel, in situ monitoring, high resolution (sub-hourly to sub-daily) streamflow and water quality data are being collected for baseline and post-fertilization conditions in two first-order, coastal blackwater streams draining approximately 6,000-acre watersheds in North Florida. This high frequency data collection includes: nitrate (NO3-), soluble reactive phosphorus (SRP), colored dissolved organic matter (CDOM), dissolved oxygen (DO), turbidity, stage, discharge, and pH. Following a year-long sampling period, results for baseline conditions illustrate dissimilarities among solute behaviors within each watershed based on loading and concentration, as well as event-driven dynamics compared to seasonal averages. Following baseline measurements, maximum allowable levels of elemental N and P were applied using diammonium phosphate (DAP) and urea fertilizers to one watershed in accordance with commercial pine management using aerial techniques. The post-fertilization response is being evaluated in the context of concentration-discharge (C-Q) relationships of solutes, as well as residence time within the watersheds using tracer isotopes. In general, assessing anthropogenic impacts requires a clear understanding of natural variations occurring over both long and short temporal scales. Available in situ sensors and high resolution data provide this information across a set of parameters and temporal scales, and give evidence of possible timescales of responses to fertilization, which would otherwise not be possible with conventional monitoring practices.

Dobberfuhl, Dean

Authors: **Dean Dobberfuhl**, St. Johns River Water Management District
Andy Canion, St. Johns River WMD
Lori McCloud, St. Johns River WMD

Session Title: Springs I - Groundwater and Surface Water Interactions

Predicting elevated groundwater nitrate concentrations using a decision tree-based geospatial model in the Silver Springshed, FL

The Upper Floridan Aquifer (UFA) receives nitrogen loads from a variety of sources varying through space and time, the fate of which is influenced by a range of hydrogeologic and biogeochemical factors. Mechanistic models of nitrogen fate and transport are difficult to construct because of the complicated karst geology and high potential for conduit flow. As an alternative, we developed a statistical model using spatially explicit geologic, land use, and nutrient loading data to predict occurrence of elevated aquifer nitrate concentrations. We retrieved nitrate monitoring data for groundwater wells within the vicinity of Silver Springs, including public water system (PWS) wells, private drinking wells, and monitoring wells from multiple government agencies. The final dataset consisted of approximately 3,000 wells in the 574,000 acre springshed that had been sampled for nitrate within the last 13 years. We used recursive partitioning, applying the random forest technique to identify important predictive variables and construct decision trees. Nitrogen loading, recharge to the UFA, and depth to the UFA were determined to be important predictors of elevated nitrate concentration in the aquifer. To investigate temporal effects of evolving land use, we regressed imputed N loading, based on periodic land use mapping, against groundwater N concentrations. Wells demonstrating significant positive or negative nitrate trends were identified and additionally examined for influence of local land use. The current modeling framework provides a promising approach for describing karst areas, where the Floridan aquifer is minimally confined and there is a tight spatial and temporal link between land surface activities and aquifer contamination.

Dutton, Andrea

Authors: **Andrea Dutton**, University of Florida

Session Title: Sea Level Rise: Projections and impacts

The multi-billion dollar boundary condition: How fast will sea level rise along the Florida coastline?

Providing robust projections regarding loss of land as well as loss of valuable coastal freshwater resources requires a detailed understanding of the physics that will contribute to future sea-level rise (SLR). Unfortunately, determining the time until sea level rises to critical tipping points for loss of freshwater or land resources is not straightforward. While much of the physics controlling the rate of SLR—such as that of the thermal expansion of water—is well understood, there are two components that add considerable uncertainty to existing projections. The first of these is the incomplete knowledge regarding the physics of rapid ice sheet retreat. For example, the Antarctic ice sheet is a large potential contributor to future SLR, but the rate at which this ice sheet is expected to retreat cannot be adequately modeled. In place of models, evidence of SLR during past warm periods can be used to constrain potential rates of ice sheet collapse. The second component to the uncertainty in future rates of SLR is the shorter-term annual to decadal scale variability that contributes to extreme events. The processes driving this short-term variability include changes in winds and current strength, as well as storm surges. The timing of some of these events can only be explained in terms of the probability of event frequencies, such as that of hurricanes that may threaten our coastlines. Hence, the timing at which we reach critical tipping points of SLR is highly uncertain, yet there is certainty that sea level will continue to rise. For this reason, despite the apparent utility of sea-level projections that are used for regional planning and adaptation, I argue that it is dangerous to latch on to a particular projection for future SLR scenarios.

Ehrlich, Oren

Authors: **Oren Ehrlich**, University of Florida
Xiang Bi, University of Florida

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues 2

A Latent Class Analysis on Public Attitudes Towards Water Resources in Florida: Implications for Recreational Demand

The recent development on nonmarket valuation has focused on identifying preference heterogeneity and examining its impact on willingness to pay. The objective of this paper is to examine the extent to which heterogeneous environmental attitudes influence demand for freshwater recreational activities and valuation of freshwater recreational benefits. We focus on the longest river in Florida, the St. Johns River, and use a telephone survey of Florida's residents to elicit information regarding household outdoor recreational experiences on the river. Additional information about respondent attitudes and perceptions about Florida's water resources and natural resource policy are also collected. We use latent class analysis to reveal two distinct classes based on their environmental attitudes and perceptions. We then estimate a recreational demand model with respect to travel costs to the river, household income, perceived water quality of the river, and respondent's environmental attitudes for each latent class. We find that the willingness to pay estimates for improved water quality are statistically different for the two classes. We contribute to the literature by emphasizing that environmental attitudes directly influence consumer's recreational demand and valuation of the river thus should be taken into consideration for managing water resources.

Engel, Angelica

Authors: **Angelica Engel**, University of Florida
Sanjay Shukla, University of Florida
Hilary Swain, Archbold Expiditions
Patrick Bohlen, University of Central Florida

Session Title: Poster Session - Policy & Behavior Change

Biodiversity-related Services, Dis-services, and Tradeoffs in a Payment for Water Storage Program in the Everglades

Agricultural lands provide a wide array of services including water storage and cycling. Enhanced water regulation services by flooding ranchlands were tested in a pilot water storage payment for environmental services (PES) program in the Northern Everglades watershed to reduce damaging excessive flows to the Lake Okeechobee and connected estuaries and the Everglades. As part of the PES, south Floridian ranchers raised the drainage ditch spillage elevations to reduce surface flows and store water. Ecohydrological models were developed to evaluate biodiversity services using data from 15 wetlands on four previously-drained ranches that participated in the PES program. Seven indicators of biodiversity, plants (wetland, forage, and weedy/exotic), fish, amphibian, mosquito, and macroinvertebrates, were measured. Biodiversity services and dis-services were estimated for a tradeoff analysis using spatiotemporal measures of inundation (%, area, volume, hydroperiod, connectivity). Three general regression models for wetland vegetation cover ($R^2=0.28$;$p<0.001$), forage vegetation cover ($R^2=0.33$; $p<0.001$) and fish abundance ($R^2=0.33$; $p<0.001$) had reasonable amount of predictability. The models were applied for two of the ranches participating in the water storage PES using water availability predictions from an integrated spatially explicit hydrological model, for a wide range of drainage levels. Generally, diversity-related services increased with increased spillage levels. However, not all ranches responded the same. At one ranch services occurred at intermediate spillage levels while at another, maximum services were predicted for the highest spillage levels. Although significant uncertainty existed in predictions, they were directionally correct with increasing spillage levels resulting in increased biodiversity services. The results from these analyses indicate that biodiversity services can be successfully linked to water storage services with different levels of uncertainties. Although ecohydrological models are not accurate enough to develop a PES program which is designed to pay landowners for the provision of biodiversity services, they can provide decision makers with a method for selecting ranches which may be able to better provide ecosystem services above and beyond water storage alone. Future efforts should be focused on improving accuracy of models, with larger datasets (multiple years and sites), for biodiversity specific PES programs.

Engstrom, Johanna

Authors: **Johanna Engstrom**, University of Florida, Department of Geography
Peter Waylen, Professor

Session Title: Poster Session - Climate Change & Variability

Variations of, and changes in the hydroclimatology of the southeast United States

The hydroclimatology of the southeast United States (AL, GA, NC, SC and TN) is analyzed from a holistic perspective, including multiple climate drivers that have been investigated separately in previous research. Monthly precipitation modelled by the PRISM group, and runoff data (1952-2011) from 18 unregulated basins (USGS) are analyzed using a single-field based Principal Component's Analysis. Results indicate that the Atlantic Multidecadal Oscillation and El Nino-Southern Oscillation are the main drivers of hydroclimate variability in the region, sometimes operating at several months lag. Their influence is the strongest in the fall through spring, which corresponds with the dry season in the southern parts of the study area, increasing pressure on already limited water resources. The North Atlantic Oscillation and Pacific-North American patterns vary on shorter term bases, and also show a significant, but temporally more sporadic influence. A study of the relationship between the time series of precipitation and runoff indicates that the correlation between the two has become stronger over time, particularly in winter and spring, indicating an altered hydrologic cycle, which might be explained by a warmer climate.
Findings can be used in water resources forecasting, indicating expected water volumes several months ahead and giving an idea about future changes to the water cycle, following a warmer climate.

Epstein, Joshua

Authors: **Joshua Epstein**, University of Florida
Alexa Lamm, University of Florida, Department of Agricultural Education and Communication
Lisa Lundy, University of Florida, Department of Agricultural Education and Communication

Session Title: Poster Session - Policy & Behavior Change

Agricultural Water Use in Florida: Applying a Visual Semiotics-Framing Approach to Understand Perceptions

Members of the general public and state decision-makers often perceive information regarding water use in agriculture differently. This is an issue in Florida where water quantity is a concern, and the distribution of accurate knowledge will be necessary to assist in effective conservation efforts. This study was conducted to gain insight into Florida resident and state decision maker perceptions of water use associated with specific agricultural-related operations. An online public opinion survey was sent to Florida residents and Florida decision makers and, after removing responses for missing data, a total of 525 residents and 169 decision makers' responses were analyzed. Although the survey contained questions pertaining to many facets of water quality and quantity, only the section on perceived water use pertaining to specific agricultural operations was utilized in this analysis. Applying a visual semiotics-individual framing study design, participants were asked to state whether they would associate a specific agricultural operation, based on an image of it, with high, moderate, or low water usage. Differences between resident and decision maker responses were compared using an independent t-test, and significant differences were evident between means for citrus grove, hay field, plant nursery, horse farm, cattle pasture, home landscape, tree farm, and public use perceptions. Understanding where these differences exist will assist in the communication of accurate information between decision makers, the agricultural industry, and Florida citizens. In a subsequent analysis, perceptions will be compared with actual water-use data to target misconceptions and assist in implementing effective water conservation initiatives.

Ezell, John

Authors: **John Ezell**, University of Florida
Jonathan Martin, University of Florida
Liz Screaton, University of Florida
Amy Brown, University of Florida
Jason Gulley, University of South Florida

Session Title: Springs III - Chemical Processes and Nutrient Fluxes

Dissolution patterns shaping landscapes: potential links to climatic cycles

Ezell, J., Martin, J., Screaton, E., Brown, A., Gulley, J., Sutton, J., Spellman, P.
Periods of elevated precipitation cause spring flow to reverse and flood water to flow into river bank sediments. This intruding water will dissolve aquifer limestone during subsurface recharge and contribute to dissolution as precipitation recharges the aquifer through the land surface. Determining the frequency of reversals and which mechanisms contribute the most dissolution is important because each shapes landscapes and regional hydrology in unique ways, yet relative reversal frequency and volumes dissolved by these three mechanisms remain unknown. We partition the amount of dissolution resulting from each of these mechanisms following a precipitation event in 2012 in north-central Florida that caused a reversal into Madison Blue Spring. Water flowing into the spring as it reversed dissolved ~3.8 x 108 mmol of calcite. Dissolution caused by intruding river water, not including the spring reversal, along the studied river reach was ~2.3 x 109 mmol of calcite. Dissolution resulting from recharge of rainfall through the land surface was ~6 x 109 mmol of calcite. Dissolution resulting from direct recharge is widespread in time and space while dissolution from river intrusions is focused at the location of conduits. Rainfall and stage data reveal that Madison Blue Spring has reversed on average ~1.5 times/year for the last ~80yrs. The frequency of reversals is controlled by precipitation patterns which appear partially controlled by climatic cycles such as El Nino and the AMO. The balance between dissolution drivers created the current geomorphology and hydrology of north Florida, including both long phreatic caves and surface rivers, and a different dissolutional balance may have been reached without climatic cycles influencing precipitation patterns.

Fang, Yu

Authors: **Yu Fang**, School of Natural Resources and Environment, University of Florida
James Jawitz, Soil and Water Department, University of Florida

Session Title: Poster Session - Policy & Behavior Change

Is There a Universal Fractal Human Population Distribution in River Basins?

Human settlement locations are determined by heterogeneous landscape factors together with varied socio-economic conditions. Among these influencing factors, river networks hold an important historical role in affecting human population distribution. Classic scaling relations, Horton's laws, have been described for stream order and various river network geomorphological variables (e.g. stream number, stream length, and river basin areas). However, it is still an open question on how human population distribution is related with river network topological structure. In this study, we focus on the human population distribution in the river basins of the USA and test the following hypotheses: 1) Human population distribution shows a scaling law with stream order within river basins; 2) Such scaling relationships are universal across space. We used 2010 Landscan human population distribution data and extracted river sub-basins from DEMs in the USA. Our results show that: 1) the human population distribution shows a fractal structure, with power-law scaling between human population and stream order. This relationship is robust in sub-regions throughout the USA. However, area also shows a similar power-law scaling so population alone is not sufficiently informative. Because the exponents on the area relationship are consistently greater than for population, population density is negatively associated with stream order. Not all the regions show a scaling relationship characterized by human population density and the scaling get less steady from the East to the West of US. The observed reciprocal coupling between human population density and river basin order may reflect an optimum arrangement for humans to better utilize the water resource, ecological assets, and geographic advantage in river basins. The scaling relationships found here underline the controlling influence of river networks on landscape processes.

Felter, Liz

Authors: **Liz Felter**, University of Florida
Tracy Irani, University of Florida
Michael Dukes, University of Florida

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues - 1

Perceptions of Homeowner Association (HOA) Board Members in Orange County, Florida about Water Conservation and the Use of Florida Friendly Landscaping (FFL) Principles

A recent study was conducted to examine the perceptions of homeowner association (HOA) board members in Orange County, Florida about water conservation and the use of Florida Friendly Landscaping (FFL) principles. Specifically, the study looked at how open the HOAs were to increasing water conservation among the residents and how likely they were to accept FFL designs.
This study used qualitative research methods through the use of focus groups to determine whether a the board members attitude was open to change when it came to increasing water conservation and incorporating FFL principles. The focus group participants consisted of HOA board members from Orange County, Florida. A total of four focus groups were conducted which included 42 participants, and represented 31 different homeowner associations. Emerging theme for barriers to increasing water conservation practices was the need to maintain property value by having a nice landscape and green grass. Another emerging theme was that as an HOA board they did not have the skills to build consensus between the residents that had lived in the subdivisions for 30 years and the young 30 year olds moving into the neighborhood who don't want the "cookie cutter" look or the quarterly spray program for the grass. Some HOAs are allowing residents to have Bahia grass in the backyard and St. Augustine in the front yard. Felter et al. determined in 2013 that homeowners do not know how to properly care each of the different varieties of turf. Allowing this practice will contribute to the confusion that already exists about lawn care. Perceptions about using FFL were it had to be neatly manicured and not create a security hazard. The landscape design should include a lot of color and texture.

Foster, Dorah

Authors: **Katelyn Foster**, University of Florida
Patrick Inglett, University of Florida

Session Title: Poster Session - Springs & Rivers

Tracing Nitrate from the Source? A study on the influence of stable isotope fractionation on NO3- source end members from surface to ground water.

The use of stable isotopes in groundwater studies is not a new concept. Stable isotopes have been used as far back as the 1970s for N-source identification, and since the 1980s to distinguish between N-cycling processes. Current groundwater studies have combined these applications of stable isotopes (N, O, and C) to trace the forms of N found in the groundwater back to the source at the soils surface. The majority of these studies involve measuring the isotopic signature of the expected source and comparing it to the signature measured in the groundwater. Source can be grouped by land use and include conventional fertilizers, septic and sewage waste, manure, and treated wastewater. Isotope fractionation can occur via chemical processes (different processes that make up the N-cycle) as the source passes through the soil before reaching the groundwater, and can affect the end members of the isotopic signatures. The occurrence of fractionation in the soil can alter the signature of the source before it reaches the groundwater, leaving the potential for misidentification of the source from groundwater measurements alone. Because there has been an increase in the levels of nitrate in the Silver Springs springshed over the last 100 years, accurate source identification is an important component to groundwater remediation; if the source can be identified in the groundwater, then proper action can be taken at the surface. This study focuses on the stable isotope fractionation of 15N and 18O in NO¬¬3- as it passes through selected soil profiles that include top soil, vadose zone and aquifer material, and that differ with land use. The expected outcome for this study is the 18N and 15O signature will change as NO3- undergoes N-cycling processes in the soil. The end members measured at the surface will change and will not match the end members measured in the aquifer material and groundwater.

Francis-Floyd, Ruth

Authors: **Ruth Francis-Floyd**, University of Florida
Roy Yanong, UF SFRC, Tropical Aquaculture Laboratory
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Session Title: Emerging Diseases and Contaminants in Florida Waters - 2

Health Assessment of Florida's Long-Spined Sea Urchin, Diadema antillarum: A Keystone Species on Florida's Coral Reefs

Additional authors: Debbie Pouder, UF SFRC, Tropical Aquaculture Laboratory; William Sharp, FWC Fish and Wildlife Research Institute; Gabriel Delgado, FWC Fish and Wildlife Research Institute; Nicole Stacy,UF College of Veterinary Medicine; Tom Waltzek, UF College of Veterinary Medicine; Greg Beck, University of Massachusetts (Boston); Roxanna Smolowitz, Roger Williams University. The long-spined sea urchin, Diadema antillarum, is a keystone species in coral reef ecosystems throughout the Caribbean basin. In 1983-1984, a wide scale mortality event resulted in the loss of more than 90% of the D. antillarum populations throughout the region. The cause of this die-off is believed to have been an infectious agent, but a specific etiology was never determined. The loss of these important grazers has been tied to declines in coral reef habitat and environmental health, and although changes to the coral reef ecosystems are complex, the current hypothesis is that recovery of D. antillarum is necessary for their successful restoration. The State of Florida has invested substantially in coral reef restoration efforts in the Florida Keys. Concurrent with efforts to culture D. antillarum for future stock enhancement, the State determined that health assessment would be required before these cultured organisms could be released in Florida waters. To develop meaningful diagnostic protocols for this species, it was necessary to determine baseline health data, to collect reference tissue samples, and to assess the "normal background flora" of D. antillarum. Seasonal sampling was conducted in March, April, and September 2015 and a total of 189 D. antillarum (46 from the Lower, 71 from the Middle, and 72 from the Upper Keys) were necropsied using health assessment protocols developed during this project. Physical examination, including a behavioral assessment, was useful in recognizing potentially unhealthy animals. Coelomic fluid was used for bacterial screening and fecal examination provided for an assessment of gastrointestinal flora which routinely included several commensal ciliates. Most D. antillarum examined appeared to be in good physical condition, based on examination criteria. A few, however, were less responsive to behavioral stimulation or had visible external lesions. Findings from these few individuals will be compared to the broader group.

Gillum, Amanda

Authors: **Shawn Landry**, University of South Florida Water Institute
Jan Allyn, USF Water Institute

Session Title: Poster Session - Climate Change & Variability

Florida Water-CAT: Making it easier to share metadata about chemical, physical and biological water monitoring activities

The State of Florida has over 7,700 lakes, more than 11,000 miles of rivers/streams, more than 2,000 miles of tidal shoreline, and it sits atop one of the most plentiful aquifers in the United States. Water resource monitoring is vitally important so that water resource managers can ensure that this water meets the needs of the human population and ecosystems of Florida. Monitoring activities are carried out by hundreds of individual organizations, including: local, state and federal environmental agencies, educational and research institutions, environmental consultants and volunteer monitoring groups. In order to make it easier to coordinate monitoring efforts and share data, the Florida Water Resource Monitoring Catalog (www.Water-CAT.org) was developed as a publicly accessible online searchable database of metadata about water resource monitoring activities in Florida. The Water-CAT was developed by the USF Water Institute in partnership with the Florida Water Resource Monitoring Council (FWRMC) and launched in 2014 with metadata extracted from Florida STORET.
Since the release of the Water-CAT, the project partners have been working with data providers to acquire metadata, populate the online database, and refine the application. The effort to obtain comprehensive metadata is being balanced with the reality that data providers can only dedicate a minimal amount of time towards metadata documentation. For example, data providers indicated that a lack of time or budget would made it difficult for them to assemble supplementary metadata. Metadata acquisition efforts have thus forced design changes to the Water-CAT, including: making specific metadata elements optional, redesigning the database schema to allow flexibility between data providers, and new efforts to accommode biological and ecological monitoring activities. This presentation discusses the future of the Water-CAT and the lessons learned during the first two years of efforts to obtain metadata and manage the website.

Glodzik, Katie

Authors: **Katie Glodzik**, University of Florida
Bill Pine, University of Florida
Carrie Reinhardt Adams, University of Florida

Session Title: Poster Session - Coastal Waters

Road impacts to salt marsh salinity and vegetation via interrupted surface flow: observations from four Big Bend sites

Saltwater intrusion caused by sea level rise and decreased freshwater influence is leading to widespread coastal wetland change along Florida's Big Bend. Additionally, many coastal wetlands in the Big Bend are bisected by roads that potentially alter local salinity patterns by diverting freshwater and tidal flow. These road networks include "relic" unmaintained roads within protected lands, as well as frequent-traffic county roads. Studies have demonstrated that canals and drainage ditches can convey saltwater inland, but the role of roads in saltwater intrusion has not been examined. We selected four salt marsh study sites (>13 km apart) in the Big Bend Water Management Area and Lower Suwannee National Wildlife Refuge to compare vegetation and porewater salinity between two sides of a road. We hypothesized that (1) roads parallel to the coast reduce tidal flow to inland areas leading to drier conditions, increased evaporation, and higher salinity, and (2) higher inland salinity would cause altered vegetation characteristics, such as salinity stress-induced biomass reductions. At each site, we sampled porewater and surveyed vegetation at 5-9 stations spaced 25 m apart along transects perpendicular to the roads. We also installed shallow groundwater monitoring wells to continuously track salinity. We found differential salinity in sites bisected by roads, although these patterns varied depending on distance from road and site hydrology. Vegetation responses were highly variable. Our results suggest more work is needed to quantify the potential role roadways play in altering coastal areas, including addressing a key uncertainty as to whether roads affect salt marsh vegetation resilience to sea level rise.

Graham, Wendy

Authors: **Wendy Graham**, University of Florida Water Institute
Rob de Rooij, UF Water Institute
Wes Henson, UF water Institute

Session Title: Springs I - Groundwater and Surface Water Interactions

Effect of conduit/fracture geometry and porous matrix properties on predicting the sources, fluxes, travel paths and travel times of water and solutes to Silver Springs

Physics-based distributed models for simulating flow and solute transport in karst aquifers are generally based on the discrete-continuum approach in which flow in the three-dimensional porous limestone matrix is coupled with flow in discrete one-dimensional conduits. In general, however, little is known about the geometry of conduit networks. To quantify and analyze the reliability of discrete-continuum models it is important to explore flow and transport behavior over an ensemble of possible karst conduit networks within a stochastic framework. In this project we generate representative realizations of conduits and fractures that honor what is known about the geology, geomorphology and hydrogeology of Silver Springshed and incorporate them into a local-scale Silver Springshed equivalent porous media model. Monte Carlo simulation is used to systematically explore the relative importance of conduit/fracture geometry and porous matrix properties on predicting the sources, fluxes, travel paths and travel times of water and solutes to Silver Springs.

Guan, Jing

Authors: **Jing Guan**, University of Florida

Session Title: Poster Session - Springs & Rivers

Light Attenuation by Epiphytes on Vallisneria americana

Declines in the abundance of submersed aquatic vegetation (SAV) in Florida's spring systems are attributed, in large part, to the proliferation of nuisance algae. Macroalgal mats and increased periphyton burdens on the leaves of native vascular plants are particularly problematic as these algae intercept incident light necessary for photosynthesis and maintenance of SAV beds that provide important ecosystem services. In the spring-fed systems along the west coast of peninsular Florida, documented increases in periphyton on SAV are temporally concordant with losses of important plant species such as Vallisneria americana. This observation is suggestive of a cause and effect relationship, though the direct effects of periphyton on light reduction and performance of SAV in these systems have not been investigated. Toward this end, we used field collected data to model the relationship between periphyton biomass on Vallisneria americana leaves and light transmission. Our results suggest that the PAR attenuation as a function of epiphytes biomass can be well described by a negative hyperbolic equation, with a rapid reduction in light transmission associated with an increased epiphytic load. Based on known light requirements of SAV we will use the modeled data to make predictions about periphyton thresholds and plant performance. The ultimate aim is to provide water resource managers with an objective tool to assess the vulnerability of SAV to the negative impacts of increased periphyton loads.

Hahus, Ian

Authors: **Ian Hahus**, Department of Agricultural and Biological Engineering, University of Florida
Kati Migliaccio, Professor, Agricultural and Biological Engineering, UF
Donatto Surratt, Ecologist, National Park Service

Session Title: Poster Session - Watershed & Wetland Management

Statistics-based Hydrologic Model Compartmentalization for a Water Conservation Area

Improving the understanding and management of the hydrology of the Everglades will have great economic benefits for the state of Florida. In addition to hydrologic services such as groundwater filtration and recharge, benefits from the hydrology-driven ecology of the system include revenues from National Park visitation, hunting, and fishing. Due to its position within the watershed, the hydrology of Water Conservation Area 1 (WCA 1) can influence the hydrology of downstream portions of the Everglades system through the timings and amounts of controlled surface water releases. Previous modeling efforts in WCA 1 have focused on water quality with only required hydrologic components integrated. A compartmentalized hydrologic model of WCA 1 is needed to evaluate potential water management strategies based on predicted hydrologic outcomes. Boundary conditions and hydrologic forcing due to the perimeter levees and water control structures serve as constraints to the system. Cluster analysis was used to distinguish compartments within these boundaries that share statistically similar attributes for designing model structure. Digital elevation maps, vegetative cover classifications, and pumping station operations, as well as water stage and water quality monitoring data will factor into the analyses. The model's user interface will enable easy adjustment of parameters to test a variety of scenarios. Results of these simulations may encourage new management strategies to be advocated depending on targeted Habitat Suitability Indices (HSIs).

Hanson, David

Authors: **David Hanson**, Department of Geography

Session Title: Poster Session - Climate Change & Variability

Livelihoods at risk? Applying a Gendered Livelihood Vulnerability Index in Grenada

Small island developing states like Grenada are vulnerable to various hazards as a result of their relatively small size, insularity and remoteness, small exposed interiors and large coastal zones, limited human resource base, small economies and dependence on natural resources. Further, livelihood vulnerability is not equally distributed as a result of social structures such as gender, age and caste. Gender was chosen as the main social structure as it is argued that women are more vulnerable to natural hazards. Thus, this study examines gendered vulnerability to climate variability by adapting the Livelihood Vulnerability Index (LVI) for the Willis/New Hampshire community in Grenada. Whereas other LVI studies have sought to compare vulnerabilities between two communities, this study looked at differences within a community. Household data was collected for eight types of assets- including water resources, which were aggregated into composite LVIs and differential vulnerabilities of female headed households and non-female headed households ("other") was compared. Results suggest that female headed households are generally more vulnerable than non-female headed households. However, female headed households were less sensitive to climate variability and employed more effective coping and adaptive strategies than non-female headed households

Hensley, Robert

Authors: **Robert Hensley**, University of Florida
Matthew Cohen, University of Florida

Session Title: Sensors and Technologies

Variation in stream solute dynamics across temporal scales

Climatic, hydrologic, and biogeochemical controls on stream solute delivery and in-stream processing vary over a range of time scales from tidal, to diel, to storm event, to seasonal, to multi-decadal. Long-term, high frequency sampling using in-situ solute sensors has proved exceedingly useful in identifying trends, cycles and responses to extreme events, which may not be apparent from periodic grab sampling. Here we present datasets from a variety of stream ecosystems across north Florida, which offer novel insight into temporal variation in stream solute dynamics. Understanding the drivers and time scales of natural variation is critical in establishing a baseline for assessing anthropogenic impacts and for establishing regulatory standards which properly account for such natural variation.

Henson, Kevin

Authors: **Kevin Henson**, University of Florida
David Kaplan, University of Florida
Matthew Cohen, University of Florida
Daniel McLaughlin, Virginia Tech

Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Management of Evapotranspiration and Water Yield in Florida Pine Systems

Water scarcity presents a crucial challenge for water resource managers charged with maintaining hydrologic resources for domestic, industrial, and agricultural use while protecting natural systems. While the perceived benefits of forest management are often limited to habitat improvement, specific management actions that reduce forest biomass (from thinning and prescribed fire) may also have implications for regional water yield. Because evapotranspiration (ET) dominates ecosystem water losses, even modest reductions in the proportion of rainfall lost to ET (e.g., from 90% to 80%) can result in large fractional increases (e.g., doubling) in water yield. It follows that forest biomass reduction by land management agencies and private or industrial landowners should increase water subsidies to surface water and groundwater resources. To reduce uncertainty around projected water yield subsidies from modified management we are applying a comparative evaluation of the effects of land management on forest biomass, ET, and water yield across a gradient of environmental conditions (soil type, aquifer confinement, and climate). Within each site, treatments target variation in management activities (e.g., thinning, clearcutting, and fire) and forest biomass. Groundwater and soil moisture data are used to construct daily vadose zone and aquifer water budgets to determine ecosystem ET and water yield, while forest structure is evaluated via measurements of leaf area index (LAI), which has been shown to regulate stand ET and is directly related to management strategies. These data will then be used to derive specific management-water yield relationships to guide watershed-scale strategies for sustaining regional water resources.

Henson, Wes

Authors: **Wes Henson**, University of Florida/ USGS
Wendy Graham, UF
Laibin Huang, UF
Andrew Orgram, UF

Session Title: Poster Session - Springs & Rivers

Combining Push Pull Tracer tests and Microbial DNA and mRNA analysis to assess In-Situ Nitrate Transformations

Nitrogen transformation mechanisms in the Upper Floridan Aquifer (UFA) are still poorly understood because of karst aquifer complexity and spatiotemporal variability in nitrate and carbon loading. Transformation rates have not been directly measured in the aquifer. This study quantifies nitrate-nitrogen transformation potential in the UFA using single well push-pull tracer injection (PPT) experiments combined with microbial characterization of extracted water via qPCR and RT-qPCR of selected nitrate reduction genes. Tracer tests with chloride and nitrate ± carbon were executed in two wells representing anoxic and oxic geochemical end members in a spring groundwater contributing area. A significant increase in number of microbes with carbon addition suggests stimulated growth. Increases in the activities of denitrification genes (nirK and nirS) as measured by RT-qPCR were not observed. However, only microbes suspended in the tracer were obtained, ignoring effects of aquifer material biofilms. Increases in nrfA mRNA and ammonia concentrations were observed, supporting Dissimilatory Reduction of Nitrate to Ammonia (DNRA) as a reduction mechanism. In the oxic aquifer, zero order nitrate loss rates ranged from 32 to 89 nmol /L*hr with no added carbon and 90 to 240 nmol /L*hr with carbon. In the anoxic aquifer, rates ranged from 18 to 95 nmol /L*hr with no added carbon and 34 to 207 nmol /L*hr with carbon. These loss rates are low; 13 orders of magnitude less than the loads applied in the contributing area each year, however they do indicate that losses can occur in oxic and anoxic aquifers with and without carbon. These rates may include, ammonia adsorption, uptake, or denitrification in aquifer material biofilms. Rates with and without carbon addition for both aquifers were similar, suggesting aquifer redox state and carbon availability alone are insufficient to predict response to nutrient additions without characterization of microbial response. Surprisingly, these rates are consistent with reported rates of denitrification in other PPTs performed in basin fill aquifers which range from 10 to 360 nmol /L*hr. Thus, assuming equivalency between nitrate loss rates and denitrification rates may be an oversimplification when microbial response, nutrient spiraling, and all reaction byproducts are not evaluated.

Hernandez Ayala, Jose

Authors: **Jose J Hernandez Ayala**, University of Florida

Session Title: Impacts of Climate Variability and Change on Water Availability and Quality

Spatial climatology of rainfall associated with tropical cyclones and their contribution to overall precipitation in Puerto Rico

The island of Puerto Rico receives significant amount of rainfall associated with tropical cyclones (TC's) in the months of June through November, however little is known about the spatial and temporal characteristics of this rain. This study aims two explore two different tropical cyclone rainfall (TCR) problems, first the identification of areas where heavy tropical cyclone rainfall (TCR) occurs and second their contribution to the precipitation climatology of Puerto Rico for the period 1970 to 2010. A total of 86 tropical cyclones within a 500 km radius of Puerto Rico were analyzed. Daily and monthly rainfall data from 32 weather stations with at least 80% of completed observations in the time period were used to produce interpolated surfaces in order to explore the spatial distribution and contribution of TCR. Two interpolation techniques were implemented, natural neighbor-ordinary kriging and ordinary cokriging. Results show that for the mean 86, land falling and top rainfall events the TCR tends to be cluster in the eastern, southeastern and central regions of the island with a decrease in values as we move west. A strong correlation with elevation was found in the southeast. The month with the largest contributions (>20%) for most of the stations was September followed by August and October while the months with the lowest contributions were June and July. For September the stations in the south and eastern portions of the island had TC rainfall percentages of more than 20% with a few stations in the southern coastal plains reaching 30%.

Holt, Nathan

Authors: **Nathan Holt**, UF/IFAS Southwest Florida Research
Sanjay Shukla, University of Florida
Kira Hansen, University of Florida

Session Title: Water Use in Agriculture

Designing Bed Geometries for Sustainable Vegetable Production

Raised-bed plasticulture is used worldwide for growing high-value crops, especially vegetables. This high-input, intensive system must become more efficient to meet food demands while reducing its environmental footprint. Futuristic tall and narrow compact beds were designed with an aim to transform the plasticulture system by increasing economic and environmental sustainability. Newly-designed bed geometries that ranged from 41 to 61 cm wide and 25 to 30 cm high were evaluated against beds traditionally found in plasticulture systems, which tend to be between 76 to 91 cm wide and 10 to 20 cm high. Multiple seasons of field studies were conducted at commercial farms in Southwest Florida for fresh market tomato and eggplant production. Results indicate compact beds can be used in commercial production without sacrificing yield, while providing savings of up to $450/ha in seasonal production cost and 50% in irrigation water. Compact beds can also reduce carbon emissions by 5-10%, flood risks, and field runoff. Based on study results, multiple commercial vegetable farms representing over 1,500 ha have converted to taller and narrower bed geometries. Multi-season studies for single-row (tomato) and double-row (pepper) crops are currently underway to further assess the potential for compact bed geometries to improve the economic and environmental sustainability of plasticulture production.

Hopkins, Morgan

Authors: **Morgan Hopkins**, UF/IFAS Extension Miami-Dade County
Laura Vasquez, UF/IFAS Extension, Miami Dade County
Bertha Goldenberg, Miami Dade County Water and Sewer Department

Session Title: Poster Session - Policy & Behavior Change

Evolution of a water conservation program: How Miami-Dade County is saving water

I am applying for an Extension Scholarship. Miami-Dade County is no stranger to dealing with challenging situations as a direct result of water-related trends, cycles, and extreme events such as: sea level rise, drought, flooding, and saltwater intrusion. Since the establishment of the Water Use Efficiency Plan in 2006, Miami-Dade County has been developing and implementing water conservation measures and best management practices (BMPs) for commercial and residential entities to ensure sustainable management of local water resources. The Florida Yards & Neighborhoods (FYN) program has been involved since 2006, and expanded to include the Urban Conservation Unit (UCU) in 2008 to conduct irrigation assessments and rebates through the Landscape Irrigation Evaluations and Rebate Program for large properties and single family homes. The FYN program promotes water conservation through public education of the 9 Florida-Friendly Landscaping Principles in various outlets, such as yard certifications and rain barrel workshops. The UCU conducts irrigation system evaluations of properties that want to retrofit their systems with rebates that promote water use efficiency in the landscape. In addition to irrigation assessments, the FYN and UCU programs also conducts high efficiency showerhead exchanges. Our program has certified 103 properties as Florida-Friendly Landscapes since 2001. From 2006 to 2014, our program has conducted 95 rain barrel workshops to 2301 citizens, and distributed 1525 rain barrels. From 2006 to 2014, 254 large properties have received irrigation evaluations and rebates with an estimated total savings of 8,890,000 gallons per day. From 2009 to 2014, 690 single-family homes have received irrigation evaluations and rebates with an estimated total savings of 160,770 gallons per day. My objectives for the Symposium are to learn what strategies other water conservation programs in Florida are doing to reach their target customers, to learn more about water smart technologies as they relate to irrigation, and to learn more about how to educate citizens on the relationship between climate change, water, and the urban community. The partnership between Miami-Dade County Extension and Miami-Dade County Water and Sewer Department continues to evolve and educate citizens about water conservation and I plan to bring back the knowledge from the Symposium to ensure that our program continues to succeed and reach our county's water efficiency goals.

Hoyer, Mark

Authors: **Daniel Canfield**, University of Florida
Mark Hoyer, UF

Session Title: Impacts of Climate Variability and Change on Water Availability and Quality

Long-term Changes in Water Quality at an Outstanding Florida Water System: Importance of Stochastic Events and Climate Change due to the Atlantic Multidecadal Oscillation

Since 1986 citizen scientists from the Florida LAKEWATCH program have monitored nutrient concentrations (total phosphorus and total nitrogen), algal biomass (chlorophyll) and water clarity (Secchi transparency) at Little Lake Santa Fe, Lake Santa Fe and Melrose Bay, an Outstanding Florida Water system (OFW). Designating the Santa Fe Lake system as an OFW was to provide special protection to prevent impairment of water quality due to anthropogenic activities, but during 2007 measures of lake trophic state surged upward and water clarity decreased. The sudden increase in nutrient concentrations was linked to a catastrophic, 5,100-ha, forest fire (2007 Dairy Road Fire) that occurred in the adjacent Santa Fe Swamp. Further analyses of the data documented the impact of the hurricanes that struck Florida in 2004 and the impacts of droughts during the period of record. There was also an upward trend of the yearly measured minimal values for different water chemistries not only in the Santa Fe system, but also in other nearby lakes. Regional changes suggested in-lake changes were related not just to specific stochastic events or anthropogenic activities, but also to long-term climatic change. Changes within the 28-yr database at the Lake Santa Fe system were linked to the Atlantic Multidecadal Oscillation (AMO), causing Florida to enter a period of cumulative rainfall deficits since the 1980s. Trends in water quality at the Lake Santa Fe system could, therefore, reverse if Florida enters a period of increasing cumulative rainfall surpluses with a shift in the AMO.

Huang, Pei-wen

Authors: **Pei-wen Huang**, University of Florida
Alexa Lamm, University of Florida
Michael Dukes, University of Florida

Session Title: Poster Session - Policy & Behavior Change

Should Water Conservation Program Targeting High Water Users Be Provided Similarly Statewide? Hints from Three Regions of Florida

Competition for water sources in urban areas of Florida has increased due to increased population and human activities. High water users have been identified as a specific group Extension should focus water conservation education on due to their low awareness of water issues and active landscaping water uses. In order to ensure the effectiveness of extension programs targeting high water users, this study sought to explore regional differences in water conservation behavior engagement within Florida high water users. An online survey was conducted to capture responses of high water users (N = 932) in southeast, southwest, and central regions for this comparative study. Respondents were asked to indicate their current engagement in water use behavior, application of water conservation strategies, and the likelihood of engaging in water conservation and related societal behaviors. Regional differences were found in all four examined constructs. Therefore, extension educators should develop and deliver educational programs relevant to regional audiences' behavior patterns instead of treat all high water users in Florida as a whole to ensure program effectiveness.

Huang, Laibin

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Caitlin Young, Department of Geological Sciences
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Session Title: Poster Session - Coastal Waters

The responses of key nitrogen cycling genes to seasonal and tidal variations in a tropical estuary

To study the effect of different seasons and tidal variations on the abundance of key nitrogen (N) cycling genes around the Yucatan Peninsula, Mexico, water samples were taken across the halocline in the groundwater system, Cenote 7 Bocas (C7B), during the dry season (April, 2014) and wet season (September, 2014). Corresponding samples were taken from an area associated with submarine groundwater discharge (Pargos Spring) during low and high tides during the wet season. Results showed that: 1) Most key N cycling genes were enriched during the wet season in C7B and at high tides in Pargos, and significantly higher numbers of denitrification genes (nirK and nirS) were observed at high tides in Pargos, indicating that lower groundwater input to coastal regions may favor nitrate removal; 2) Most N cycling genes were more abundant at higher pH in this area, and that nitrite reductases (nirK, nirS, nrfA genes) were significantly positively related to salinity in Pargos; 3) The similarity between the lower depths of C7B and a channel leading to the Pargos spring was possibly due to the connection between Pargos and a cenote similar to C7B; and 4) seasonal and tidal variations clearly change the distribution of N cycling genes in these freshwater and marine systems. The results have implications for the impacts of sea level rise on coastal submarine estuaries.

Jawitz, James

Authors: **James Jawitz**, University of Florida
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Session Title: Springs I - Groundwater and Surface Water Interactions

Why is the flow in Silver Springs decreasing?

Silver Springs with an approximate discharge of 25 m3/s is one of Florida's first magnitude springs and among the largest springs worldwide. Its 2500-km2 springshed overlies the mostly unconfined Upper Floridan Aquifer. The aquifer is approximately 100 m thick and predominantly consists of porous, fractured and cavernous limestone, which leads to excellent surface drainage properties (no major stream network other than Silver Springs run) and complex groundwater flow patterns through both rock matrix and fast conduits. Over the past few decades, discharge from Silver Springs has been observed to slowly but continuously decline, while nitrate concentrations in the spring water have enormously increased from a background level of 0.05 mg/l to over 1 mg/l. In combination with concurrent increases in algae growth and turbidity, for example, and despite an otherwise relatively stable water quality, this has given rise to concerns about the ecological equilibrium in and near the spring run as well as possible impacts on tourism. The purpose of the present work is to elaborate parsimonious lumped parameter models that may be used by resource managers for evaluating the springshed's hydrologic and nitrate transport responses.
Instead of attempting to explicitly consider the complex hydrogeologic features of the aquifer in a typical numerical model, we use a transfer function approach wherein input signals (i.e., time series of groundwater recharge and nitrate loading) are transformed into output signals (i.e., time series of spring discharge and spring nitrate concentrations) by some linear and time-invariant law. The dynamic response types and parameters are inferred from comparing input and output time series in frequency domain (e.g., after Fourier transformation). Results are converted into impulse (or step) response functions, which describe at what time and to what magnitude a unitary change in input manifests at the output. For the hydrologic response model, frequency spectra of groundwater recharge and spring discharge suggest an exponential response model, which may explain a significant portion of spring discharge variability with only two fitting parameters (mean response time 2.4 years). For the transport model, direct use of nitrate data is confounded by inconsistent data and a strong trend. Instead, chloride concentrations in rainfall and at the spring are investigated as a surrogate candidate. Preliminary results indicate that the transport response function of the springshed as a whole may be of the gamma type, which possesses both a larger initial peak as well as a longer tail than the exponential response function. This is consistent with the large range of travel times to be expected between input directly into fast conduits connected to the spring (e.g., though sinkholes) and input or back-diffusion from rock matrix. The result implies that reductions in nitrate input, especially at remote and hydraulically not well connected locations, will only manifest in a rather delayed and smoothed out form in spring concentration.

Julian, Paul

Authors: **Paul Julian**, University of Florida

Session Title: Restoration and Connectivity

Hydrologic restoration of the Taylor Slough Region of Everglades National Park. Changes in water quality and implications for ecosystem management.

This study addresses water quality conditions across several distinct hydrologic regimes in the Upper Taylor Slough (UTS) region of Everglade's National Park and briefly considers implications of conditions for long-term water quality management. Due to hydrologic restoration Taylor Slough has experienced significant changes in hydrology and water quality progressing from a direct inflow via a pump station to sheet flow conditions via groundwater seepage over a 27 year period. Cumulative flow and rainfall relationships demonstrate clear breakpoints document changes in hydrology to the upper portion of Taylor Slough. Associated with these hydrologic changes, water quality has also changed with total phosphorus inflow flow-weighted mean (FWM) concentrations ranged from approximately 12.5 ug/L to 5 ug/L. Meanwhile UTS total phosphorus outflow FWM concentration ranged from approximately 13 ug/L to less than 4 ug/L. Due to changes in water delivery and management hypoerhic exchange of water is likely between inflow and outflow of UTS, based on analysis of surface water ion ratios. Based on analyses and information presented the UTS region is a resilient oligotrophic wetland system retaining strong assimilation capacity in the face of major management changes. While great gains in ecosystem restoration has been achieved restoration is not complete for the Taylor Slough region and adjacent coastal basins.

Kane, Andrew

Authors: **Andrew Kane**, UF Environmental & Global Health

Session Title: Emerging Diseases and Contaminants in Florida Waters - 2

Emerging Perspectives Post-Deepwater Horizon Oil Spill: Gulf Seafood, and Environmental and Human Health

This study conducted analytical toxicology of inshore-harvested seafood to address public health and coastal community concerns regarding seafood safety in the Gulf of Mexico following the Deepwater Horizon oil spill. Over 1,000 fish, shrimp, blue crab and oyster samples were analyzed using GC/MS-SIM. The estimated sum of parent polycyclic aromatic hydrocarbons (PAHs) and respective alkyl homologs for all analyses revealed that 74% of samples were below detection limits; 23% were between 0.1-0.9 ppb; and 3% were between 1.0 and 38.0 ppb. Based on PAHs measured in Gulf seafood thus far, contaminant levels are remarkably low based on FDA levels of concern, and indicate that edible portions of inshore-sampled seafood species do not have elevated contaminant body burdens. These data do not reflect hepatic or biliary burdens of contaminants that were not analyzed in this study. An in-person food frequency questionnaire (FFQ) was developed and implemented to analyze household seafood consumption patterns and body weights from Gulf coast communities in Florida and Alabama. Initial FFQ data from over 900 individuals indicate that seafood consumption in Gulf coast communities is higher than national estimates derived from 2003-2010 NHANES studies (from which limits of concern were derived for this oil spill). Upper percentile seafood consumption for Gulf coast survey participants was 231% (adults) and 298% (>21yo) higher for finfish, and 536% (adult) and 984% (>21yo) higher for shellfish (shrimp + crab + oyster), than upper percentile national estimates. Further, seafood consumption patterns varied substantially between communities. Analytical toxicology data, combined with consumption patterns of coastal high-end consumers of Gulf seafood, are being used by our transdisciplinary team to refine risk communication and resiliency programs, and develop probabilistic community-based risk assessments.

Kane, Andrew

Authors: **Andrew Kane**, UF Environmental & Global Health

Session Title: Poster Session - Policy & Behavior Change

Emerging Perspectives Post-Deepwater Horizon Oil Spill: Gulf Seafood, and Environmental and Human Health

This study conducted analytical toxicology of inshore-harvested seafood to address public health and coastal community concerns regarding seafood safety in the Gulf of Mexico following the Deepwater Horizon oil spill. Over 1,000 fish, shrimp, blue crab and oyster samples were analyzed using GC/MS-SIM. The estimated sum of parent polycyclic aromatic hydrocarbons (PAHs) and respective alkyl homologs for all analyses revealed that 74% of samples were below detection limits; 23% were between 0.1-0.9 ppb; and 3% were between 1.0 and 38.0 ppb. Based on PAHs measured in Gulf seafood thus far, contaminant levels are remarkably low based on FDA levels of concern, and indicate that edible portions of inshore-sampled seafood species do not have elevated contaminant body burdens. These data do not reflect hepatic or biliary burdens of contaminants that were not analyzed in this study. An in-person food frequency questionnaire (FFQ) was developed and implemented to analyze household seafood consumption patterns and body weights from Gulf coast communities in Florida and Alabama. Initial FFQ data from over 900 individuals indicate that seafood consumption in Gulf coast communities is higher than national estimates derived from 2003-2010 NHANES studies (from which limits of concern were derived for this oil spill). Upper percentile seafood consumption for Gulf coast survey participants was 231% (adults) and 298% (>21yo) higher for finfish, and 536% (adult) and 984% (>21yo) higher for shellfish (shrimp + crab + oyster), than upper percentile national estimates. Further, seafood consumption patterns varied substantially between communities. Analytical toxicology data, combined with consumption patterns of coastal high-end consumers of Gulf seafood, are being used by our transdisciplinary team to refine risk communication and resiliency programs, and develop probabilistic community-based risk assessments.

Kaplan, David

Authors: **David Kaplan**, University of Florida
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Session Title: Coastal Water Resources

Oyster Reefs Impact Estuarine Salinity Over Large Spatial Scales

Oyster reefs have been shown to provide myriad critical ecosystem services, however their role in directing flow and currents during non-storm conditions has been largely neglected. In many regions, oyster reefs form as linear structures perpendicular to the coast and across the path of streams and rivers, potentially entraining large volumes of freshwater flow and altering nearshore mixing. We hypothesize that these reefs have the potential to influence salinity over large areas, providing a “keystone” ecosystem service by supporting multiple estuarine functions. Here we present results from a field and modeling study to quantify the effects of reef extent and elevation on estuarine salinities under varying river discharge. We found salinity differences ranging from 2 to 16 g/kg between inshore and offshore sides of degraded oyster reefs in the Suwannee Sound (FL, USA), supporting the role of reefs as local-scale freshwater dams. Moreover, differences between inshore and offshore salinities were correlated with flow, with the most marked differences during periods of low flow. Hydrodynamic modeling using the 3-D Regional Ocean Modeling System (ROMS) suggests that the currently degraded reef system entrained greater volumes of freshwater in the past, buffering the landward advance of high salinities, particularly during low flow events related to droughts. Using ROMS, we also modeled a variety of hypothetical oyster bar morphology scenarios (historical, current, and “restored”) to understand how changes in reef structure (elevation, extent, and completeness) impact estuarine mixing and near-shore salinities. Taken together, these results serve to: 1) elucidate a poorly documented ecosystem service of oyster reefs; 2) provide an estimate of the magnitude and sptial extent of the freshwater entrainment effect; and 3) offer quantitative information to managers and restoration specialists interested in restoring oyster habitat.

Kaplan, David

Authors: **David Kaplan**, University of Florida
Nathan Reaver, University of Florida

Session Title: Springs II - Hydrography and Ecology

Collaborative Research Initiative on Sustainability and Protection of Springs: Quantifying Silver River Hydraulics and Hydrodynamics

Many of Earth's aquatic ecosystems have experienced shifts in ecosystem structure and function due to nutrient enrichment and subsequent algal proliferation. In many of Florida's spring-fed rivers, benthic and periphytic algae are replacing submerged aquatic vegetation (SAV), however the cause of these shifts in primary producer community structure is unclear. An alternative and perhaps concurrent hypothesis to eutrophication-driven algal proliferation is hydraulic control of algal abundance. This work presents preliminary results of an ongoing three-year study to characterize local- and reach scale hydraulics and hydrodynamics in the Silver River (Ocala, FL). We investigate local-scale relationships between flow velocity and algal abundance by mapping periphytic algal cover distributions on SAV beds along with spatially and temporally corresponding flow velocity distributions. SAV beds were divided into standardized quadrants and photographed, and algal abundance was quantitatively computed from quadrant images by extracting average color pixel values using a photometric color system calibrated against field measurements. Field observations and preliminary results from the Silver River suggest a clear inverse relationship between flow velocity and benthic and periphytic algae cover. At the reach scale, tracers allow for the investigation of reach-scale physical properties of streams. Typically, a tracer is released upstream and its concentration is measured downstream, producing a break through curve (BTC). The BTC contains information about the physical properties of the reach through which the tracer has passed, such as transient storage and residence time distribution. These properties are important in dictating stream chemistry and biology. Here we examine how the Sliver River's physical transport properties vary across flow conditions by comparing tracer studies in October 2009, March 2015, and October 2015. Observed BTCs were fitted to the OTIS model, a one dimensional transport and mixing model, using non-linear regression optimization and Bayesian inference. Results suggest that the Silver River's hydraulic transport properties are substantially different under the three different stage/discharge conditions. For example, mean residence time of the spring run decreased and the transient storage increased with increasing discharge. In addition, tracer experiment results were used to calibrate and validate a hydrodynamic EFDC model, which will be used to further test relationships and feedbacks between flow, vegetation, and algal cover.

Khadka, Mitra

Authors: **Mitra Khadka**, University of Florida
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Session Title: Springs III - Chemical Processes and Nutrient Fluxes

Benthic fluxes of nutrients and trace metals in a spring-fed Silver River

River benthic sediments act as a biogeochemical reactor and could provide important sources or sinks of solutes to or from river water, depending on the magnitude of fluxes of porewater and solutes. Solute fluxes across the sediment-water interface are driven by advective and diffusive processes. We assess relative importance of these two processes on solute budget in the Silver River, particularly for redox-sensitive nutrients and trace metals, by measurements of river water and porewater chemistry, hydraulic gradients and sediment hydraulic conductivity. Gradients of increasing Fe, Mn, soluble reactive phosphorous (SRP), NH4, and H2S concentrations in sediment porewater relative to the river water indicate diffusive fluxes of the solutes from sediments to the overlying river water. On the other hand, decreasing NO3 concentration gradients in porewater with sediment depth suggest that river bottom sediments act as a natural filter for NO3 removal from the river water column. Highly permeable river bottom sediments with hydraulic conductivities ranging from 1 × 10-3 to 5.06 × 10-4 m/s and orientation of hydraulic gradients towards the river suggest advection also provides an additional mechanism to transport solutes to the river. Interbedded layers of course-grained sediments and fine-grained sediments suggests that most of the advective flow could be horizontal rather than vertical. Our results show that nutrient and metal inputs from sediments to the water column could boost algal blooms in the Silver River and subsequently affects benthic and lotic ecosystems.

Kincaid, Todd

Authors: **Todd Kincaid**, GeoHydros, LLC
Brent Meyer, GeoHydros, LLC

Session Title: Groundwater Resource Evaluation

Modeling methods for the karstic Floridan aquifer: Consequences of inappropriate groundwater models and assumptions

Groundwater flow models deliver predictions of the impacts of human actions or natural phenomena on groundwater resources based on an underlying set of assumptions regarding the physical characteristics of the hydrogeologic environment. In the most general sense, we assume that models can reliably predict future impacts if they reasonably simulate current conditions. The degree to which they do this is evaluated through the model calibration process where good calibration to existing conditions indicates that the underlying model assumptions are reasonable and the predictions can be regarded as reasonably reliable. But, what defines “good calibration” or even “existing conditions?” Here we demonstrate through an analysis of regional-scale groundwater flow models that “good calibration” can be misleading, that by expanding the tests of “existing conditions” a substantially different picture of model reliability can be revealed, and by adapting the underlying assumptions, a substantially better match to a more reasonable and robust definition of existing conditions can be achieved. We show that a simple calibration to heads through the evaluation of average absolute residuals is insufficient to provide a meaningful test of model reliability. For the evaluation presented, we show that despite being described as well-calibrated on the basis of only average absolute residual, the model displayed a spatial pattern of large residuals outside of the acceptable range, failed to reasonably simulate observed cones-of-depression, failed to reasonably simulate mapable springshed boundaries, and failed to reasonably conform to sub-watershed water budgets defined on the basis of measured discharge. The result was a model for which more than 40% of the simulated extractions could be sourced to model boundary assignments. By comparison, we show that by changing the underlying assumptions and adhering to a more rigorous definition of calibration, all of these conditions can be adequately simulated.

King, Sean

Authors: **Sean King**, Southwest Florida Water Management District

Session Title: Springs IV - Temporal Dynamics

Coastal Springs Restoration in a Changing Environment

The Springs Coast region of Florida is known for four first-magnitude spring systems: Crystal River/Kings Bay, Homosassa River, Chassahowitzka River, and Weeki Wachee River. These spring systems have experienced substantial changes to their ecological drivers over the past century including nitrogen enrichment, riparian development, nuisance vegetation expansion, manatee population growth, recreational use, and sea-level rise. These changes tend to favor a plant community shift from macrophyte to algae dominance, which has been observed particularly for Crystal River/Kings Bay and Homosassa River. The Southwest Florida Water Management District is testing a variety of innovative restoration techniques to address these plant community shifts and their drivers. The Kings Bay Revegetation Project is underway as an experiment to re-establish desirable native aquatic vegetation primarily eelgrass (Vallisneria americana). This project will address key drivers that inhibit the re-establishment of the macrophyte-dominated state by deploying temporary herbivory exclusion barriers and managing filamentous algae and other nuisance species. The District is also evaluating the effects of sea-level rise on these coastal spring systems and the efforts to restore their ecology.

Kirk, Lily

Authors: **Lily Kirk**, University of Florida
Matthew Cohen, School of Forest Resources and Conservation

Session Title: Poster Session - Springs & Rivers

Can simultaneous O2 and CO2 measurement illuminate respiration dynamics in rivers?

The respiratory quotient (RQ = moles CO2 produced/moles O2 consumed during aerobic respiration) is used to convert ecosystem metabolism rates measured in oxygen to carbon fluxes. There are few direct measurements of RQ in aquatic systems, and it is often assumed to be 1. Actual RQ is a function of organic matter composition, and we propose to use it to tease apart the differential respiration of organic carbon in sediments. To scale up from controlled laboratory experiments to in situ open water measurements in rivers, we first need to determine the effect of reaeration on RQ. Deviations in open water CO2:O2 molar ratios from the RQ will allow us to partition between aerobic and anaerobic respiration. If anaerobic respiration is high, there is the possibility that we have been underestimating ecosystem respiration – and hence overestimating net ecosystem production – by only calculating ecosystem metabolism using oxygen concentrations.

Klarenberg, Geraldine

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Stephen Perz, UF Sociology and Criminology & Law
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Session Title: Poster Session - Watershed & Wetland Management

Determining Stochasticity and Causality of Vegetation Dynamics in the Southwestern Amazon

Infrastructure projects such as road paving have proven to bring (mainly) socio-economic advantages to countries and populations. However, many studies have also highlighted the negative socio-economic and biophysical effects that these developments have at local, regional and even larger scales.
The “MAP” area (Madre de Dios in Peru, Acre in Brazil, and Pando in Bolivia) is a biodiversity hotspot in the southwestern Amazon where sections of South America’s Inter-Oceanic Highway were paved between 2006 and 2010. We are interested in vegetation dynamics in the area since it plays an important role in ecosystem functions and ecosystem services in socio-ecological systems: it provides information on productivity and structure of the forest. In preparation of more complex and mechanistic simulation of vegetation, non-linear time series analysis and Dynamic Factor Analysis (DFA) was conducted on Enhanced Vegetation Index (EVI) time series - a remote sensing product which provides information on vegetation dynamics as it detects chlorophyll (productivity) and structural change.
Time series of 30 years for EVI2 (from MODIS and AVHRR) and socio-economic and biophysical variables were obtained for 100 communities in the area. Through specific time series cluster analysis of the vegetation data, communities were clustered to facilitate data analysis and pattern recognition. The clustering is spatially consistent, and appears to be driven by median road paving progress – which differs per cluster.
Non-linear time series analysis (multivariate singular spectrum analysis, MSSA) separates common signals (or low-dimensional attractors) across clusters. Despite the presence of this deterministic structure, we conclude vegetation time series behaves mostly stochastic. Granger causality analysis between EVI2 and all explanatory variables renders a causal ecological network, and cross-correlation indicates which variables (and with what lags) are to be included in DFA. This results in unique Dynamic Factor Models for each cluster, explaining vegetation dynamics with biophysical and socio-economic variables.

Kopiyawattage, Kumudu

Authors: **Kumudu Kopiyawattage**, University of Florida
Alexa Lamm, Assistant Professor

Session Title: Poster Session - Policy & Behavior Change

Public Perception and Willingness to Pay for Agricultural Best Management Practices

Cost effective and practical actions that could be taken by agricultural producers to minimize pollutants such as pesticides, fertilizers, and animal waste from entering water resources are called agricultural best Management Practices (BMPs). BMPs are important for maintaining and improving water quality over time. The purpose of this study was to identify Florida residents' perception and awareness of agricultural BMPs and their willingness to pay for products produced while engaging in BMPs. Non-probability opt-in sampling techniques were used to collect data and an online survey was distributed to Florida residents. A response rate of 26% was obtained with 524 (N = 524) responses. Based on the associated importance of implementing BMPs in Florida, respondents were categorized into 'high', 'average' and 'low' groups and their willingness to buy and pay more for products that are raised by BMP were examined. First, the respondents were asked about their awareness of BMPs implemented by farmers. The majority (81%) stated that they are unaware of BMPs. Despite this lack of awareness, 59%, 56%, 59% and 57% of the respondents agreed or strongly agreed that farmers in Florida practice proper nutrient/fertilizer, pest, water and animal waste management practices respectively. When the respondents were asked whether they would like to buy products from a farmer that they know uses BMPs, 93% indicated they would. In addition, 73% stated they were willing to pay more for products that were grown or raised by farmers using BMP. Results of this study revealed that respondents are not aware of the BMPs practiced by farmers in Florida even though they are willing to pay more for products produced using BMPs. Extension programs should be developed to create awareness of agricultural BMPs, both those practiced and campaigns around products resulting from BMP engagement.

Kumar Chaudhary, Anil

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Session Title: Poster Session - Policy & Behavior Change

Conducting Economic Analysis of State Extension Programs Using a Standard Evaluation Tool

Water is a scarce resource in the U.S., and stress on this resources is heightened by a growing population, urbanization, and change in climate (Adams et al., 2013; Wolters, 2014). Florida is reputed for its pleasing landscapes, and the state's residents pump thousands of gallons of water to maintain their landscapes, consuming 61% of the public supply water for irrigation (Baum, Dukes, & Miller, 2005; Haley, Dukes, & Miller, 2007; Monaghan, Ott, Wilber, Gouldthorpe, & Racevskis, 2013). To reduce stress on water resources in Florida, conservation of water is an immediate answer. UF/IFAS Extension takes this issue seriously and delivers a number of programs to encourage water conservation among Florida residents. However, evaluation of these programs to showcase their impact is a challenge. To address this, a team of researchers and Extension professionals developed a standard evaluation tool. To establish validity and reliability of tool, a pilot test was conducted to measure intended and actual reported landscape water conservation behavior change. Based on pilot test results, changes were made to the final instrument. The pilot test results indicated that there is some difference between behavioral intentions and actual behaviors adopted. Economic evaluation of actual behaviors adopted was conducted using Boyer and Dukes' (2015) potential water savings table and Raftelis Financial Consulting (2014) report. Based on 23 six-month follow-up participants, overall savings corresponding to actual behaviors adopted was 52,106 gallons of water per month and this water savings is equivalent to $241.25 monthly water bill savings. Additionally, this quantity of water saved corresponds to a $104.21 savings on water delivery costs to Florida water utilities. Overall, several lessons were learned while developing the standard evaluation tool. Standard evaluation tools are needed in era of complex funding, strict accountability requirements, and need to report impact of programs in terms of behavior change.

Laing, Joelle

Authors: **Joelle Laing**, University of Florida

Session Title: Restoration and Connectivity

Restoration strategies for Vallisneria americana on sites high in sediment organic matter

In recent decades populations of native submerged aquatic vegetation (SAV) have declined in Florida spring runs due to sharp increases in benthic filamentous algae and a suite of other anthropogenic changes. Though managers are attempting to revegetate many degraded spring runs, sediments in these sites are often highly reduced due to high sediment organic matter content and thick mats of benthic algae. In these reduced conditions, phytotoxic compounds such as hydrogen sulfide can potentially hinder plant establishment and growth.
In this study we compared three different methods for planting eelgrass (Vallisneria americana) in a formerly vegetated section of a Florida spring run: seed broadcasting, ramet planting, and sod installation. For each planting method, we established plots in organic sediments covered in benthic algae, in mineral sediments free of benthic algae, and in sediments where benthic algae and organic matter had been recently removed via hand dredging (n=3). To determine which management approach was best for reestablishing eelgrass, we monitored sediment redox potential and plant growth for four months. Preliminary results show that biomass in both ramet and sod plots had increased after one month in both the mineral sediment treatments and in treatments where benthic algae was removed. Conversely, many ramets planted in benthic algae/organic treatments have senesced after only a few weeks. When planting eelgrass in sites high in organic matter, managers can increase planting success by first dredging and/or removing benthic algae from sediments. In sites where this is not possible, installation of eelgrass sod with an established root system may act as a viable planting alternative.

Landrau Giovannetti, Nelmarie

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Session Title: Emerging Diseases and Contaminants in Florida Waters - 1

Phylogenomic diversity of cetacean morbilliviruses

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Cetacean morbillivirus (CeMV) is a member of the genus Morbillivirus in the family Paramyxoviridae that include enveloped negative-sense RNA viruses of importance in both human and veterinary medicine. Over the past 25 years, CeMV has emerged as the most significant pathogen of dolphins. Since July of 2013, a CeMV unusual mortality event in bottlenose dolphins along the Mid-Atlantic coast of the United States from New York to Florida has resulted in greater than 1800 strandings. We describe the phylogenomic diversity among five CeMV strains: dolphin morbillivirus (DMV-A) isolated from the aforementioned Mid-Atlantic bottlenose dolphins (Tursiops truncatus), dolphin morbillivirus (DMV-M) isolated from a Mediterranean striped dolphin (Stenella coeruleoalba), dolphin morbillivirus (DMV-G) from a bottlenose dolphin in the Gulf of Mexico, porpoise morbillivirus (PMV) isolated from a harbor porpoise (Phocoena phocoena), and beaked whale morbillivirus (BWMV) from Longman's beaked whale (Indopacetus pacificus). Full CeMV genomes were sequenced by performing overlapping reverse transcription PCR. The phylogenomic diversity of the CeMV strains were compared to the six other recognized morbillivirus species including: Measles virus, Rinderpest virus, Peste-des-petits-ruminants, Phocine distemper virus, Canine distemper virus, and Feline morbillivirus. Sequences were aligned in MAFFT 7.0 followed by evolutionary model optimization and Maximum Likelihood analysis in MEGA 6.0. The five CeMV strains formed a well-supported clade. BWMV was the most divergent and formed the sister taxon to the rest of the CeMVs. Although considerable sequence variation was detected among the four, the magnitude of the difference was suggestive of separate CeMV strains (i.e. DMVs, PMV, and BWMV) rather than separate morbillivirus species. Although preliminary, recent detections of a high divergent morbillivirus in Indo-Pacific bottlenose dolphins (T.aduncus) from Western Australia and a Guiana dolphin (Sotalia guianensis) from the South Atlantic suggests the creation of a new morbillivirus species may be warranted. This study provides a much needed update to morbillivirus taxonomy, a foundation for future efforts aimed at developing improved CeMV molecular diagnostics, and a better understanding of the temporospatial dynamics of these emerging marine mammal pathogens.

Landsberg, Jan

Authors: **Jan Landsberg**, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission

Session Title: Emerging Diseases and Contaminants in Florida Waters - 1

A Brief Overview of Factors Affecting the Health of Florida's Aquatic Organisms

Florida has a high diversity of habitats with hundreds of miles of natural and developed coastline, open water, and freshwater systems that are particularly at risk from natural and anthropogenic stressors. Poor water quality; land-based nutrient or contaminant inputs; eutrophic systems; pathogen introductions; and water management activities have significant effects on the health of aquatic animals. Antibiotic resistance and introduced pathogens are two potential consequences of sewage spills and microbial inputs. Synergistic or compounding environmental factors can exacerbate disease outbreaks. Harmful algae blooms (HABs) cause acute and chronic effects with lethal to sublethal consequences. Anthropogenic and natural contaminants are diverse and have been partially managed or mitigated, but there are new and emerging issues from a range of human-derived products entering aquatic systems. In the last two decades, epizootics have emerged in foundation communities such as coral reefs and seagrass beds, with widespread disease incidences in keystone, economic, or endangered species. Multiple, wide-scale mass mortality events have affected hundreds of thousands of animals along with benthic community die-offs and local extirpations. Die-offs of amphibians have been attributed to co-occurring pathogens, some reported for the first time in Florida. Rapid salinity shifts through water management or adverse weather can stress animals and cause health issues. For example, ulcerative mycosis is partly attributable to rapid water inputs and associated salinity decreases, stressing estuarine fish and increasing their susceptibility to infection by the oomycete, Aphanomyces invadans. In the Indian River Lagoon, a range of tumors have been documented in different animal species (e.g. gonadal neoplasia in hard clams, Mercenaria; fibropapillomas in sea turtles; and lymphosarcoma in red fin needlefish), but common etiological cofactors, if any, have not been identified. The increasing incidence of diverse disease outbreaks and emerging pathogens demonstrates the continued need for water quality improvements and other adaptive management strategies.

Langston, Amy

Authors: **Amy Langston**, University of Florida
David Kaplan, University of Florida

Session Title: Poster Session - Coastal Waters

Sea Level Rise and the Future of Florida's Forested Freshwater Islands

Manifestations of climate change in the forms of sea level rise, extreme weather events, and rising temperatures elicit short- and long-term changes in coastal wetlands by altering the physical conditions that affect the survival of wetland vegetation. Previous research has focused on the relationship between coastal vegetation dynamics and climate change phenomena in dominant wetland ecosystems such as saltmarsh and mangrove forest; however, little work has been conducted in wetlands with limited distributions. This study investigates long-term vegetation trends in forested freshwater islands concentrated along the Big Bend coast of Florida (USA). In 2014 we conducted a tree census and understory sampling in 13 previously established forest plots located along a tidal creek in Waccasassa Bay Preserve State Park, extending a dataset that started over twenty years ago. Ten plots occur in forest islands surrounded by saltmarsh and three occur in continuous forest. Earlier studies found that salt stress from increased tidal flooding frequency prevented tree regeneration in frequently flooded plots, resulting in relict forest stands. By 2014, four of the six island plots subject to 10 or more weeks of tidal flooding had no live trees and two plots had one live tree each. Tree survival declined in all other island plots while survival remained stable in the continuous forest plots. Results of understory sampling show a successional trajectory in which dominant vegetation transitions from forest to saltmarsh shrubs to herbaceous saltmarsh along a tidal flooding gradient. These vegetation trends indicate that forested islands, a characteristic feature of the Big Bend landscape, are headed toward extinction. Ongoing research includes understanding landscape-level spatial patterns of forest island decline, examining the potential for mangrove encroachment in relict stands, and testing the extent to which different trajectories of climate change drive community reassembly in coastal wetlands.

Leitman, Steve

Authors: **Steve Leitman**, Waters Without Borders
Greg Kiker, University of Florida

Session Title: Planning and Governance

Selecting Performance Metrics to Evaluate Output from a Watershed Model of the Apalachicola-Chattahoochee-Flint watershed

Although considerable effort has been put forth to develop models to simulate the behavior of natural systems, not enough effort is being put forth to develop methods of translating model output into relevant factors relating to the management, sustainability and resilience of ecosystems. This lecture will focus on both how surface water, ground water and estuarine models are currently being used in the decision-making process in the Apalachicola-Chattahoochee-Flint (ACF) watershed and how the use of these models can be improved. Specifically, the lecture will focus on metrics the U.S. Army Corps of Engineers used to select an alternative for managing the federal storage reservoirs in the watershed, the strengths and weaknesses of the metrics the Corps used with a special focus on whether the metrics selected truly represent the major management issues in the basin and then recommend alternative metrics which could have been used better represent public and agency concerns in the watershed.

Lester, William

Authors: **William Lester**, UF/IFAS Extension Hernando County

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues 2

Utilization Of Science In Crafting And Evaluating A Fertilizer Ordinance

I am applying for an Extension scholarship.
Situation: Testing has shown that the levels of nitrates in local springs along the Florida Nature Coast have been rising over the past several decades. Even though Hernando County contains a first magnitude spring (Weeki Wachee), elected officials opted out of septic tank inspections in 2012. This, combined with elected officials' ecological concerns, prompted Hernando County government to craft a Fertilizer Ordinance. UF/IFAS Extension faculty were asked to assist with the science associated with fertilizers and water quality. They were also tasked with educating the public and with the evaluation of knowledge gain associated with the new ordinance.
Methods: UF/IFAS Extension faculty called upon Dr. Laurie Trenholm for turfgrass information, model ordinance language, and suggestions regarding the blackout period. A grace period of one year (no code violations) was established during which homeowners would be offered education via the Florida Friendly Landscaping and Horticulture programs. An overview of the new restrictions that most affect residents was included in horticulture classes offered to the public. Results: The Fertilizer Ordinance was adopted in 2013 without objection from homeowners, industry representatives, or environmental groups. The efforts to reduce nitrate pollution caused by residential use of fertilizers took on new importance because in 2014, the Florida Department of Environmental Protection established a Total Maximum Daily Load consisting of nitrate reductions of 71.1% in Weeki Wachee Spring and 77.3% in the Weeki Wachee River (Dodson et al, 2014). The Hernando County ordinance is novel because it is the first to include a winter blackout period, when residents are not allowed to apply fertilizers to their lawn. A video public service announcement, county factsheets, and a PowerPoint have been created by UF/IFAS Extension faculty to educate the homeowners and landscape professionals about the ordinance. A pre/post was utilized at the beginning of horticulture classes to ascertain the knowledge gain of homeowners. The knowledge gain associated with the Fertilizer Ordinance is 24% (n=131). A survey is planned for November of 2015 (two years after the passage of the ordinance) to evaluate any positive changes in behavior of the residents who have been taught about the ordinance. During 2014 a total of 851 residents participated in classes where the components of the ordinance were taught, and to date during 2015 that number is 721. Conclusion: Science is crucial in the crafting, implementation, and evaluation of Fertilizer Ordinances, which is where UF/IFAS Extension can play an important role. But it is equally important to educate the public and to explain the science behind fertilizer ordinances for them to be effective in reducing nitrate levels in groundwater and springs.

Lindsey, Angela

Authors: **Tracy Irani**, UF/IFAS Center for Public Issues Education in Agriculture and Natural Resources
Angie Lindsey, UF
Kacie Pounds, UF

Session Title: Collaborations and Partnerships

The Gestalt of the group: Water resource management and the self directed working group

Self-directed working groups have become an increasingly important way for stakeholders of all types to explore, understand, become informed, share knowledge and work together to solve complex environmental issues. In the water resource management arena, such groups often include a diverse range of stakeholders in the community and beyond representing multiple interests or stakes often trying to manage a complex set of interrelated issues. Membership in such groups often ranges in expertise from scientific experts, to regulators, to natural resource managers and local and regional planners, to special interest group advocates to lay persons.
Groups exist because members want to share common activities, interests and knowledge. Since no one organizational entity can "manage" a community based natural resources issue alone, such groups become essential to members and the organizations they represent to network, navigate available resources and services and get information and communication out. Commonalities and distinguishing factors of three self directed working groups (the ACF Stakeholders, the Florida Water and Climate Alliance and the Seafood Management Assistance Resource and Recovery Team (SMARRT) operating in the Apalachicola-Chattahoochee-Flint river basin will be examined, with a view toward understanding how organizational structure, group dynamics and internal and external communications affect water resource policy and decision making in the region.

Lindsey, Angela

Authors: **Tracy Irani**, UF/IFAS Center for Public Issues Education in Agriculture and Natural Resources
Angie Lindsey, UF
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Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues 2

The role of social capital, risk perceptions and adaptive capacity five years after the DWH oil spill.

The 2010 Deepwater Horizon oil spill was an extreme event considered to be the largest environmental disaster in U.S. history, sending an estimated 4.1 million barrels of oil and 2.1 million barrels of dispersants into the Gulf of Mexico and impacting over 1,600 kilometers of coastal shoreline. Gulf coast residents, whether they directly observed the effects of the spill or, like many others, were exposed to it through the long running coverage in the media, were adversely affected physiologically, psychologically, economically and emotionally. These effects have persisted for many to this day, which may create ongoing challenges for adaptively managing future risks. In addition to the ecological and human health effects, the spill also influenced residents' perceptions, attitudes and levels of satisfaction with their communities' response and preparedness for future disasters. This presentation will examine results of a public opinion survey conducted on the fifth anniversary of the spill with residents (N = 444) living in areas along the eastern gulf coast of Florida and Alabama. Results showed that respondents' levels of satisfaction with their community post-spill significantly differed from pre-spill as a function of factors related to social capital (home ownership, employment status, the compensation claims process) and their perceptions as to the safety of eating locally caught seafood. Results from the study will be utilized to show how such factors can be integrated into an adaptive capacity framework designed to reduce community vulnerabilities and enhance preparedness for future extreme events.

Lohr, Kathryn

Authors: **Kathryn Lohr**, University of Florida
Joshua Patterson, University of Florida

Session Title: Poster Session - Coastal Waters

Genotype-based differences in extension, calcification, and bleaching resistance among aquacultured staghorn coral Acropora cervicornis

Staghorn coral Acropora cervicornis once dominated south Florida and Caribbean reefs, but has declined up to 98% throughout its range in recent decades due to a variety of stressors. One of only two branching coral species in the Caribbean, A. cervicornis builds important reef structure and provides habitat for ecologically and economically important fishes and invertebrates. A. cervicornis became one of the first corals listed under the U.S. Endangered Species Act in 2006, resulting in an impetus to develop effective methods to aquaculture this species for use in active restoration. Selection of genotypes for use in culture generally relies on proximity and availability of healthy wild colonies rather than an evaluation of performance. However, genotype is important to consider as it may affect growth rates and susceptibility to bleaching and disease in nurseries.

To quantify differences in phenotype, ten known genotypes from the Coral Restoration Foundation nursery in Tavernier, FL were selected for study. Three source colonies per genotype were used to control for any intercolonial variation in phenotype. Four 5-cm fragments were clipped from each of the three source colonies and suspended from four identical PVC tree structures for grow-out. Total linear extension (TLE) and number of branches were measured at 45-day intervals for a period of six months. These measurements will be continued for an additional five months. Buoyant weight was determined for each fragment initially and again after five months in order to assess calcification.

After six months, significant differences in growth parameters, including rate of TLE (Fig. 1), calcification, and branch formation were detected between genotypes at a significance level of α=0.05. Phenotypic variation documented in this study has implications for nursery management and may play a role in future outplant success and gamete compatibility in spat stocking efforts.

Lowe, Edgar

Authors: **Edgar F. Lowe**, Private Consultant
Robert A. Mattson, St. Johns River Water Management District
Jian Di, St. Johns River Water Management District

Session Title: Springs I - Groundwater and Surface Water Interactions

Florida's Springs: The Tip Of The Iceberg

Florida's springs are internationally noteworthy in their number and magnitude but this natural artesian wealth has declined in modern times. Prominent springs have seen declining flow rates, increasing nitrate concentrations, increasing populations of filamentous benthic algae and invasive aquatic plants, and substantial restructuring of fish and invertebrate communities.

The changes in springs are manifestations of changes in the Floridan Aquifer, the major source of freshwater for public water supplies and agriculture in Florida. The Floridan aquifer together with the terrestrial systems that recharge its water and elemental constituents and its artesian springs might aptly be called the karst ecosystem. The ecological roots of the springs extend into and through the karst ecosystem and effects on any aspect of this ecosystem are expressed in the springs. As such, the springs are the final expression of the status of the karst ecosystem and management of the springs is tantamount to management of the karst ecosystem.

Improved understanding of the karst ecosystem is necessary but is confounded by the fact that its hydrogeologic structure is hidden beneath the land surface. Further, knowledge of its biogeochemistry is rudimentary. Substantial variation in spring flows and water quality indicates considerable heterogeneity in the hydrogeological structure and biogeochemistry of the karst ecosystem. Although the system may be dominated by porous media flow, conduit and fracture flow can also create networks of groundwater flow. The picture for nitrogen, a pollutant of major concern in the springs, is also complex with considerable variation in source loading rates and forms, transformation rates, and loss rates within the karst ecosystem.

The belief that sources near the springs are the best targets for management might aptly be called the "proximity hypothesis". However, as a consequence of geohydrologic and biogeochemical heterogeneity, areas of a springshed distant from the spring vents could be more significant sources of water and pollutants than are areas nearer the spring vents. This alternative perspective might be termed the "network hypothesis". To the extent that the network view is more apt, it calls for a deeper understanding of the flow networks of the karst ecosystem.

To provide adequate guidance for regulatory and management programs, springs research must be integrated across the breadth of the karstic ecosystem. Integrated research is now underway through the Collaborative Research Initiative for Springs Protection and Sustainability, a cooperative program between the St. Johns River Water Management District and the University of Florida.

Machado, Victoria

Authors: **Victoria Machado**, University of Florida

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues 2

Entering a Watershed Moment: Community Voices a bridge for Florida's Water Issues

Science and policy are imperative to a discussion about water issues. However, often times we neglect to address the people and groups driving this information and pushing for larger policies. The purpose of my presentation is to look at how local groups around the state of Florida are engaging their communities in an effort to uphold safe and sustainable water resources. Drawing from my own experience as an environmental organizer (the groups I worked with and those I encountered), I offer a broad look at the public advocacy surrounding many of Florida's current water issues. I show how ordinary citizens are demanding more stringent environmental policies for the health of their communities and regions. They do this by educating their neighbors, actively engaging local politics, and collectively pushing for stronger statewide water standards.

This form of advocacy and civil engagement is usually omitted from conversations about water resources. It is important to recognize the numerous people, countless hours, and tremendous community efforts that are driving the push for stricter policies and local measures supporting responsible water use and water protection.

For the purposes of this presentation, I focus on the community organizing efforts surrounding fracking in Florida (Naples, South Florida, Tallahassee), the Sabel Pipeline (Fort White), and offshore drilling (Jacksonville). Everglades restoration (Okeechobee), salt-water intrusion (Miami), and a handful of other water issues come into the discussion, too. Recognizing the importance of civil engagement in particular areas helps us to understand how to better bridge the gap between science and policy.

Marella, Richard

Authors: **Richard Marella**, U.S. Geological Survey
Darbi Berry, U.S. Geological Survey
Stacie Greco, Alachua County Enviromental Protection Department

Session Title: Groundwater Resource Evaluation

Uncertainty associated with estimating domestic self-supplied and private landscape irrigation water use

Domestic self-supplied use includes water withdrawals from individual private wells that provide drinking water to those not served by public supply. An estimated 2.251 million residents in Florida were included in this category for 2012, for an estimated total water withdrawal of 211 million gallons per day. This withdrawal was based on an estimated domestic per capita use of 81 to 103 gallons per day (gal/d) multiplied by the population not served by public supply. Per capita values are based on domestic use of public supply water.
To improve the estimate of per capita use, a small pilot project was conducted in Alachua County between 2011 and 2015. Ten domestic household wells were metered, and per capita water use for a twelve month period between 2012 and 2013 ranged from 66 gal/d to 300 gal/d. Although this sample size is small and the participants were not randomly selected, it indicates that per capita use may be under-estimated, particularly where water is used for landscape irrigation in addition to household use.
Another source of error in estimating domestic self-supplied water use is not accounting for private landscape irrigation wells. Generally these residential wells are used solely for landscape irrigation purposes (primarily lawn irrigation) and household drinking water is provided by a public water supplier. Preliminary results indicate that for the twenty year period between 1995 and 2014, Manatee County issued 3,700 drilling permits for small landscape wells while Sarasota County issued 13,000. These wells have a significant impact on the public supply per capita calculations, because these households no longer use public supply water for landscape irrigation. The result of the use of a secondary source of water for landscape irrigation is a lower public supply withdrawal and a corresponding lower apparent per capita use, while the actual water withdrawal is often not accounted for in the estimates made for domestic self-supplied.

Martin, Jonathan

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Session Title: Springs IV - Temporal Dynamics

Controls and effects of time-varying apparent ages in karst spring water

Water quantity and quality in karst aquifers may depend on decadal-scale variations in recharge or withdrawal, which we hypothesize could be assessed through time-series measurements of apparent ages of spring water. We test this hypothesis with analyses of various age tracers (3H/3He, SF6, CFC-11, CFC-12, CFC-113) and selected solute concentrations (dissolved oxygen (DO), NO3, Mg, and SO4) from 6 springs in a single spring group (Ichetucknee springs) in northern Florida over a 16-yr period. These springs fall into two groups that reflect shallow short (Group 1) and deep long (Group 2) flow paths. CFC-12 and CFC-113 concentrations yield the best apparent ages. These tracers show a 10 to 20 year monotonic increase in apparent age from 1997 to 2013 and indicate most water discharged during the study recharged the aquifer within a few years of 1973 for Group 2 springs and 1980 for Group 1 springs. The increase in apparent age included the flood recession following Tropical Storm Debby in mid-2012. Inverse correlations between apparent age and DO and NO3 concentrations reflect reduced redox state in older water. Positive correlations between apparent age and Mg and SO4 concentrations reflect increased water-rock reactions. Concentrated recharge in the decade around 1970 resulted from nearly 2 m of rain in excess of the average that fell between 1960 and 1980, followed by a nearly 4 m deficit to 2014. The excess rain coincided with two major El Niño events during the maximum cool phase in the Atlantic Multidecadal Oscillation. Although regional water withdrawal increased nearly 5 fold between 1980 and 2005, withdrawals represent only 2 to 5% of Ichetucknee River flow and are less important than decadal-long variations in precipitation. These results suggest that aquifer management should consider climate cycles as predictive tools for future water resources.

Martin, Emmett

Authors: **Emmett Martin**, UF/IFAS Center for Public Issues Education
Alexa Lamm, UF/IFAS Center for Public Issues Education
Laura Warner, UF Department of Agricultural Education and Communication

Session Title: Water Use in Agriculture

Barriers and Motivators Associated with Adopting Water Conservation Technologies in Crop Production Operations

Water conservation has become a very critical topic worldwide. In the United States, certain regions are facing drought due to changes in weather patterns, and high demands associated with increases in population. The field of agriculture has encountered criticism due to high water usage. Nursery and greenhouse crop production operations require significantly large amounts of water to maintain their products. Water conservation practices and technologies have been developed to assist with water savings in such operations. However, many growers are reluctant to implement technology due to cost, labor, and beliefs that horticulture is a manual field. Exploring perceived barriers and motivators related to adopting water conservation technologies is essential for researchers. Qualitative interviews were conducted with nursery and greenhouse operations nationwide. The findings were analyzed a priori using Rogers (2003) Theory of Diffusion five attributes of adoption an innovation which includes: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. The findings revealed that growers are more receptive to adopting water conservation practices and technology if they have the capital available, and it saves on manual labor. Growers were also motivated to adopt water conservation technologies if they had a chance to test them before fully implementing them at their operation. Barriers to adopting an innovation were associated with financial factors, incompatibility, and perception that horticulture and technology are not traditional. Based on these findings, researchers suggest creating outreach material for growers that stress the importance of adopting water conservation practices and technologies. This study will be followed with quantitative surveys to make statistical inference regarding barriers and motivators to adopting water conservation practices and technology in nursery and greenhouse operations.

Martyniuk, Chris

Authors: **Chris Martyniuk**, University of Florida College of Veterinary Medicine
Nancy Denslow, Dept. of Physiological Sciences, University of Florida College of Veterinary Medicine

Session Title: Emerging Diseases and Contaminants in Florida Waters - 2

Understanding the biological impacts of legacy and emerging contaminants in Florida water systems using the largemouth bass as a model species

Largemouth bass (Micropterus salmoides) are apex predators in Florida water ecosystems and can be considered a keystone species. There is a rich history of literature on Floridian largemouth bass regarding legacy pesticides such as organochloride pesticides. This environmental contamination arose from heavy pesticide use and production in the Apopka, Fl. region in the 1970-80s and is still present today. Recent studies by us have shown that animals that are placed into ponds along the Lake Apopka North shore increase their OCP body burden load by 10-100X compared to background levels in only 4 months. These animals show impaired reproduction, and new evidence suggests that there are negative effects on immune system function. Emerging pesticides can also negatively affect largemouth bass populations. For example, perfluorinated chemicals (PFASs) stem from a wide range of sources and have been detected in aquatic ecosystems worldwide including Florida. Largemouth bass collected from Lakes that are high in PFAS concentrations exhibit changes in the expression of genes related to lipid metabolism, energy production, and contaminant detoxification. Thus, there can be significant biological impacts of these contaminants on fish and ecosystem health. Environmental monitoring programs should consider both legacy and emerging pollutants when doing impact assessments on fish and wildlife, with a focus on action following consistent deviations of endpoints from a normal population range established with baseline studies.

McBride, Jennifer

Authors: **Jennifer McBride**, University of Florida Ecohydrology Lab (Matt Cohen, SFRC)
Matthew Cohen, School of Forest Resource and Conservation

Session Title: Poster Session - Springs & Rivers

Controls on morphology and productivity of submerged aquatic vegetation in two spring-fed rivers

Submerged aquatic vegetation (SAV) is an important biological, chemical, and physical component of many spring-fed lotic ecosystems, influencing water column chemistry, stabilizing sediments, and providing habitat. Excessive levels of NOx-N in groundwater discharged from many springs, generally attributed to fertilizer application and wastewater, are often implicated in the loss of SAV and propagation of algae. Nitrogen enrichment is presumed to impact ecosystem integrity and primary producer community structure as algal proliferation results in macrophyte shading. However, the paradigm of nitrogen effects on SAV often takes precedence over other potential causes of SAV decline, and the factors exerting direct and indirect control on SAV growth in Florida springs are poorly understood. Potential controls include water column and pore water chemistry, sediment texture, flow velocity, human disturbance, algal abundance, and light regime. Long-term data quantifying the relationship between SAV productivity and environmental variables is inadequate, impeding the ability to recognize the predominant physical, chemical, and biological factors that drive ecosystem changes. An in situ assessment of SAV growth under a natural gradient of ambient conditions over an annual cycle will elucidate the role of nitrogen availability and a multitude of environmental conditions in SAV growth. Understanding the environmental controls on primary producer community structure and function is integral to effectively managing and restoring spring-fed river ecosystems. In particular, it remains unclear whether management efforts to reduce nitrogen concentrations are sufficient to restore SAV communities. To address this question, monthly dynamics of SAV shoot elongation and aboveground productivity are assessed in Silver River and Alexander Springs Creek, two spring-fed rivers in north-central Florida with similar physical attributes, but strongly contrasting nitrate concentrations. Growth attributes are evaluated within and between sites across natural gradients in environmental drivers. The study focuses on growth attributes of the two dominant SAV species, Sagittaria kurziana (tapegrass) and Vallisneria americana (eelgrass) using a modified leaf clipping technique, and tests the hypothesis that SAV growth is primarily controlled by physical attributes such as light, flow velocity, and sediment texture, rather than chemical and biological conditions. Preliminary length and width measurements of intact shoots reveal differences in SAV morphology and growth form. Maximum water velocity is positively correlated to shoot length-to-width ratio for both species, suggesting augmented energetic investment in longer and narrower leaf blades at high water velocity sites to reduce resistance and drag. Shoot length also increased with high canopy cover (low light), which reveals maximizing light capture under stressed conditions. Light stress causes SAV to redirect resources away from other vital processes (rosette production, total biomass, reproduction) in order to implement shade-adaptation mechanisms (canopy formation and leaf elongation). A decrease in growth rate is observed for both species with increasing distance from the headspring. Potential causal mechanisms include elevated downstream turbidity resulting in diminished light attenuation or growth inhibition due to toxicity or other undetermined factors, thus requiring further investigation.

McMorrow, Shannon

Authors: **Shannon McMorrow**, Amec Foster Wheeler
Mary Szafraniec, Amec Foster Wheeler
Sky Notestein, Southwest Florida Water Management District
Sean King, Southwest Florida Water Management District

Session Title: Springs III - Chemical Processes and Nutrient Fluxes

Characterizing Spatial Variability and Ecological Interactions of Benthic Macroinvertebrate Communities in their Associated Habitats and Across Salinity Gradients in Florida Springs

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) assisted the Southwest Florida Water Management District (SWFWMD) with characterizing the spatial variability of benthic macroinvertebrate community abundance and distribution within the Homosassa, Chassahowitzka, and Weeki Wachee Springs and Rivers in Florida. The overall objective of the project was to assess the benthic communities across salinity gradients and across habitat types in various areas within the mainstem of the rivers along with head spring areas, spring runs, and tributaries associated with the main rivers. Primary habitats within the various zones included submerged aquatic vegetation, macroalgae, snags, rocks and sediment. In addition to biological monitoring, physicochemical data was collected and relationships between biological and physicochemical data were evaluated across zones within and across each system. Primary objectives included developing empirical relationships that can be used to assess current ecological conditions and to compare to historical and future conditions in these spring influenced coastal ecosystems.

Middleton, Beth

Authors: **Beth Middleton**, Wetlands & Aquatic Research Center

Session Title: Restoration and Connectivity

Hydrologic remediation revives stressed tree species in tidal swamps

Freshwater supply is becoming a key conservation issue for coastal freshwater wetlands, because freshwater is becoming more limited due to increased anthropogenic water usage and climate-induced drought. Examples from Texas, Louisiana and Australia demonstrating the responses of tree species to high salinity, drought, and in some cases freshwater remediation will be described in this presentation. Excessive water extraction and drought in 2011–12 in Big Thicket National Preserve (BTNP, TX) increased salinity levels to above 6 ppt in tidal swamps, causing death of freshwater species. These observations were the basis for a new project to track groundwater salinity levels in tidal freshwater swamps across the Gulf of Mexico (USGS and UF). Earlier research assessing the hydrologic remediation effort following the Deepwater Horizon Incident demonstrated that freshwater could ameliorate salinity and biogeochemical stresses to trees in Jean Lafitte National Historical Park and Preserve (JLNHP&P; LA). Tree production increased in JLNHP&P after four months of hydrological remediation in 2010 versus other years (2007–12). Similarly, tree health increased dramatically after two months of hydrologic remediation in a study by another research group of drought/salinity stressed Eucalyptus forests along the Murray River (Australia). In JLNHP&P after freshwater remediation, elevation increased from 2011–14, and this phenomenon constituted a temporary directional change in elevation decline (regime shift) as tested using pairwise regression of elevation over time (2007–10 versus 2011–14). By 2015, the elevation in these swamps began to decline suggesting that remediation benefits may not be permanent. These studies suggest that hydrologic remediation could be a useful engineering tool to conditions for tree growth in impaired freshwater tidal forests. Even short–term releases of freshwater can benefit the health of freshwater tree species in tidal coastal forests. These water management tools may be used to offset future conservation problems due to climate change and/or water extraction.

Mishra, Akhilesh

Authors: **Akhilesh Mishra**, COAPS, Florida State University
Vasu Misra, Florida State University

Session Title: Impacts of Climate Variability and Change on Water Availability and Quality

The influence of the neighboring oceans on Florida's climate

In this study we show that the unique geography of the peninsular Florida with close proximity to strong mesoscale surface ocean currents among other factors warrant the use of relatively high resolution climate models to simulate its hydroclimate. In the absence of such high-resolution climate models we highlight the uncertainty in the simulation of the warm western boundary current (the Gulf Stream) in two relatively coarse spatial resolution CMIP5 models. As a consequence it affects the coastal SST and the land-ocean contrast, affecting the rainy summer seasonal precipitation accumulation over peninsular Florida simulated by the two global models. We also show this through two sensitivity studies conducted with a regional coupled ocean atmosphere model with different bathymetries that dislocate and modulate the strength of the Gulf Stream and which locally affects the SST in the two simulations. These studies show that a stronger Gulf Stream produces warmer coastal SST's along the Atlantic coast of Florida that enhances the precipitation over peninsular Florida relative to the other regional climate model simulation. However the regional model simulations indicate that wet season rainfall variability in peninsular Florida becomes less dependent on the land-ocean contrast with stronger Gulf Stream current and warmer western Atlantic coastal SSTs.

Mohd Jani, Siti Jariani

Authors: **Siti Jariani Mohd Jani**, University of Florida
Gurpal Toor, University of Florida

Session Title: Poster Session - Watershed & Wetland Management

Bioavailability Of Organic Nitrogen in Residential Stormwater Runoff

Organic nitrogen (ON) is the main fraction of total nitrogen in urban water bodies. Yet our knowledge about contribution of ON to nutrient enrichment and eutrophication in water bodies is poorly understood. Research on bioavailability of ON in residential stormwater runoff from urban catchments is lacking. The objectives of this study were to determine and quantify the spatial and temporal evolution of bioavailable ON in urban stormwater runoff. Our methods including sampling stormwater runoff from residential catchments using autosamplers and grab samples. Bioassay experiments were conducted using samples collected from stormwater ponds inlets and outlets. Samples were incubated for 5 days under 12:12 light:dark cycle at the ambient temperature of 26°C. Samples were then analyzed for ammonium (NH4-N), nitrate (NOx-N), total nitrogen (TN), total organic carbon (TOC) and dissolved organic carbon (DOC). Selected samples were analyzed for stable isotopes of N and O of NOx-N. Data are being interpreted and will be used to prepare a poster presentation.

Morie, Amy

Authors: **Amy E Morie**, UF/IFAS Extension Clay County
Evelyn Prissy Fletcher, UF/IFAS Extension Putnam County

Session Title: Poster Session - Policy & Behavior Change

Ops For Drops: Promoting Responsible Water Use Through Florida Friendly Landscaping

We are applying for an Extension Scholarship
The pressure on water resources with Florida's growing population is an increasing issue for the state. Many residents are unaware of the impact they have on water resources, and are likely to overuse water without realizing it. Knowledge of personal water use and various options for reducing potable water use on landscapes are valuable insights for residents to begin implementing better usage habits. Often, such learning provides healthier overall landscapes in terms of reduced disease and pest problems, creating added incentive for behavior change. Various applications of "Water Efficiently," a key principle of Florida Friendly Landscaping, are being taught with measurable impact in Putnam and Clay County. Residential education programs that target water use teach best management practices and interventions that reduce reliance on potable water. These efforts help residents with knowledge gain and practice change, resulting in demonstrable savings. The use of both quantitative and qualitative methods to determine program success reveal increasing audience awareness and practice change. By promoting awareness of water habits and teaching water saving techniques for landscapes, our work provides residents the tools they need to become responsible stewards of water resources.

Mullen, Jeffrey

Authors: **Jeffrey Mullen**, University of Georgia
Gregory Colson, University of Georgia

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues 2

Effects of Uncertainty on Support for Water Quality Improvement Programs

Privately owned residential onsite wastewater treatment systems (OWTS), or septic systems, are gaining attention as a source of waterborne contaminants. High concentrations of OWTS have emerged in suburban metropolitan areas across the United States. The impact of these systems on water quality is an important water resource issue for urbanizing landscapes. While it is understood that malfunctioning septic tanks contaminate surface and/or groundwater, recent studies indicate that even properly functioning septic tanks can contribute significant quantities of pollutants.

Costly approaches to reducing contamination from OWTS are available, e.g., replacing residential OWTS by expanding sewer service. In addition to the cost, this approach is often hindered by regulatory hurdles. In lieu of addressing contributions from OWTS, previous studies have explored other methods – riparian buffers, constructed wetlands, and fertilizer restrictions – for reducing pollutant loads in urban watersheds.

An alternative approach is to retrofit existing septic systems to contain or convert harmful pollutants into benign compounds. While upgrading residential OWTS with new technology has the potential to reduce watershed contamination, there are significant policy hurdles to implementing the upgrades. Septic system owners are legally responsible for maintaining their systems, but requiring them to upgrade their otherwise well-functioning tanks is outside the scope of current regulations. An incentive structure is necessary to induce private homeowners to invest in upgrades that deliver both private benefits and the positive externality of improved water quality.

The aim of this study is to determine whether residents in an OWTS-dense community would support a septic upgrade program, in general, and to identify characteristics that would affect the likelihood of supporting such a policy. In order to assess the acceptability of different public financing mechanisms for upgrading privately-owned OWTS in a setting with uncertain benefits, a choice experiment was conducted with current homeowners in Gwinnett County, GA. In the choice experiment three key attributes pertinent for policy makers considering public financing are considered: 1) how funds are collected; 2) how the program cost is shared across the community; and 3) the uncertainty related to the benefits of the upgrades – namely, how the upgrade would affect the probability of water quality standards not being met. The uncertainty related to the status quo was also addressed through the experimental design.

The marginal effects associated with the conditional logit estimation reveal the following statistically significant results: 1) support for a retrofit program is inversely related to program costs, and positively related to program efficacy; 2) support for a program is unaffected by the financing mechanism; 3) respondents are generally adverse to programs with unequal cost shares across stakeholder groups, but especially reluctant to support programs in which their group pays a larger share; 4) the status quo probability of failure matters.

Marginal willingness to pay (MWTP) for program attributes were calculated using the bootstrapping method with 50 replications. MWTP to reduce the probability of failure by one percentage point ranges from $0 to $30, depending on the status quo probability of failure.

Nelson, Natalie

Authors: **Natalie Nelson**, University of Florida
Rafael Muñoz-Carpena, Agricultural and Biological Engineering, University of Florida
Edward Phlips, Fisheries and Aquatic Sciences, University of Florida

Session Title: Poster Session - Springs & Rivers

Why does tidal creek dissolved oxygen peak at night? Abiotic vs. biotic forcing of oxygen dynamics

Cyanobacteria, prokaryotic photoautrophs referred to as “blue-green algae,” form harmful algal blooms in freshwater and estuarine systems that are capable of producing toxins, shading out submerged aquatic vegetation, prompting hypoxic/anoxic conditions, and restricting recreational activity. Several cyanobacteria genera are also capable of tapping into nutrient pools that are typically inaccessible to eukaryotic phytoplankton, such as through N2-fixation. N2-fixation results in the introduction of “new” nitrogen to the system. Such cyanobacteria-nutrient feedbacks complicate the development of water quality targets for systems affected by blooms, but are necessary to understand for the purpose of creating effective management plans. Thus, we seek to explore cyanobacteria-nitrogen feedbacks and identify environmental controls on N2-fixation. Important management questions we aim to address include: how can TMDLs be adjusted to prevent cyanobacteria blooms and N2-fixation? Which environmental variables correspond to high bloom and N2-fixation conditions? To tackle these questions, we evaluate a unique long-term (17.5 years) dataset composed of time series (monthly step) of the abundances of several phytoplankton and zooplankton phyla, water quality constituents, and hydrologic variables from Lake George, a flow-through lake located along the St. Johns River, Florida, USA. Using Granger causality analysis, a time series analysis approach, cyanobacteria and nutrient data were evaluated under both additive and interactive/non-additive assumptions to identify biological and physical drivers of cyanobacteria-nitrogen feedbacks. Causal effects and interactions, and associated magnitudes of influence, were compiled using network diagrams to map influential environmental factors across cyanobacteria taxa. These maps depict webs of interacting species and physicochemical drivers, which are then presented in the context of questions related to water management.

Nifong, James

Authors: **James Nifong**, University of Florida
Thomas Frazer, UF
Robert Mattson, SJRWMD

Session Title: Springs II - Hydrography and Ecology

Florida's spring ecosystems: rethinking trophic structure

The identification of trophic linkages and quantification of interaction strengths among consumers and resources within food webs is critical if we are to understand how human-induced stressors impact the structure and function of ecosystems. In Florida, freshwater springs and associated river runs are increasingly under threat due to variety of factors including, but not limited to, nutrient enrichment, reduced discharge, and exotic species. While myriad research studies have assessed the role of abiotic factors in driving patterns of primary producer abundance and distribution; we understand relatively little about pathways of energy flow and material transport through the food webs operating within these systems.
We employed stable isotope and dietary analyses of consumers inhabiting Silver River, Florida to elucidate food web structure and identify important trophic interactions. Through sampling of food web constituents and resource pools along the entire length of Silver River we determined that submerged macrophytes and their epiphytes contributed the majority of energy to upper trophic levels, while benthic filamentous algae contributed relatively little. Results indicate a high degree of omnivory among taxa, but also some surprising examples of dietary specialization. Stable isotope analysis coupled with other diet information indicates that redear sunfish and kinosternid turtles are primary predators on gastropods that are known to have the potential to exert control on nuisance filamentous algae production. Finally, we note that alligators in the Silver River rely heavily on both gastropods and crustaceans to support metabolism and growth. These predator-prey interactions to date have received little attention, but merit further study to understand more fully the strength of the relationships as they are likely to have a profound influence on ecosystem function. Integration of these novel data and insights will help to refine our understanding of predation and top-down pressures in influencing community dynamics within these complex ecosystems.

Notestein, Sky

Authors: **Sky Notesein**, Southwest Florida Water Management District

Session Title: Springs IV - Temporal Dynamics

Changing submerged aquatic vegetation in the coastal spring systems of Citrus and Hernando Counties

Four major springs groups, Kings Bay / Crystal River, Homosassa, Chassahowitzka, and Weeki Wachee are located along the coastal margin of Citrus and Hernando Counties. Groundwater discharge from these spring groups create spring fed rivers that discharge into the Gulf of Mexico, and in turn, support an expansive estuary and associated seagrass meadow ecosystem. These low gradient coastal rivers are susceptible to storm surges and the introduction of elevated salinities. During the last century gradual sea level rise appears to have increased the opportunity for salt water intrusion events as the estuarine transition moves inland. Aquatic vegetation, particularly submerged species, have responded to changes in ambient salinity with changes in species composition and an overall decrease in abundance. Corresponding increase in nitrogen loading, herbivore grazing, and recreation are other ecological drivers that also structure the type and abundance of submerged aquatic vegetation (SAV). Ecosystem disturbance in the form of riparian develop and the introduction of invasive plant species have further destabilized the ecology of these coastal spring fed rivers. This presentation characterizes the changes in SAV communities and their corresponding drivers that have been documented in these systems.

Nowicki, ReNae

Authors: **ReNae Nowicki**, University of South Florida
Mark Rains, University of South Florida

Session Title: Poster Session - Watershed & Wetland Management

Ecohydrogeology of Isolated Wetlands & Waters in West-Central Florida

Geographically isolated wetlands (GIWs) are those considered to be completely surrounded by uplands and with little or no surface water connections to other wetlands or waters. Numerous studies of GIWs suggest controls on their hydrology are largely local, being driven by a surficial aquifer or under perched conditions. A group of GIWs in west central Florida, USA (locally referred to as “sandhill” wetlands and waters) were examined to determine the degree of hydrologic control by a large, regional source (i.e., the Upper Floridan aquifer). To make this determination, the chemistry, elevation and level variation of surface water and shallow groundwater from these GIWs and waters were evaluated relative to water from surficial aquifer piezometers and from shallow and deep regional aquifer piezometers. Results from hydrographic analyses indicate close and even coincident water level elevations between wetlands and the nearest regional aquifer monitor wells. Regression analysis of wetland-well levels show high to extremely high correlation coefficients (R2 values between 0.79 and 0.99), with among-wetland variations due likely to wetland-well distance and differences in land surface elevations and site-specific hydrogeomorphology. Geochemical and isotopic analyses of wetland water samples indicate a mixing of surface and groundwater end-members due to the direct or near-direct connectivity between the wetlands and the Upper Floridan aquifer. The mixing is due to the unconfined, thinly confined or karstic-breached nature of this aquifer. Collectively, this evidence suggests sandhill wetlands and waters are largely under the control of the potentiometric surface of the regional Upper Floridan aquifer and thus represent a variant of GIWs situated at the extreme end of a groundwater-to-surface water or regional-to-local hydrologic source continuum not previously documented. These findings are important not only for their contribution to the current body of GIW knowledge, but also for the information they provide to natural resource managers, particularly in evaluating potential impacts to wetlands and waters of this kind from groundwater withdrawal and climate change.

Osborne, Todd

Authors: **Leah Laplaca**, Whitney Laboratory, University of Florida
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Michael Coveney, St. Johns River Water Management District
Robert Mattson, St. Johns River Water Management District

Session Title: Springs III - Chemical Processes and Nutrient Fluxes

Nitrate Inhibition of Submerged Aquatic Vegetation: Investigation of the Nitrogen Overload Hypothesis

Current observations of water quality in groundwater discharge from springs in Florida show anthropogenic enrichment of nitrate plus nitrite (NOx-N) generally attributed to fertilizer application and/or wastewater or manure sources in individual spring sheds. Excessive levels of NOx-N have been implicated in eutrophication of, and observed changes in, submerged aquatic vegetation (SAV) communities in several spring runs. While the indirect effects of nitrogen (N) enrichment on aquatic macrophytes are well-documented (i.e. algal productivity resulting in shading of macrophytes) in aquatic ecosystems globally, there is considerably less information available concerning direct effects of NOx-N such as toxicity or inhibition of macrophyte growth. This research aims to understand the direct effects of elevated nitrate on SAV by using growth indices in roots and shoots, allocation of biomass and changes in plant cellular structure and health associated with elevated NOx-N in several spring ecosystems in Florida. We tested the nitrogen overload hypothesis in mesocosms by growing Sagittaria kurzianna and Vallisneria americana under treatments of 0.1, 0.5, 1.0 and 5.0 mg l-1 NOx-N. Indicators of nitrate inhibition such as unregulated nitrate reductase activity, decreased root to shoot ratios, and decreased cellular starch storage were compared across all treatments. Results of this work are presented in the context of current spring ecosystem restoration efforts.

Ott, Emily

Authors: **Emily Ott**, University of Florida AEC/CLCE
Paul Monaghan, UF AEC/CLCE
Maria Morera, UF AEC
Michelle AtKinson, UF/Manatee County Extension
Ross Peterson, Manatee County Extension

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues - 1

Community-Based Social Marketing to Increase Stormwater Pond Best Management Practices

Stormwater ponds are increasingly considered aesthetic amenities that add value to real estate. Research has shown many homeowners are unaware of the function of these engineered structures in their residential landscapes. Homeowner preferences and landscape practices can increase nutrient loading in residential ponds and pollute the broader watershed. A Community-Based Social Marketing campaign was conducted in Manatee County, Florida to improve understanding of residential perceptions of stormwater systems and extension of best management practices (BMPs). Focus groups and a 2013 survey with a sample of Manatee county residents in a large planned development revealed opportunities to educate homeowners about stormwater ponds and non-structural BMPs for managing stormwater pond quality. A stakeholder task force of UF researchers, UF IFAS Extension, local governance and operations, landscape contractors, and residents used this social research to develop outreach strategies and materials on nutrient management and shoreline planting. Research results, outreach strategies, program impact, and future research will be discussed.

Papacek, Joshua

Authors: **Joshua Papacek**, University of Florida
Edward Phlips, Fisheries & Aquatic Sciences
Patrick Inglett, Wetland Biogeochemistry Laboratory

Session Title: Poster Session - Coastal Waters

An investigation of nitrogen fixation in the northern Indian River Lagoon, Florida

Nitrogen fixation, the conversion of atmospheric nitrogen (N2) to a biologically-available form, represents a potential source of new nitrogen (N) to aquatic systems. Although N2 fixation has been largely overlooked in estuaries, increasing eutrophication and occurrence of harmful algae blooms in the northern Indian River Lagoon (IRL) has led to an investigation of potential internal nutrient sources, including N2 fixation by several distinct IRL pools: 1) the water-column 2) benthic vegetation and 3) IRL sediments. This research aims to address the seasonal and spatial importance of each of these pools to supplying N to the IRL. Water column fixation was tested from samples collected at three locations within the major IRL basins, Mosquito Lagoon (ML), Banana River (BR), and the northern Indian River (IR). Collections occurred on a bi-monthly basis between September 2014 and October 2015, and N2 fixation response was measured via the acetylene reduction assay (ARA) technique under light (100-200 μE) and dark conditions. Fall and winter rates remained low (< 0.01 ng N/ml/hr; < 2 ng N/μg chlorophyll/hr) and June 2015 rates were significantly higher for both dark and light treatments on a per volume basis. When normalized for chlorophyll, however, June rates were comparable to dark rates in winter. Two-way ANOVA results confirmed a significant temporal effect as well as a significant interaction between month and treatment ($p<0.05$). This may suggest higher heterotrophic bacterial contributions over winter months while photosynthetic N2 fixers were most active as temperature increased in the IRL. Preliminary data for ARA of benthic vegetation showed that epiphytic coverage of seagrasses (e.g. Halodule wrightii) and macroalgae act as an additional N source. Overall, results from this research indicate that N2 fixation is a potentially important processes in supplying new N the IRL.

Perez, Elizabeth

Authors: **Scott Kelly**, Collective Water Resources, LLC
Elizabeth Perez, Collective Water Resources, LLC
O'Neil Kathleen, Pi Innovation

Session Title: Planning and Governance

The City of West Palm Beach: Pioneering a New Future for Florida's Water Resources

The City of West Palm Beach is pioneering a unique combination of research and simulation-focused studies to better integrate and manage their complex system. The City is uniquely poised to contribute to water resources planning discussions because it is one of the only surface water supply systems in the region that is also actively linked to stormwater, groundwater (including ASR), and wetland treatment systems. Furthermore, staff has launched a focused discussion on long-term policy changes to address water quality, sea level rise, stakeholder involvement/behavioral change, and low impact development. The City's One Water initiative spans the entire City – from the Mayor's office to all levels of staff, and leverages extensive and ongoing community involvement.
Some of the One Water projects includes the City's Stormwater Master Plan (SWMP) and Long Term Water Supply Plan. The SWMP is a futuristic master plan that integrates extensive data review/development, stormwater modeling, ordinance revisions, water quality and pollutant load analyses, operations and maintenance refinements, community rating system improvements, sea level rise assessment, and capital improvement project analyses and development. The City will actively leverage a new geodatabase format, improvements to flood insurance rates, an ongoing "City Watersheds Committee" comprised of citizen leaders, cooperative peer review with SFWMD, and active management of water quality data – among other unique features. For the Long Term Water Supply Planning effort, the City leveraged a prior Palm Beach County regional dynamic tool that used the SEI Water Evaluation and Planning (WEAP) model. This scenario-based planning platform is capable of climate-driven integrated water supply and demand analysis, with the simulation and ranking of capital improvement projects under a range of variable future conditions. Other One Water initiatives that will be discussed are the Loxahatchee River Restoration, cooperative stormwater harvesting with Palm Beach County, and operational optimization using the OASIS model.

Pettit, Chris

Authors: **Chris Pettit**, Palm Beach County Water Utilities Department
Maurice Tobon, Director of Engineering - PBCWUD

Session Title: Collaborations and Partnerships

Comparative Climate Change Adaptation In the US and Philippines

Members of the Palm Beach County Water Utilities Department have partnered with representatives of the government of the Philippines and executives from several water districts throughout the country to develop a community of partnership regarding climate change mitigation/adaptation and emergency preparedness. The partnership has included visits from the US mentors to the Philippines to undertake surveys and assessments of the participating water districts, as well as return visits from the Filipino representatives to the United States to ascertain the benefits of certain mitigation and adaptation techniques being employed by individual governmental entities as well as the SE FL Climate Change Compact. The presentation will undertake a comparative analysis of the state of acceptance of climate change impacts in the two regions, methods for implementation of the COP and corresponding action items, the viability of those steps being undertaken to address climate change and emergency preparedness in the two jurisdictions, and will offer additional suggestions regarding the expansion of such partnerships.

Power, Sarah

Authors: **Sarah Power**, University of Florida
Courtney Reijo, University of Florida
Matt Cohen, University of Florida

Session Title: Poster Session - Springs & Rivers

A Nutrient Enrichment Experiment at Silver River: Using the benthos box to determine effects of added nutrients (N, P, Fe) on stream metabolism

While nutrient availability is an important controlling factor of primary production in aquatic systems, evidence has shown that nutrient concentration alone is an ineffective predictor of autotrophic production in flowing waters. Effects of nutrient enrichment differ in lotic systems as upstream fluxes resupply nutrients to primary producers downstream. Understanding these effects and describing the nutrient kinetics of a system are important objectives when setting ecological nutrient thresholds or predicting possible shifts in aquatic communities. To better understand the impact of enrichment on stream metabolism (i.e. gross primary production and ecosystem respiration) and the response of assimilation (i.e. nutrient uptake) to varying nutrient supply, we designed a factorial nutrient addition experiment at Silver River. The benthos box, a Plexiglas chamber, inserts into stream sediments and allows characterization of the isolated benthos (a 0.6m x 0.6m area), as nutrient supply is blocked and thus depleted over time. The chamber was coupled with a clustered nutrient bioassay to include one control chamber paired with three treatment chambers, which were deployed adjacent to each other for one week at a unique location along the river. Each treatment chamber was enriched with one of seven nutrient combinations of nitrate, phosphate, and iron. Within each box, a HOBO dissolved oxygen (DO) probe and a light logger captured DO and light intensity dynamics at 15-minute intervals. From these data, stream metabolism and light use efficiency measurements are estimated, and ancillary factors (e.g. canopy and algal cover, porewater chemistry, etc.) are tested as other potential explanatory factors of metabolic variation. From this study, we will determine 1) the effect of nutrient enrichment on stream metabolism and 2) how primary production and nutrient assimilation change under nutrient supply that varies from above saturation to below ambient.

Quintero, Carlos

Authors: **Carlos Quintero**, University of Florida
Matthew Cohen, SFRC

Session Title: Poster Session - Watershed & Wetland Management

Extremely High Soil PCO2 in Big Cypress Wetlands

Carlos Quintero, PHD Student, Soil and Water Sciences, Carlosjquintero@ufl.edu
Water
Poster
Extremely High Soil PCO2 in Big Cypress Wetlands
Karst landscapes are formed by water acting upon carbonate rocks, the dissolution or denudation of which can be facilitated by the presence of CO2. Carbonate dissolution by way of carbonic acid takes place when CO2 becomes dissolved and hydrated to form Carbonic acid, the most common weathering agent for all rock types (Martin et al, 2013). Two major sources for CO2 for carbonate dissolution include The Atmosphere, with a CO2 concentration of around 0.04% PCO2, and remineralized soils which have the ability to create environments in which CO2 concentrations exceed those of the atmosphere by orders of magnitude (Martin et al, 2013). As part of a greater NSF project to look at the mechanisms of patterning and landscape formation of Cypress Domes within Big Cypress National Park, we outfitted two wetlands with CO2 sensors modified for aquatic deployments. When inundated, soils at the center of these wetlands were found to contain extremely high PCO2 concentrations often exceeding the range of our sensors >20%. This is significant because the extremely high PCO2 concentrations in these wetlands create the perfect environment for CO2 gas to diffuse into water, become hydrated, and then proceed to dissolve away the underlying bedrock and form the landscape we see today.
Martin, J. B., Brown, a, & Ezell, J. (2013). Do carbonate karst terrains affect the global carbon cycle? Acta Carsologica, 42(2-3), 187–196. Retrieved from O:\Projets\nen\ncours\Documentation\Bibliotheque_Numerique\Martin_2013.pdf

Rankin, Laura

Authors: **Laura Rankin**, University of South Florida
Sarina Ergas, University of South Florida
Mahmood Nachabe, University of South Florida

Session Title: Poster Session - Policy & Behavior Change

State of Low Impact Development Practices for Control of Urban Stormwater Runoff in Florida

Florida has numerous natural water features, springs, and estuaries that attract visitors and new residents annually. By 2040, Florida is likely to add 6.5 million new residents, who will mainly settle in environmentally sensitive coastal areas such as the Tampa Bay region. Incremental demands by tourism and population stress urban stormwater infrastructure, resulting in water quality degradation, eutrophication, and loss of freshwater ecosystems. In recent years, Low Impact Development (LID) practices, such as bioretention and rainwater harvesting, have been perceived as innovative approaches to stormwater mitigation that preserve green space and create opportunities for stormwater reuse, thereby making stormwater a resource instead of a nuisance. For instance, implementation of infiltration based LID practices improve water quality and recharge groundwater, which provides 70% of the drinking water in Southwest Florida. Groundwater replenishment benefits aquifer recharge, maintains stream base flow, and provides stormwater management mitigation.
By continuing to manage stormwater runoff using traditional pipes and concrete, Civil Engineers can potentially remain part of the problem plaguing Florida's waterways. The objective of this presentation will be to facilitate further implementation of LID in Florida by: 1) reviewing the science and case studies of rainwater harvesting and infiltration based LID practices, 2) providing recommendations and design guidelines for both new construction and retrofitting suitable for the geology and hydrology of Southwest Florida, 3) summarizing the holistic economic benefits of LID implementation, and 4) identifying regulatory and social barriers to LID implementation.

Reaver, Nathan

Authors: **Nathan Reaver**, University of Florida
David Kaplan, University of Florida

Session Title: Poster Session - Springs & Rivers

How do spring run physical and transport properties vary under different flow conditions?

Tracers allow for the investigation of reach-scale physical properties of streams. Typically, a tracer is released upstream and its concentration is measured downstream, producing a break through curve (BTC). The BTC contains information about the physical properties of the reach through which the tracer has passed, such as transient storage and residence time distribution. These properties are important in dictating stream chemistry and biology. A stream's physical transport properties can change under different flow conditions. Application of tracers can quantify these changes. In March of 2105, we applied a pulse injection of Rhodamine WT to the headspring of the Silver River (Silver Springs, FL, USA) and measured BTCs at nine fixed locations downstream. Additionally, roving vessels collected 318 samples to characterize differential mixing along the channel's width, depth, and eco-geomorphological features. The observed BTCs were "fitted" to the OTIS model, a one dimensional transport and mixing model, using non-linear regression optimization and Bayesian inference. The resulting parameter values were compared to fitted OTIS parameters from a 2009 Silver River Rhodamine WT dye trace, when the river discharge was approximately 22.5% lower. The comparison suggests that the Silver River's hydraulic transport properties are substantially different for the two discharges. For the larger discharge, the mean residence time of the spring run decreased and the transient storage increased. In addition, the tracer experiment results were used to calibrate and validate a hydrodynamic EFDC model being developed by the St. Johns Water Management District. The EFDC model was used to simulate the dye trace. The results of the simulation were compared with observed BTCs. The model was able to capture most of the major features of the BTCs and provide insight where the match was poor. Continuing work will include additional dye trace experiments timed to different flow conditions and further EFDC calibration.

Reijo, Courtney

Authors: **Courtney Reijo**, University of Florida
Matthew Cohen, University of Florida

Session Title: Poster Session - Springs & Rivers

Grazer Effects on Rates of Stream Metabolism and Nitrate Uptake: Estimating Feedbacks across Different Vegetative Regimes and under Reduced Nitrate Levels

While changes in stream gross primary production (GPP) and shifts in vegetative communities have traditionally been attributed to nutrient enrichment, other factors such as grazer presence and density may influence overall stream structure and function. Evidence shows that grazers are a top-down control in algae-dominated streams; however, the specific feedbacks between rates of total stream GPP, grazer effects, and nutrient cycling have been variable and little is known about these interactions at nutrient levels below ambient. To further our understanding of these linkages, a nutrient depletion chamber was created and paired with high-resolution in situ sensors to estimate stream metabolism and characterize nitrate uptake (UNO3) pathways (i.e. plant uptake and denitrification) at Gum Slough Springs, Florida. Paired chambers with and without the presence of snails (Elimia floridensis) were deployed across submerged aquatic vegetation (SAV; Vallisneria americana and Sagittaria kurziana), algae (Lyngbya), and combined SAV/algae substrates. Using these methods, we tested our hypotheses that 1) grazers alter stream ecosystem metabolism and therefore impact nitrogen cycling through multiple pathways, 2) rates of stream metabolism and UNO3 respond differentially to grazer presence by vegetative regime, and 3) the presence of grazers alleviates nutrient limitation if present in the system. While GPP and UNO3 were higher under SAV and there was a general lack of plant nutrient limitation even at low nitrate concentrations (i.e. zero-order uptake kinetics), initial results suggest grazer presence alleviates nitrate depletion (and therefore potential limitation) and elicits different responses by substrate type. Continued work includes estimating grazer effects on denitrification, quantifying snail nutrient excretion contributions, and scaling up estimates from the patch to reach level. Overall, this study will further our understanding of grazer-production-nutrient-microbial interactions within stream ecosystems, making it possible to predict changes in feedbacks when one part of the biotic or abiotic ecosystem is altered.

Rodea-Palomares, Is

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Session Title: Emerging Diseases and Contaminants in Florida Waters - 2

GSUA-EBS as a way forward to understand combined effects of chemical mixtures and environmental factors?

Current methodologies applied to characterize the effect of suspect substances, such as emerging micropollutants (EMPs) are based on the classical dose-response approach [1]. However, present efforts pose on the identification and prioritization of new emerging pollutants are hampered by some practical difficulties when trying to apply the dose-effect paradigm: In the best cases, clear monotonic dose-response profiles are found at high doses (orders of magnitude higher than relevant ones for realistic exposures). However, very common situations are also the inexistence of monotonicity, non-concentration dependent statistically significant effects at low dosis, statistically significant interactions of individually non-active substances, and/or biotic and abiotic factors. In addition, combined effects of environmenta factors such as natural stressor or climate change are can´t be included in praxis in current risk assessment approaches. In the present work we applied a new experimental framework for the effect-based identification of hazardous micropollutants (pharmaceutical pollutants) in combination with environmental variables. The metodology, we called GSUA-EBS, consists in incorporating Global Sensitivity and Uncertainty Analysis (GSUA) family tools to assist Effect-Based Screening (EBS) of suspect substancies. GSUA tools are top-down approaches which serve to identify important factors driving a system´s response independenty of any mechanistic assumption, such as linearity, additivity or MoA. In the present study, we used the gobal sensitivity computational screening tool known as Morris Method [2] to study main drivers controling usually found in freshwaters. The effect of one environemntal factor (light intensity) was also included in the analysis as an example of the open possibilities that GSUA-EBS offers to experimental ecotoxicologists.

1 Altenburger R, Backhaus T, Boedeker W, Faust M, Scholze M (2013) Simplifying complexity: Mixture toxicity assessment in the last 20 years. Environmental toxicology and chemistry / SETAC 32: 1685-1687.
2 Morris MD (1991) Factorial sampling plans for preliminary computational experiments. Technometrics 33: 161-174.
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Rundel, Tyler

Authors: **Tyler Rundel**, University of Florida

Session Title: Poster Session - Watershed & Wetland Management

A Spatial-Temporal Analysis of Mauritia Palm Swamp Degradation

Mauritia flexuosa is an arborescent palm from the flooded forests of the Amazon basin and adjacent regions. The flavorful and highly nutritious fruit are extensively consumed in the Loreto region of northeastern Peru. Increased demand and the common practice of felling the palm has led to an extensive degradation of the species in the region. A Seasonal Kendall trend test was selected to analyze this process using MODIS EVI data from 2000 to 2015 because of its ability to accommodate the prevalence of missing data, seasonal variation in enhanced vegetation index (EVI) values, and the presumed non-normal distribution of anthropogenic land-cover degradation. To validate the results of the time-series analysis, a logistic regression model was conducted to determine if the areas of degradation were correlated to variables typical of extractive industries. Of the 59,300 km2 of Mauritia palm swamp in the Loreto region of Peru, 25.7% were found to have a significant decreasing trend in EVI from 2000 to 2015, while only 1.6% were increasing. The logistic regression indicated that the decreasing trends were strongly correlated to accessibility variables. The findings show the serious impact overharvesting has had on M. flexuosa communities. However there is a silver lining, the degradation is fairly dispersed and harvesters are leaving intact less accessible patches. As such, degraded populations should be more able to regenerate on their own from these reservoirs.

Scarlatos, Panagiotis

Authors: **Panagiotis Scarlatos**, Florida Atlantic University

Session Title: Coastal Water Resources

Comparison of Lagrangian and Eulerian simulation of contaminant transport in Thermaikos Gulf, Greece and Lake Okeechobee

Mitigation planning for accidental releases of pollutants in marine systems necessitates the ability to predict the temporal and spatial fate of the contaminant. That requires understanding of the meteorological driving forces, the resulting hydrodynamic velocities field and wave climate, and the physicochemical processes affecting the advection, diffusion and decay rate of the contaminant substance. All of the above are very complex phenomena that require the use of computer models. This paper describes the application of a hydrodynamic geophysical model and two pollutant transport models for the simulation of a point-source contaminant release. The applications involve an open sea system as in Thermaikos Gulf, Greece and an enclosed water system as in Lake Okeechobee. The hydrodynamic and one of the transport models are using a deterministic Eulerian approach while the second transport model is based on a stochastic particle-tracking Lagrangian framework. The deterministic models are using explicit finite differences discretization schemes. All of the models are written in MATLAB for wide accessibility and easy graphic representation of the results.

Schuman, Carrie

Authors: **Carrie Schuman**, University of Florida School of Natural Resources and Environment/Fisheries and Aquatic Sciences

Session Title: Poster Session - Coastal Waters

The Secret Life of Filter Feeders: Estimating Oyster Filtration Rates in the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM NERR) in St. Augustine Region of Florida

Oysters have been lauded for being “ecosystem engineers” as well as providing a variety of ecosystem services including storm protection, habitat stabilization, provision of microhabitat, and carbon sequestration. Other services like improved water quality and control of harmful algal blooms are closely linked to oyster filtration. Frequently, filtration rates attributed to oysters (and bivalves in general) have been the result of laboratory studies. These observations may then be incorporated into models meant to simulate the system-wide level impact of oyster reefs. There is controversy as to how well lab data can be applied to systems of interest, and the studies that have extended this exploration to in situ, field-based measurements are limited.

This part of my dissertation work was focused on characterizing in-field oyster filtration rates in the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM NERR) in the St. Augustine region of Florida. Along with this objective, I explored two sub-questions to support better filtration estimates: 1) How do filtration rates differ on higher and lower points on oyster reefs? Prior studies suggest reef elevation may affect certain characteristics of oyster success such as growth and mortality, so filtration rates may show similar patterns. 2) How do filtration rates attenuate as oysters are aggregated? As oysters become clustered on reefs, re-filtration occurs and should be taken into account when upscaling study results to reef-scale estimates.

Biodeposition methods employing sediment traps were based on and adapted from those in Yu and Culver (1999) and Sroczyńska et al (2012). Pairs of control and experimental traps were placed on high and low points on 9 reefs within the reserve for a two week period. Control traps collected background sediments, while experimental traps additionally collected faeces and pseudofaeces (rejected food particles) from 10 live filtering oysters. Oyster-produced biodeposits were ashed to determine inorganic content, and then paired with data on inorganic matter in the water column, number of oysters in each experimental trap and total hours of trap deployment to generate an integrated effective clearance rate (Yu and Culver 1999) which was then standardized to gram dry weight.

Smaller experimental plots explored effect of oyster aggregation on filtration rates. Plots contained replicates of controls and experimental traps containing 1, 5, and 10 oysters. A re-filtration curve was generated as a tool to up-scale results to the reef level. Further lab studies characterizing how the effect of aggregation as well as size class were completed to provide supplemental data and context for field results. Preliminary data and conclusions from these experiments are presented.

Seals, Linda

Authors: **Chris Martinez**, UF IFAS Extension Brevard County
Lynn Barber, UF/IFAS Extension Hillsborough County
Tatiana Borisova, UF/IFAS Food and Resource Economics
Shannon Carnevale, UF/IFAS Extension Polk County
B.J. Jarvis, UF/IFAS Extension Citrus County

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues 2

Water School Extension Program to Educate Public Officials and Decision-Makers

Additional author: Yilin Zhuang, UF/IFAS Extension Marion County. Water quality, water availability and water conservation are top priorities for Florida's 19.9 million residents and, therefore; important to the University of Florida/Institute of Food and Agricultural Sciences (UF/IFAS.) Municipalities are often involved in contentious debates concerning water allocation, rates, quality, funding for new facilities, nutrient management in local watersheds, and so forth. When these debates arise, elected officials must make difficult decisions, and it's in the community's interest for decision-makers to be well-informed. The goal of Water School is to inform participants about local water supply and water issues, and encourage informed decision-making on water management and policy. Local water issues vary by community, and each Water School must be developed separately to ensure that it addresses local circumstances adequately. Program development is handled by advisory committees comprising of Water School personnel, local water utilities personnel, agricultural producers and other community members. Topics often covered in the Water School curriculum include watershed theory, basic hydrology, alternative water supply, utility rate structures, community water conservation and common sources of water pollution. To date, Water School has been offered 18 times in a total of six central Florida counties. Survey results from the most recent Water School – conducted in Marion County – indicate that over 90% of participants thought water education programs, such as Water School, help improve public policy. Self-assessment, based on a scale of 1 to 5, reflected participants' average knowledge level of key water quality and quantity topics increased from 2.8 (i.e., "know approximately 50% of the content) to 3.8 (i.e., "know approximately 76% of the content). Water School is a novel approach that will result in greater community awareness of water-related issues, the generation of timely solutions and support from decision-makers, appointed and elected officials, and community leaders.

Sepulveda, Nicasio

Authors: **Nicasio Sepulveda**, USGS-CFWSC

Session Title: Groundwater Resource Evaluation

Analyzing Flows Through Structures Using MODFLOW-NWT Packages

In the karst terrain of Citrus and Hernando Counties in Florida, spatial variations in hydraulic connectivity between the stream or lake beds and the Floridan aquifer affect surface and subsurface water-level and flow conditions. The Tsala Apopka Lake pools at Floral City, Inverness, and Hernando in Citrus County must be maintained within a range of specified stages to meet human and environmental needs. Changes in rainfall patterns also affect the fraction of the flow in the Withlacoochee River that could be used for diversion through water-control structures to these pools. Available simulation tools that can analyze the temporal changes in pool stages due to flows of various magnitudes through the structures vary in complexity and a rather simple surface-water/groundwater simulation is proposed based on the lake, streamflow routing, and the unsaturated zone packages of MODFLOW-NWT. Simulated stages at the three pools for 2004 were within 0.5 ft of the measured stages and simulated infiltration rates between the stream and lake beds and the aquifer were calculated to be about 25 percent of annual rainfall. The conceptual flow model, the inverse modeling calibration for 2004 hydrologic conditions, and the application of the calibrated parameters to simulate hydrologic conditions from 2004 to 2012 for these three pools are presented in this study. Flows through the structures are specified as multiples of the estimated flows using existing rating curves for the structures. The capability of the MODFLOW-NWT packages to simulate complex surface-water/groundwater interactions such as the effects of the flows through structures on the pool stages in Citrus County, makes it an effective simulation tool. The merits and limitations of this modeling approach are recognized and were appropriately considered to attain a more comprehensive understanding of the hydrologic system and to optimize the effectiveness of surface-water management practices.

Shukla, Asmita

Authors: **Asmita Shukla**, Southwest Florida Water Management District
Sanjay Shukla, University of Florida
Rajendra Sishodia, University of Florida

Session Title: Water Use in Agriculture

Enhancing the Phosphorus Retention Efficiency of Agricultural Stormwater Detention Areas

Detention areas are an important part of the agricultural as well as urban landscapes throughout the world fulfilling the water storage and treatment needs. In Florida, they are ubiquitous in the farmed areas as a best management practice (BMP) to retain nutrients lost as a result of the sandy soils, shallow water table, and sub-tropical climate. A measurement study was undertaken to estimate the phosphorus (P) treatment efficiency of two agricultural stormwater detention areas (SDAs) in south Florida and identify modifications to enhance P retention. Located in a sugarcane farm in the C-139 basin, SDA1 was a source of P for year 1 (2008-2009) and a P sink with 54% retention efficiency in year 2 (2009-2010). The release of P during year 1 was attributed to limited to no soil phosphorus storage capacity (SPSC) and excessive dilution of P-laden drainage from a large rainfall event. The second SDA (SDA2), located in a vegetable farm, consistently functioned as a P sink during year 1 (2009-2010) and 2 (2010-2011). At both sites, P load reduction was mainly driven by volume retention, not biochemical processes. Hydraulic and managerial (biomass harvesting and chemical (alum) treatment) modifications were identified as avenues to enhance the P retention efficiency of the SDAs. The hydraulic modifications included dividing the SDA into two cells and raising its storage capacity. These hydraulic modifications have been implemented and a comparison between post and pre-modification water and P fluxes will be conducted to quantify the improvement in P treatment efficiency, if any.

Singleton, Lloyd

Authors: **Lloyd Singleton**, UF/IFAS Extension

Session Title: Poster Session - Policy & Behavior Change

Sharing Water Wisdom in The Villages

I am applying for an Extension Scholarship.
Situation:
In Florida, over 50% of residential water used is to irrigate landscapes. The Villages has over 120,000 people in one retirement community. The developer has addressed water use concerns by implementing a storm water reuse system and encouraging Florida-Friendly Landscaping™ practices throughout much of the development. Some residents have made additional efforts for water savings and conservation, including the use of native plant landscapes. These efforts make a good model for Florida residential developments, and are worthy of sharing.
Program and Methods:
UF/IFAS Central District “Green Team”, comprised of Extension Agents with Horticulture responsibilities gathered for an educational event that would showcase the successful implementation of Florida-Friendly Landscaping™ principles and storm water reuse. The agenda was:
12:00 noon - lunch
1:00 - 1:45 Walking tour of Brownwood Paddock Square with Landscape Architect Michael Pape.
2:00 - 2:45 WaterWise irrigation innovations presentation by Trey Arnett of Arnett Environmental
3:00 - 3:45 Tour Turnipseed's amazing FFL/Florida Water Star landscape.
The event was advertised with an email invitation to the 38 Extension faculty and 16 Master Gardener trainees with Eventbrite registration at no-cost. 40 registered.
Summary and Results:
33 did attend. The casual lunch at a restaurant situated in Brownwood Paddock Square offered a great networking time for the participants. Immediately after, Michael Pape, Landscape Architect for Brownwood led a walking tour of the award winning landscape, featuring the principle of Right Plant, Right Place throughout. Two buses, provided free of charge by The Villages, were loaded to transport the group to the nearby Recreation Center that offered a room for presentation free of charge. Trey Arnett, of Arnett Management provided actual water use data and an overview of the storm water system. The third stop for the event was at the Turnipseed residence. Although native plants are often thought of as wild and unkempt, this residential landscape meets and exceeds the high aesthetic standards of The Villages. After admiring the landscape, the participants outfitted with clipboard, pencil, and plant list were tasked with identifying plants by the number on the tag. With a 25 minute time limit, the numbers were removed from the plant ID tags and self-grading results brought the winner with 31 correct answers. A follow up survey will be sent to all the participants to determine knowledge gain and behavior change. It is hoped that many will use this event as a model to reward the good practice of some of Florida’s developers in supporting water conservation and Florida-Friendly Landscaping™. The survey results will be complete by mid-November.

Sishodia, Rajendra

Authors: **Rajendra Sishodia**, University of Florida
Sanjay Shukla, University of Florida

Session Title: Poster Session - Watershed & Wetland Management

Trends and sustainable management options for groundwater in semi-arid hard rock region of India

Rapid increase in groundwater use is causing groundwater depletion and water scarcity in many parts of the world. This study evaluates whether the semi-arid southern India is also experiencing significant decline by analyzing the long term (1990-2012) groundwater levels for three districts (administrative division in a state) with diverse land uses. We also use a modeling (MIKE SHE/MIKE11) approach to evaluate potential management solutions. Non-parametric trend test results showed statistically significant ($p < 0.05$) declines in 22% to 36% of the wells. This is contrary to commonly held view of widespread groundwater decline. Trend tests for rainfall and rainfall adjusted groundwater levels (locally weighted regression residuals) showed that rainfall variability could not fully explain the declining trends. Increase in numbers of irrigation wells and irrigated area combined with the free electricity policy for farmers, implemented in 2004, were the main causative factors. Up to 76% of these wells also showed a statistically significant step-up trend in groundwater levels during the post-subsidy (2005-2012) period, confirming the nexus between power subsidy and groundwater. Continued increase in groundwater-based irrigated areas is likely to increase the groundwater level declines and well drying occurrences in the future. The MIKE SHE/MIKE 11 modeling for a watershed (Kotahpally, 320 ha) in the region showed that a combination of demand and supply management strategies such as runoff water retention through check dams, conversion from flood to drip irrigation, reduced power subsidy and regulated pumping could help maintaining or improving the groundwater levels thereby increasing the water availability in the region. Weathered fractured aquifers, similar to those in this study, cover about two-third of India (240 million ha) and their appropriate management is critical to maintain or enhance the agricultural production and provide adequate water supply to urban and industrial sectors under the current and future climatic conditions.

Skrivanek, Alexandra

Authors: **Alexandra Skrivanek**, University of Florida
Andrea Dutton, University of Florida
Thomas Stemann, University of the West Indies

Session Title: Sea Level Rise: Projections and impacts

Assessing the occurrence of rapid sea-level oscillations during the Last Interglacial period in the Falmouth Formation of Jamaica

We evaluate the potential occurrence of rapid, millennial-scale sea-level oscillations in the limestone Falmouth Formation from Jamaica. Fossil coral reefs are observed in outcrops of the Falmouth and date back to the Last Interglacial period, or Marine Isotope Stage (MIS) 5e. The stratigraphy, age and elevation of these reefs can be used to constrain the timing and rates of sea-level rise during this warm period of earth's history. These insights will help us to understand potential rates of sea-level rise as the climate warms in the future, affecting coastal ecosystems and water resources. Across the Caribbean, many exposed MIS 5e reefs were investigated to understand sea level and ice sheet dynamics in a warming world; however, the rates of sea-level change during MIS 5e remain unclear.
In Jamaica, transitions between reef units are sometimes associated with sharp unconformities in vertical exposures. Outcrops in East Rio Bueno feature a clear change in coral taxonomy from in situ Montastraea spp., Siderastrea and Diploria sp. encrusted by coralline algae, next to a repeated succession of Porites furcata, Acropora cervicornis, coralline algae and Porites astreoides, to in situ P. furcata. This sequence is capped by a fining-upwards unit of coral rubble, a laterally-persistent layer of small in situ Siderastrea and a ~1-m thick caprock. Eastward, a layer of primarily Acropora palmata transitions upwards into in situ Montastraea spp., Siderastrea, Colpophyllia natans, Diploria sp. and A. cervicornis. The southwestern coastline features situ A. palmata and/or rubble, and a reduction in algal encrustation upsection, overlain by head corals and a regressive beach unit.
These observations will be paired with radiometric dates of corals to determine if millennial-scale sea-level oscillations occurred as sea-level rose to the MIS 5e highstand, shedding light on the capability of sea-level and ice sheets to respond to global warming on shorter timescales.

Smith, Chelsea

Authors: **Chelsea Smith**, J.W. Jones Ecological Research Center
Steve Golladay, J.W. Jones Ecological Research Center

Session Title: Impacts of Climate Variability and Change on Water Availability and Quality

Water Quality Changes in the Face of Increased Variability: How Floods and Droughts Affect Not Only the Quantity but Quality of Water

The quality and availability of water has become a growing concern within the Southeast in the last fifteen years as multiple multi-year droughts have occurred. Future climate predictions are unclear on precipitation changes; however increases in temperature are predicted, especially during the summer months. Within southwest Georgia these increased summer temperatures coupled with human water use will likely increase the strain on water quantity and quality in the area. Since 1994, water quality measures have been taken monthly across three adjacent coastal plain streams in Southwest Georgia. These samples include normal annual hydrologic variation, floods and multiple droughts. Comparisons across watersheds revealed that one tended to have higher DOC and higher alkalinity levels. This is likely the result of extensive wetland areas within this watershed as well as the importance of the underlying Floridan aquifer to this system. This watershed also generally showed a greater change in water quality between drought and normal conditions. DOC or SRP were higher in flood years as compared to normal and drought years. Ammonium levels decreased as conditions became drier while nitrate increased. Much of the changes in water quality observed are the result of a disconnection from the surrounding flood plain. The effect of drought on water quality is not solely the product of changes in water quantity but also the connection to the surrounding land. A compounding factor during these extended droughts could be further alteration to previously inaccessible land (i.e. stream side areas and isolated wetlands). Knowing how water quality could be altered with increased droughts will be important in predicting the impact on organisms within streams in addition to reduced water levels.

Sobczak, Robert

Authors: **Robert V. Sobczak**, Big Cypress National Preserve

Session Title: Restoration and Connectivity

Restoration Rally Cry for the Big Cypress Swamp

The Big Cypress Swamp of Southwest Florida has historically been perceived as a lower urgency subarea of the Greater Everglades Restoration effort. Factors contributing to this perception include its geographic separation from the highly-managed main Everglades flow way, its mosaic of smaller natural flow ways, an assumption that land conservation alone was enough to protect the area, and the widely held misconception that its hydrology has been less impacted than within the footprint of the Central and South Florida Project to the east.

A more accurate assessment reveals an area where conservation alone has fallen short of achieving and sustaining the ecological health of the swamp ecosystem. Instead, a network of legacy and now aging drainage infrastructure has caused widespread disruption of the swamp's characteristic sheet flow regime. Major impacts include severed inflows, interrupted overland flows, shallower surface water depths, seasonally shortened hydroperiods, degradation of wetland habitat, increased exposure to exotic biota, decreased freshwater contributions to estuaries in downstream Everglades National Park and Ten Thousand Islands National Wildlife Refuge, increased vulnerability to saltwater intrusion, and rising frequency and intensity of ecosystem-damaging and financially costly wildfires.

Restoring hydrologic regimes represents the next vital stewardship step for the Big Cypress Swamp. An overarching plan is needed to bring the area's legacy drainage infrastructure up-to-date with modern engineering and water conservation principles, to revitalize a hydrologic regime which achieves and sustains the swamp's ecological health, to unite resident watershed stewards under a common restoration umbrella, and to assimilate this renewed vision into Greater Everglades Restoration planning circles. Left unchecked, the current status quo will continue to imperil the swamp, increase its vulnerability to new threats and leave potential corrective actions unfulfilled.

Steckler, Natalie

Authors: **Natalie Steckler**, University of Florida College of Veterinary Medicine
James Wellehan, University of Florida College of Veterinary Medicine
Lisa Farina, University of Florida College of Veterinary Medicine
Gregory Krane, University of Florida College of Veterinary Medicine
Thomas Waltzek, University of Florida College of Veterinary Medicine

Session Title: Emerging Diseases and Contaminants in Florida Waters - 1

Ranaviruses: an Emerging Threat to Florida Fish, Amphibians, and Reptiles

Ranaviruses are a genus of large double-stranded DNA viruses within the family Iridoviridae that infect three classes of poikilothermic vertebrates. Nearly identical strains of Frog virus 3, type species for the genus Ranavirus, have been linked to significant epizootics in wild and farmed North American fish, amphibians, and reptiles. These mortality events have included species of conservation concern including the gopher tortoise (Gopherus polyphemus), dusky gopher frog (Lithobates sevosus), boreal toad (Anaxyrus boreas boreas), and numerous species of sturgeon (family Acipenseridae). Ranaviral infections may result in lethal systemic disease with hemorrhage, edema, and necrosis observed among affected tissues. Due to increased detections of ranaviruses in an expanding number of lower vertebrates around the globe, they are considered an emerging group of pathogens and increasing attention is being given to their potential impacts on both aquaculture and aquatic ecosystems. In 2015, approximately 75 scientists and veterinarians attended the Third Global Ranavirus Symposium in Gainesville, FL to discuss recent developments in ranavirology. This talk will provide an overview of ranaviruses, with emphasis placed on ranavirus epizootics within Florida's wildlife and animal industries.

Sudol, Taryn

Authors: **Taryn Sudol**, UF IFAS Extension Seminole County

Session Title: Poster Session - Policy & Behavior Change

Comparing Aquascape Education Methods

I am applying for an Extension Scholarship. In UF IFAS Extension, the need to teach and motivate Florida residents about improving water quality is clear –'Protecting the Waterfront' is one of the Florida-Friendly Landscaping principles and 'Enhancing and Protecting water quality, quantity, and supply' is Initiative 2 in the Florida Extension Roadmap. The crux is how to communicate effectively and quantify behavior change. In December 2013, the UF/IFAS Center for Public Issues Education (PIE) in Agriculture and Natural Resources shared an online survey of Florida residents' interest in learning opportunities about water policy issues. Results showed a strong preference for digital communication versus in-person workshops (33% indicated they would watch a video while 14% indicated they would attend a workshop). My objectives as the Florida-Friendly Landscaping Agent in Seminole County are for residents to reduce nutrient impacts, remove invasive plants, and plant desirable plants on the shoreline. I present this in the typical class format with a pre/posttest and follow-up survey. In class we explore these issues in depth but have poor attendance (typically less than ten participants). I am in the process of creating a 3-minute video covering the same objectives. I expect higher viewership but worry that my message is too brief to motivate change. My intention is to compare attendance to class and viewership of the video as well as behavior change spurred by either format. I realize that evaluating impact of a video is difficult. My plan is to have the video shown on a subdivision's website and then email the follow-up survey to those residents. These results should be obtained in time for the symposium in February. The results of this comparison would be a tool for water policy education and outreach professionals in deciding how to most effectively direct their time and efforts.

Szafraniec, Mary

Authors: **Mary Szafraniec**, Amec Foster Wheeler
Margaret Guyette, St. Johns River Water Management District

Session Title: Springs II - Hydrography and Ecology

Evaluating Ecological Drivers and Interactions in Florida Springs

Florida springs and spring runs are highly productive, societally and ecologically valuable ecosystems. In many springs, submerged aquatic vegetation (SAV) dominate the benthic community and are critical in their role in trophodynamics, biogeochemical cycling, stability of substrates, and are indicators of overall stream health and resilience. An ecological shift has been documented in several spring ecosystems, where macrophyte-dominated communities are declining and algal communities are proliferating. Due to the broad-scale shifts that have occurred in aquatic autotroph composition and abundance that has led to the proliferation of nuisance algae (i.e. benthic macroalgae, epiphytic algae), greater attention has been drawn to the changing condition of springs. These shifts in primary producer community structure (PPCS) has fueled an impetus towards further investigation of the multi-causal interactions of drivers leading to changes in autotrophic assemblages. In this work, Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) assisted the St. Johns River Water Management District (SJRWMD) with developing a baseline set of biological, physicochemical and hydrological conditions in 14 spring systems (26 transects) with the overall objective of gaining a better understanding of the multi-causal interactions of natural and anthropogenic drivers leading to changes in ecological health and stability of Florida springs. This synoptic biological monitoring project covered a broad range of spring system types across North and Central Florida to capture the variability of physicochemical parameters, SAV, benthic macroalgae, epiphytic algae, and macroinvertebrate communities. Project objectives were consistent with the SJRWMD's Springs Protection Initiative, which included developing a baseline set of biological community composition (i.e. abundance and biomass), physiology, and distribution data that can be used to assess current ecological conditions to compare to historical and future conditions in spring ecosystems. The broad range of springs selected for this study should allow the District to determine the generality, or specificity, of abiotic-biotic empirical relationships such as those that exist between water chemistry, hydrology and biota, which will indefinitely improve the District's science-based water management decisions.

Taylor, Melissa

Authors: **Melissa Lamm**, University of Florida
Alexa Lamm, University of Florida

Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues - 1

Identifying Water Issues Opinion Leader Needs to Encourage Widespread Adoption of Best Management Practices

Opinion leaders are persuasive in convincing others within their social networks to adopt certain opinions and behaviors. By identifying and using opinion leaders, extension educators may be able to leverage individuals who have influence on others' opinions, thereby speeding up the adoption of new practices. The purpose of this research was to identify water issue opinion leaders and understand their current water conservation practices. Additionally, by using the theoretical framework of the diffusion of innovations, we explored what subject matter areas water issue opinion leaders are most interested in, and where they go for more information. These findings were used to identify how extension educators can reach opinion leaders to help disseminate important water conservation information. The findings indicated opinion leaders have a good grasp on how to conserve water, but are still misusing water in terms of protecting its quality. Based on these findings it is suggested that extension educators develop educational programming focused on improving opinion leaders' knowledge of water pollution; a connection needs to be made between water quality and the environment.

Taylor, Melissa

Authors: **Melissa Taylor**, IFAS PIE Center
Alexa Lamm, University of Florida

Session Title: Poster Session - Policy & Behavior Change

Minimizing Disparities and Developing Support by Identifying Differences in Water Confidence and Knowledge

A growing population coupled with a diminishing water supply demands a need for more knowledge of water issues facing the state of Florida. The purpose of this study was to obtain a better understanding of decision makers' and the general public's confidence in Florida's water resources as well as their awareness of water issues. It is important to understand both views. County commissioners, county managers, and county clerks make direct decisions about water regulation and control in conjunction with the Department of Environmental Protection and water management districts. However, while the general public's stance on issues does not have a direct impact on policy, it does impact their local decision maker's choices and may in fact influence policies in an indirect way. Those working to establish effective and efficient policy need to be aware of how the general public perceives issues as they make choices regarding their support of new regulations and legislation. Understanding the views and behaviors of all water users is critical to understanding the degree of success that can be achieved with any mandated policy. As hypothesized, the results revealed significant statistical differences between the groups in almost every category analyzed. The general public had a higher confidence in future water availability than decision makers. Additionally, decision makers had significantly more knowledge of water issues, particularly policies and legislation. The findings suggested it is important to expose the general public to the state's current water situation such as excessive withdrawal, frequent drought, flash flooding, sea level rise, and the impacts of population growth but to do so in a way that will not be contradictory to their current beliefs. The best ways to educate were also analyzed and discussed.

Thorslund, Josefin

Authors: **Josefin Thorslund**, Stockholm University
Matthew Cohen, University of Florida (School of Forest Resources and Conservation)
Jerker Jarsjö, Stockholm University

Session Title: Restoration and Connectivity

Using combined water and solute balances to explore wetland connectivity across space and time

The hydrological and geochemical connections between geographically isolated wetland (GIW) complexes and downstream waters can vary depending on multiple factors, such as landscape position, wetland size, geological attributes and climate. Understanding these connections and what drives them are relevant for determining how best to conserve landscape scale water quality and storage functions that these wetlands provide, under the impact of current and future changes (e.g. climate and human priorities). Further, focusing on geographically isolated wetlands is motivated by several aspects. Not only are they generally smaller than other wetland classes and thus more sensitive to changes in climate, they are often the majority in numbers compared to other wetlands, but commonly lack legal protection by the U.S law due to their geographic isolation from navigable waters. We here seek to upscale findings from individual wetlands to better assess interactions within and between wetland complexes and drainage features at the catchment scale. Such a perspective is relevant for understanding cumulative effects on downstream waters. We combine long term climatic data with chloride concentrations from different GIW types and regions across the US to evaluate spatial, temporal and categorical patterns of wetland solute concentrations and what it suggest about the hydrologic connectivity between wetlands and their surrounding landscape. By increasing our understanding of possible interactions across wider scales and different regions and enumerating the relative role of various controlling factors (e.g. climate and land-use changes), we are in a better position for predicting changes to and appropriately manage valuable water resources.

Timpe, Kelsie

Authors: **Kelsie Timpe**, University of Florida

Session Title: Poster Session - Watershed & Wetland Management

Quantifying the Hydrological Impacts of Damming the Amazon

There is increasing concern about the integrity of the Amazon ecosystem, particularly with the loss of connectivity along Amazonian rivers due to the installation of hydroelectric dams. Quantifying dam-induced hydrological changes is critical for understanding the cascade of ecological and social impacts driven by hydraulic infrastructure development in the Amazon. In this work, we apply the Indicators of Hydrologic Alteration (IHA) approach to synthesize hydrological changes due to dam construction and operation across the entire Amazon basin. With this research, we hope to paint a better picture of the hydrologic and resulting ecological changes that have happened already in the Amazon in order to better predict the alterations that will come with the construction of additional dams in the ensuing decades. We also hope that this research will offer useful environmental flow recommendations for the hydroelectric dams analyzed in this study.

Tison, Katherine

Authors: **Katherine Tison**, University of Florida
Andrea Dutton, University of Florida

Session Title: Poster Session - Coastal Waters

Improving accuracy of past sea level chronologies: Testing assumptions about seawater uranium isotope composition

To understand how coastal water resources will be affected by sea-level rise, it is imperative to constrain the potential rates of sea-level rise in a warmer world. Data of sea-level rise that occurred during past warm periods can be used to constrain potential rates of rise. One common technique used to reconstruct sea level is to determine the age and elevation of fossil corals that lived near the sea surface to develop a history of past sea level position.
One challenge to using fossil corals as a proxy for past sea-level position is that the skeletal aragonite that is dated using the U-series radiometric dating technique can undergo geochemical alteration. Modern coral skeletons have the same uranium isotope composition (δ234U) as ambient seawater during growth. Because geochemical alteration tends to impart anomalously high δ234U values, if the δ234U at the time of growth is significantly different from modern seawater, then the data is thrown out based on the assumption that the coralline aragonite has been altered.
Here we test the assumption that modern corals have the same δ234U value as modern, open ocean seawater samples that display remarkably homogeneous δ234U values. Although the mean value of modern coral data is close to that of open-ocean seawater, the variability is greater than that expected from analytical uncertainty alone, suggesting that there may be an additional source of variability. Riverine δ234U can be much higher than that of open-ocean seawater and in coastal zones this may cause elevated δ234U values of both the water and the corals growing there. To test the null hypothesis that seawater in coral reef environments is equal to that of the open ocean, we will measure the δ234U of seawater samples collected from modern reef settings around the globe.

Toor, Gurpal

Authors: **Gurpal Toor**, University of Florida
Yun-Ya Yang, University of Florida
Stefan Kalev, University of Florida

Session Title: Sensors and Technologies

Identification of Nitrate-Nitrogen Sources in Residential Stormwater Runoff Using δ15N and δ18O

Sources of nitrate-nitrogen (NO3-N) in urban residential neighborhood stormwater retention pond waters may include a combination of atmospheric deposition, fertilizers, organic materials, and soil. In this study, we used N and oxygen (O) stable isotopes of nitrate (δ18O-NO3- and δ15N-NO3-) and δ18O and hydrogen (δD) of water (H2O) to identify the dominant sources of NO3-N from a low-density residential neighborhood. Stormwater samples were collected over 25 events during 2014 wet season (July to September) at 5-min intervals using an autosampler installed at the outlet pipe. Isotopic results from δ15N-NO3 and δ18O-NO3 suggest that both atmospheric deposition and chemical fertilizers contributed NO3-N to urban stormwater runoff. The mechanisms driving NO3-N transport during runoff events were primarily hydrologic and not biogeochemical. We suggest that a better understanding of N evolution and sources in residential catchments is important to reduce N loads and improve water quality in urban waters.

Torres-Quezada, Emmanuel

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Session Title: Water Use in Agriculture

Application of kaolin clay during strawberry establishment as a water conservation practice in Florida

Strawberry bare-root transplants are the most commonly-used in Florida. In order to establish bare-root transplants during the first 10 days, overhead sprinkler irrigation is used for eight hours per day to reduce air temperature around the strawberry crown. This practice accounts for one-third of the total water needed for the strawberry season. New establishment practices could allow strawberry plants to tolerated high air temperatures during establishment without excessive use of water. Application of Kaolin clay on the top surface of the planting beds had been reported to lower the temperature around the crown during establishment. The objective of this experiment was to determine the most adequate planting date and effect of Kaolin clay as establishment practices for two strawberry cultivars. Twenty-four treatments resulted from the combination of two cultivars (e.g. 'Strawberry Radiance (SR)' and 'Florida 127' Sensation TM), three planting dates (e.g. Sept. 24, Sept. 30, Oct. 7), and four establishment practices (10 days of sprinkler irrigation (DSI) (common practice, control), 10 DSI + Kaolin clay (S) at the 11th day, 7 DSI and 7 DSI + S at the 8th day). Treatments were setup in a split-split plot design with four replications, with planting dates in the main plot and establishment practice in the sub-plot. There was an interaction between planting dates, establishment practice and cultivars. Sensation TM and Radiance, planted in Sept. 24 with 10 DSI, 10 DSI +S and 7 DSI +S and Sensation TM, planted in Sept. 30 with 7 DSI + S resulted in the highest fruit yield. Within these treatments, there was no difference between 10 DSI or 7 DSI +S. Based in our results, strawberry growers could reduce the water usage for strawberry establishment by 30% by applying Kaolin clay over the plants at the 8th day, which could represent a saving of 18,000 gal/acre.

Treuer, Galen

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Session Title: Poster Session - Policy & Behavior Change

Narrative analysis of urban water transitions: A transdisciplinary synthesis of Miami-Dade County water supply

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Over the past twenty years, numerous American cities have decreased per capita water demand and increased flexibility in their urban water distribution and management structures. Determining the conditions that enable urban areas to transition to more sustainable water governance regimes can help increase resilience as city water systems face stressors such as rapid population growth, economic volatility, and a warming climate. Extant research partially explains these complex transitions through highly contextual case studies of individual cities. In this research, we propose a standardized technique to compare transitions towards sustainable water governance across communities using a transdisciplinary synthesis of hydrologic, institutional, interview, and media data to create structured, data driven narratives. These narratives represent the complexity of such transitions while simultaneously making them accessible to both researchers and practitioners. This narrative analysis is piloted through application to Miami-Dade County's Water and Sewer Department (WASD), which has decreased per capita water demand since 2006. To create the narrative, we populate a twenty-year timeline using local expert interviews, Water Supply Stress Index (WASSI) calculations, a drought index, institutional analysis of water ordinances, municipal charter and state constitutional rules, media analysis of the Miami Herald, and longitudinal data from the department's comprehensive annual financial reports. Next, a transition[KM1] [TG2] period is identified, and pre- and post-transition contexts are described for key actors. Timeline data is interrogated to identify potential drivers of and barriers to transition. For WASD, we find water supply stress (WASSI + drought index) is a leading indicator of the transition towards a sustainable water supply. Transition is further enabled by regulatory changes to the County consumptive use permit and permanent outdoor water use restrictions. To determine common conditions driving water supply transitions, Miami-Dade's narrative can be compared to similarly structured narratives constructed for other cities.

Vyverberg, Karen

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Session Title: Sea Level Rise: Projections and impacts

Coral reef response to global sea-level change during the previous interglacial period

Characterizing the evolution of global mean sea level (GMSL) during warm periods is critical to constraining the dynamic response of the large polar ice sheets to different climatic drivers and can facilitate efforts to identify and understand those forcing mechanisms. The non-linear retreat and/or regrowth of ice sheets in the future would necessitate sophisticated adaptation measures to preserve coastal resources such as habitable living space, potable water, and ecosystems. Reconstructing the course of GMSL during a previous interglacial with a similar ice sheet configuration as today, such as Marine Isotope Stage (MIS) 5e (~129,000 – 116,000 years ago), can improve our understanding of the response, and so potentially drivers, of ice sheet and sea-level change. Because sea-level position is a primary control on coral reef morphology and composition, identifying changes in these parameters in fossil reefs can inform reconstructions of past sea-level behavior. Here we provide a detailed examination of MIS 5e fossil reefs located in the granitic Seychelles that record sea-level changes from ice-volume contributions. To reconstruct relative sea level (RSL), we combine elevation surveys with sedimentary and taxonomic examinations. At all sites we observed a similar pattern of outcrop architecture of two or three discontinuous reef growth units, which suggests a common sea-level history. In each limestone buildup, primary coralgal colonization is disconformably capped by (i) reef rubble, (ii) a Pyrgomatid barnacle-bearing micrite, and/or (iii) a reef unit with different taxa. This first package is repeated at least once more in each outcrop. Additionally, we identified four different fossil coralgal assemblages that correspond to modern communities with distinct water-depth habitats allowing for direct inferences of paleo-water depth at different phases of reef growth. The robust reef history we have in the Seychelles provides a strong control on the sea-level historyduring MIS 5e.

Wallace, Max

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Session Title: Poster Session - Watershed & Wetland Management

Where is your watershed? Lessons from a watershed delineation in Florida with low topographic gradients and complex drainage network

Lake Trafford is a ~1600 acre freshwater lake in Collier County, Florida. The lake is an important recreational resource and the headwaters for Big Cypress Preserve. Hydrologic, biologic, and chemical changes to the watershed have deteriorated the health of the lake. In an effort to restore the lake, the Florida Department of Environmental Protection (FDEP) established Total Maximum Daily Loads (TMDLs) for total nitrogen and total phosphorus entering the lake using the watershed model Hydrologic Simulation Program-Fortran (HSPF). Field visits and discussions with stakeholders indicate potential uncertainties in the watershed boundary used by the FDEP. Errors in watershed boundary delineation will result in invalid determination of watershed area, nutrient sources, and allocation of nutrient loads to different land use types. Accurate delineation of watershed boundary is the first step in development of the Basin Management Action Plan (BMAP). The goal of this study is to delineate the watershed using field measurements and topographic modeling. Inundation area maps were created for median and extreme lake levels using a high resolution LiDAR derived digital elevation model to identify potential seasonal surface water connectivity. A network of pressure transducers was installed around the floodplain to compare surface water gradients and establish preferential flow directions between the lake and adjacent ecosystems. Flow direction through hydraulic structures and natural sloughs crossing the current watershed boundary were verified after rainfall and pumping events using a handheld Acoustic Doppler Velocimeter. Initial field surveys have found areas on the order of 10% current watershed area to be removed or added to the current watershed and it is clear that the TMDL analyses for the lake must be revised using an updated watershed boundary. This study suggests that watershed boundaries should not be accepted without some level of skepticism especially in flat topographic regions like the Everglades.

Warner, Laura

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Session Title: Achieving Behavior Change: Public perceptions and awareness of water conservation issues - 1

Defining Residents who use Landscape Irrigation: Implications for Impactful Water Conservation Programming for an Important Audience

Most residential landscapes receive excess irrigation water (St. Hilaire et al., 2008), which can often be reduced by more than half without compromising aesthetic quality (Haley & Dukes, 2012). Water conservation campaigns that appeal to the needs and characteristics of audience subgroups versus a mass appeal are more salient to group members and are more likely to result in practice change (Andreasen, 2006).
Water conservation practices and perceptions were collected from a survey of Floridians who use landscape irrigation (N = 1,063). As a list of irrigation users is not available, random sampling of this group was not possible, therefore non-probability sampling was used to make estimates about this population (Baker et al., 2013).
Hierarchical cluster analysis using Ward's method was conducted on 38 variables (current water conservation practices, likelihood of engaging in conservation practices in the future, and hiring professional services practices) and identified a three cluster solution. K-means clustering was used to identify three subgroups, between which variables were significantly different. Members of the three subgroups identified were labeled as being part of the Water Considerate Majority (n = 479, 45%), Water Savvy Conservationists (n = 378, 36%), and Unconcerned Water Users (n = 201, 19%). Cluster analysis was found to be a meaningful way to divide the residential irrigator audience into subgroups. Results indicated that this target audience could be segmented by landscape water conservation practices. By understanding the three distinct subgroups, outreach professionals can develop water conservation programs with greater appeal and precision. This presentation will describe the baseline data collected on this important target audience, with an emphasis on how this group is different from the overall state population. Additionally, recommendations will be provided for developing programs for different subgroups and communicating based on their members' unique characteristics and needs.

Whann, Alexandria

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Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Fate of Applied Nitrogen from Urea and Polymer Coated Urea in Silvicultural Fertilization

Polymer coated urea fertilizers provide a gradual release of nitrogen in forest fertilization, and may have better nutrient use efficiency than conventional nitrogen fertilizers. Leaching of applied nitrogen is of particular concern in the Lower Suwannee Valley where surficial groundwater is close to the surface and soils are prone to nutrient leaching. Three rates of polymer coated urea (PCU) plus triple super phosphate fertilizer (25, 50, 125 lb N and 25 lb P), a diammonium phosphate (DAP) plus urea standard treatment (50 lb N and 25 lb P) and a non-fertilized control were compared in a nine-year-old slash pine plantation near Live Oak, Florida. Changes in soil nitrogen at various depths to 183 cm and changes in soil solution nitrogen concentration at 30 cm depth were monitored over time. Volatile losses of ammonia were measured using two trap methods. From 2 through 4 weeks after fertilization, nitrate concentrations in soil solution were significantly greater for the DAP plus urea standard treatment than for the same rate of nitrogen from PCU (50 lb N/acre). In this same period, the high PCU rate (125 lb N/acre) had significantly greater nitrate concentration in soil solution than all other treatments through week 13. From 2 through 8 weeks, there was a significant interaction between raking and fertilization treatments. In raked plots at weeks 4 and 8, nitrate concentrations for the middle rate of PCU were not significantly different than the non-fertilized control, whereas the DAP plus urea standard was. However, in non-raked plots, nitrate concentration for the DAP plus urea standard was not significantly different from the control and nitrate concentration with the middle PCU rate was significantly less than the DAP plus urea standard at week 4. Ammonia volatilization results after first sampling reported differences between the middle PCU rate and DAP plus standard urea with larger ammonia concentrations from the PCU, but no significance between raking treatments.

White Jr., Elliott

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Session Title: Poster Session - Coastal Waters

Investigating the Impacts of Chronic Low-level Salinity on the Productivity and Resilience of Coastal Bald Cypress (Taxodium distichum) Swamps

Both natural and anthropogenic drivers are increasing saltwater intrusion (SWI) in coastal wetlands. Natural drivers of SWI include: hurricanes, droughts, and sea-level rise (SLR). These natural drivers have synergistic effects with anthropogenic drivers such as: river modification, groundwater and surface water abstraction, and land use change. This project examines changes in the groundwater salinity of coastal baldcypress (Taxodium distichum) swamps and its relationship to forest productivity. Long-term groundwater salinity data are being collected via automated conductivity-temperature-depth (CTD) sensors installed in shallow groundwater wells at each site. Currently, there are 17 wells installed at 12 sites in three locations around the Gulf of Mexico. Sensors are programmed to collect data every 15 minutes and sites will be monitored over a 30-month period. The biological data is being collected by the lab of Dr. Beth Middleton. The techniques used to collect the data include: dedrometer bands on baldcypress trees, litterfall traps, root in-growth bags, canopy pictures, and soil elevation tables (SETs). The hydrologic and water quality data collected will be used as explanatory factors for observed biological data. The goal of this project is to produce a model. Model outputs will include maps of projected habitat based on different climate change, SLR, and local water management scenarios. This information is critical to understanding the future of coastal freshwater forests globally and whether areas are worth restoring or retreating from.

Xu, Zexuan

Authors: **Zexuan Xu**, Florida State University
Bill Hu, Florida State University

Session Title: Coastal Water Resources

Numerical modeling of seawater intrusion in a heterogeneous coastal karst aquifer with conduits

Karst aquifer is an important drinking water supply for nearly 25% of the world's population. Well-developed subground conduit systems usually can be found in a well-developed karst aquifer, as a dual permeability system. Hydraulic characteristics of non-laminar flow in conduits could be significantly different from darcian flow in porous medium; therefore, hybrid model and different governing equations are necessary in numerical modeling of karst hydrogeology. On the other hand, seawater intrusion has been observed and studied for several decades, also become a worldwidely problem due to groundwater over-pumping and rising sea level. The density difference between freshwater and seawater is recognized as the major factor governing the movements of two fluids in coastal aquifer.
Several models have been developed to simulate groundwater flow in karst aquifer, but hardly describe seawater intrusion through the conduits without coupling variable density flow and solute transport. In this study, a numerical SEAWAT model has been developed to simulate variable density flow and transport in heterogeneous karst aquifer. High-density seawater is verified to intrude further inland through high permeability conduit network rather than porous medium. The numerical model also predicts the effect of different cases on seawater intrusion in coastal karst aquifer, such as rising sea level, tide stages and freshwater discharge effects. A series of local and global uncertainty analysis have been taken to evaluate the sensitivity of hydraulic conductivity, porosity, goundwater pumping, sea level, salinity and dispersivity. Heterogeneous conduit and porous medium hydraulic characteristics play an important role in groundwater flow and solute transport simulation. Meanwhile, another hybrid model VDFST-CFP model is currently under development to couple turbulent conduit flow and variable density groundwater flow in porous media, which provides a new method and better description in seawater intrusion modeling.
Keywords: Seawater intrusion, Karst conduit, Sea-level rise, Numerical modeling, Variable-density flow

Yang, Yun-Ya

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Session Title: Emerging Diseases and Contaminants in Florida Waters - 2

Fate and Transport of Micropollutants in the Drainfields of Onsite Wastewater Treatment Systems

Many micropollutants including hormones, pharmaceuticals and personal care products (PPCPs), are used daily in households for personal health and cleaning purpose. Wastewater discharged from onsite wastewater treatment system (OWTS), commonly known as septic systems, can be an important source of micropollutants in the environment. This study investigated the fate and transport of 17 micropollutants, including human excretion markers, hormones, and PPCPs in OWTS drainfields. Effluent samples were collected from a tank and leachate samples were collected from three replicate OWTS drainfields constructed in lysimeters (1.5 m length, 0.9 m wide, 0.9 m high). Each lysimeter contained stacked layers of sand-gravel (7.6 cm), natural soil (30.5 cm), and commercial sand (30.5), as per guidelines for construction of commercial drainfields. A drip tube with three emitters was placed on top of the sand layer to disperse 9L/d of effluent equivalent to maximum allowable rate of 3 L/ft2 per day. The drip tube was covered with 15 cm of sand and St Augustine grass was planted on the top and sides of lysimeters to mimic typical Florida residential drainfields. Over 8-months, 14 micropollutants in the effluent and 12 in the leachate samples were detected at variable concentrations. Lysimeters were destructively sampled at end of the study from different layers and locations. The presence of acetaminophen, carbamazepine, and sulfamethoxazole in the drainfields suggested that sorption was the key mechanism. The removal of many micropollutants was >85% within 60 cm deep drainfields, suggesting vadose zone processes such as sorption, transformation, and microbial degradation likely limited leaching of micropollutants.

Yarney, Eunice

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Mark Clark, Soil and Water Science Department

Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Soil Salinity differences between Conventional Seepage Irrigation and Irrigation Tile Drainage (ITD)

Soil salinity tolerance threshold varies for different crops. Crops growing in conditions exceeding these thresholds exhibit nutrient deficiency symptoms, stunted growth, reduced yield and crop mortality. In soils with high salt concentrations, reducing new inputs and leaching salts from the soil is the most efficient means to keep the salinity below the crop tolerance threshold. Salinity impacts on potato and vegetable crop production in 2011 and 2012 in the Tri-County Agricultural Area of Florida resulted in a need to determine what alternative irrigation and drainage practices might be viable in this area to reduce soil salinity.
Soil salinity differences between Irrigation Tile Drainage (ITD) and conventional seepage irrigation were compared over a period of two years to determine which irrigation practice promoted low soil salinity concentrations. Differences in soil salinity within the soil profile at one foot depth increment was also compared among the two irrigation practices. Soil samples were collected from six farms having both irrigation practices during the growing season of 2014 and non-growing season of 2015.
Results indicate that ITD significantly reduced the soil salinity at varying percentages at all soil depths. For four out of six farms sampled, the overall average percentage soil salinity reduction was 50.27% for the two sampling events. Individual farm average percent reduction in soil salinity ranged between 18% and 68%. This study shows that ITD has a significant potential to reduce soil salinity.

Zamora Re, Maria I.

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Session Title: Poster Session - Water & Nutrients in Managed Landscapes

Evaluation of irrigation and nutrient Best Management Practices (BMPs) in the springsheds of Suwannee River Water Management District

The perception of guaranteeing maximum yield through excessive application of water and fertilizer has become a major environmental issue, since nitrate leaching is one of the major contributors of worldwide groundwater contamination. In response to this concern, a three-year research project is being performed to quantify the impacts of nutrient and irrigation management practices on a corn-peanut rotation production in springsheds of the Suwannee River Water Management District. The experimental design includes four replicate plots for each treatment, totaling 60 plots per crop. Five irrigation treatments: (I1) calendar based-simulates grower's irrigation practices; (I2) SWB: irrigation calculated using a soil water balance; (I3) SMS: used soil moisture sensors to refill in real-time the soil profile with irrigation; (I4) Reduced: applied 60% irrigation of I1 and (I5) no irrigation, were evaluated. Three nitrogen (N) fertility levels (lbs/ac): low (140), medium (220) and high (300) rates were evaluated in corn only. Drainage lysimeters were used to evaluate nutrient leaching volume and quality (N03 and NH4). As well, soil core depths were taken biweekly for nutrient leaching. Plant tissue samples were taken for N uptake of the crop over time.

Zhu, Dan

Authors: **Dan Zhu**, University of Florida

Session Title: Planning and Governance

Developing Recovery Anti-Pollution Policies: An Analysis of China's Huai River Pollution Reduction

This study examines the pollution dynamics caused by human activities in the Huai River Basin, China, the relationship between human systems and natural systems, and how mitigation policy affects the pollution dynamics of the Huai River. The Huai River is one of China's major rivers, and it drains 67,000 square miles and supports 170 million inhabitants. However, five billion tons of wastewater are dumped into the Huai River annually (World Bank, 2011). Currently, there is no comprehensive system to manage the agricultural and domestic wastewater flux into the Huai River, as the government often only requires major industries to reduce wastewater emissions. As a result, the main objective of this research is to analyze the current conditions and to develop a revised pollution mitigation policy for industry, domestic and agricultural waste treatment.

To demonstrate that successful river pollution treatment governance and regulation experiences are possible, alternative models from three different locations are incorporated into this assessment. They focus on governance, efficient funding collection, use of expert research teams, and technology and science applications. Field work at two sites along the Huai River also provide data that overall support existing datasets provided from universities and government sources in China. In addition, a distinct feature of this assessment is that Total Maximum Daily Loads and Pollutant Empower Density based Mass Balance Diagram are calculated for the Huai River to reveal an answer to the high mortality cancer rate and its relation of pollutant amount.

In the end, three policy revisions to the current Temporary Regulations on Pollution Prevention and Control of Huai River Basin (1995) are proposed in terms of future regulation, clarification of a mitigation target, and governance cooperation. New policy recommendations are suggested, in addition to the revisions, specifically to focus on domestic, agriculture and industry pollution treatment. The mitigation plan in this project will lead to a more practical way for Huai River pollution control and improve the anti-pollution policies. These polices can provide the guidelines for policy makers, local governors, water experts, and residents not only in the Huai River Basin, but also can be apply to wider range of water issue in other developing countries. Implementation of some or all of the recommendations and policies can lead to a cleaner river and healthier environment.

Zick, Stephanie

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Session Title: Poster Session - Coastal Waters

Evolving Geometries in the Water Budgets and Precipitation Patterns of US Gulf Coast Landfalling Hurricanes

According to a 2014 publication by former National Hurricane Center director Dr. Edward Rappaport, water-related deaths from inland flooding and storm surge are the leading causes of hurricane-related fatalities in the United States. Observations reveal that TCs of a given intensity vary significantly in size and structure, and there is mounting modeling and observational evidence that supports large-scale moisture as one controlling factor. Thus, the influence of environmental moisture on hurricane morphology is a critical research question, especially during the period around landfall, which has been less studied. In this analysis, we quantify the spatial distribution of TC moisture by formulating three shape metrics that encompass characteristic geometries of TCs moving into the mid-latitudes: asymmetry (A), fragmentation (F), and dispersiveness (D). Using reanalysis-derived water budget terms, the geometric patterns are measured every 3 hours, and a moving Mann Whitney U test is applied to determine significant break points in the evolution of moisture. As TCs moves into the eastern and central Gulf of Mexico, these shape statistics reveal organization into a highly symmetric, central, and circular. Furthermore, in major hurricanes (maximum wind speeds greater than 111 mph) during the 2004-2012 period (n = 11 storms), a distinct pattern emerges with a significant ($p < 0.05$) number of storms displaying a redistribution to the moisture budget during a window beginning 12-24 hours before landfall. As the TCs approach land and move inland, precipitation becomes more dispersed from the TC center but the overall structure maintains a cohesive, although asymmetric, pattern. Based on these findings, TC structural evolution needs to be closely monitored in conjunction with large-scale moisture availability in order to more accurately forecast the scale and spatial distribution of TC wind and water impacts.