Book of Abstracts

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Sustainable Water Resources

Complex Challenges, Integrated Solutions

Progress Energy

UF UNIVERSITY of FLORIDA

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Category: Hydrologic, biogeochemical and ecological processes
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Conditional Markov Mixture Models for Seasonal Rainfall Simulation

Markov mixture models (also known as hidden Markov models) have been successfully used to simulate both stream flow and rainfalls at daily and annual time scales. The models simulate a time series by switching between different unobservable (hidden) climate states and sample the parameters of interest from the distribution that is specific to the state. Then the transition probability would be used to progress through time. At a monthly time scale, their applications is limited because seasonally presents another set of challenge. One of the approaches that was used to solve the seasonality problem is by fitting individual mixture models for each seasons and simulate the time series using the entire suits of models. Such a solution even though enable one to reproduce the long-term behavior of the time series, there is no mechanism to make a conditional (short-term) simulation as there is no explicit link between two time steps, say, Jan to Feb. Each time step belongs to different season, hence, different mixture model. Here we suggest a methodology that is based on a posterior that modifies emission probabilities for each season based on previous month's observations. Previous month observation could be rainfall or some exogenous variable such as sea surface temperature anomaly. The results show a promising application of conditional Marko mixture models for short-term monthly rainfall simulation. Key words: Mixture Models, Conditional Simulation, Rainfall

Abrams, Robert

Authors: **Robert Abrams**, Florida Agricultural And Mechanical University College of Law

Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 2

Is Control of the ACF's Waters Properly Allocated?

At present, the United States Army Corps of Engineers operates the major water control structures on the ACF. The Corps does so under several different mandates, all of which date back fifty or more years. No considered or overarching federal water policy is in place to guide the Corps. Despite the acknowledged primacy of the states as managers of their natural resources, there is no effective state water planning regime that addresses the ACF in any of the basin states, far less any coordinated planning and policies for water allocation in time of shortage. Modern climatological conditions have added stresses to the system and urgency to the need for a better planning and control mechanisms to manage the basin's waters. That management system would put the states more in control of the resource and harmonize the operation of federal facilities with properly promulgated state and multi-state planning.

Abutayeh, Mohammad

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Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Sustainable Desalination

A flash desalination process sustainable by the natural forces of solar radiation and gravity has been proposed. The proposed process involves flowing seawater through solar collectors upon flashing it under vacuum in an elevated chamber where the hydrostatic pressure of the elevated flash chamber is balanced by the atmospheric pressure of the ground holding tanks. Theoretical simulations were performed using a meticulous computer code built from the fundamental thermodynamic relationships setting it apart from previous empirical correlations of conventional flash desalination systems. In addition, experimental simulations were carried out to validate the developed model using a small pilot unit depicting the proposed desalination system.

Adams, Bruce

Authors: **Bruce Adams**, EMC Engineers, Inc.

Category: Managing water and energy in a transitioning environment
Session Title: Managing Water and Energy in a Transitioning Environment

Energy and Water Conservation- Uncovering the Hidden Industrial Opportunity

As both water and energy conservation programs are developed throughout our region, an enormous source of integrated effort has been overlooked. Nearly 20% of a municpality's energy demand is tied to the full cycle of water and wastewater processing. Designing efficiency programs for water utilities which analyze both the utility's operation, as well as the energy savings associated with a comprehensive water demand management plan, can yield both cost savings and water waste reduction, as well as reduce greenhouse gas emissions. Hundreds of local governments are developing energy strategies using ARRA funding, and can “double” their program's effectiveness by integrating a comprehensive water demand management plan into their strategy. This presentation will seek to challenge the Symposium's attendees to consider the extra benefits of an integrated resource conservation approach. Examples of current local efforts, throughout the Nation, will be included in the presentation.

Ammerman, David

Authors: **David Ammerman**, AECOM

Category: Optimal use of integrated water supplies
Session Title: Use of Reclaimed Water

The Changing Role of Reclaimed Water

Just 20 years ago effluents from municipal wastewater treatment represented a disposal problem. As effluent flows increased with increasing populations the levels of treatment required became more stringent to avoid overwhelming the assimilative capacities of receiving water bodies. In some locations new or continued discharges could not be permitted regardless of the effluent quality provided. These pressures drove the implementation of land application systems as an alternative to surface water discharge. Early systems sought to apply as much water as possible to a given area to maximize the disposal capacity. Over time the focus of these programs shifted from a focus on disposal to one of beneficial reuse. Starting with agricultural sites and golf courses reclaimed water originally sent to land application systems was diverted to beneficial uses. The Florida Department of Environmental Protection (FDEP) modified the State's regulations to embrace and encourage these beneficial uses and Florida now reuses 660,000,000 gallons of reclaimed water per day, more than any other state. Based on the most recent reuse survey 59% of this water is used for urban irrigation. This includes golf course, parks and single family homes. Other important uses include agricultural irrigation, industrial uses and ground water recharge. Having proven its ability to conserve potable water supplies the roll of reclaimed water is now changing again. While once exclusively under the authority of the FDEP the State's Water Management Districts are now developing rules that encourage and in some cases require the use of reclaimed water as a means of reducing demands of traditional potable water supplies. This presentation will review the changing role of reclaimed water over the last 20 years and discuss some of the regulatory and technical challenges faced by utilities implementing reuse programs.

Arnold, Jennifer

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Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Examining the social dynamics of conflict and collaboration: A critical analysis of discourse surrounding sustainable riparian management in the southwestern US

In an attempt to reduce riparian conflicts on a National Forest in northern Arizona, a series of workshops were professionally facilitated to encourage discussion of riparian issues among diverse stakeholders, including ranchers and agency staff. Underlying this collaborative approach to natural resource management is the concept of social learning, which explains that individuals with alternative worldviews can engage in dialog to learn from each others' differences and constructively manage conflicts to arrive at mutually acceptable, innovative solutions to complex socio-ecological problems. Alternative worldviews and their associated language and culture are referred to as social discourses. As conflicts become entrenched, opposing social discourses may become more distinct, even mutually exclusive, inhibiting learning and dialog, whereas constructively managed conflicts may contribute to the development of overlapping or hybrid social discourses that encourage dialog. This study uses critical discourse analysis, which combines ethnography and qualitative analysis of "language in use," to examine how workshop participants use language, including different forms of dialog and monolog, to manage social relations that contribute to conflict and/or collaboration. Preliminary findings indicate that despite the outward appearance of a diversity of stakeholders at the workshops and swift pronouncements of "successful collaboration" by workshop organizers, workshops reinforced divisions between opposing social discourses on riparian issues, identified as "managed landscapes" and "resource protection." Workshop organizers, facilitators, and participants primarily supported the "managed landscapes" discourse with limited space given to the "resource protection" discourse indicating that the workshops served more as a force for coalition building within the "managed landscapes" discourse than for collaborative conservation or conflict resolution. These findings were presented to workshop organizers to encourage critical awareness of their use of discourse as they plan future collaborative activities. This research suggests that issues of diversity and dialog must be closely considered when designing and evaluating collaborative conservation efforts.

Artur, Adriana

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Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Water Use Efficiency by Marandu Palisadegrass as Affected by Nitrogen and Sulphur Fertilization

Water is a renewable resource, but its availability is variable and limited in many parts of the world. Thus, it is important to develop management alternatives that improve water use efficiency in agricultural systems to minimize the conflict between agriculture and urban societies for limited water resources. The objective of this study was to evaluate the effects of various N and S application rates on water use efficiency by Brachiaria brizantha cv. Marandu (Marandu palisadegrass). The experiment was conducted under greenhouse conditions, in Piracicaba, Sao Paulo State, Brazil from September to December, 2008. Soil was an Entisol that exhibited low organic matter content (0.95%), pH CaCl2 = 4.0. Treatments consisted of fractionated factorial combination of five N rates (0; 100; 200; 300; and 400 mg dm-3) and five S rates (0; 10; 20; 30; and 40 mg dm-3) with four replications. Aboveground forage biomass was harvest at 28-d intervals. The first harvest occurred 35 days after seedlings were transferred to the pots. Soil moisture was maintained at 70% of soil retention capacity by irrigation system. Water use efficiency was calculated by dividing the water consumption and the dry mass produced during each growing period. Maximum water use efficiency of the Marandu palisadegrass was obtained with 219 mg dm-3 of N during the first 35 days. N and S rates that promoted maximum water use efficiency were 311 and 29 mg dm-3, respectively, for the second growing period and 292 and 30 mg dm-3, respectively, for the third growing period. Greater dry mass production per unit of water consumed was obtained when Marandu palisadegrass received increasing rates of N and S fertilization.

Asefa, Tirusew

Authors: **Tirusew Asefa**, Tampa Bay Water
Alison Adams, Tampa Bay Water

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

A "Predictor-Correct" Framework for Aggregating Nino3.4 Forecasts for use in Local Rainfall Simulations

Abstract. Nino 3.4 (120 – 170W and 5N- 5S) Sea Surface Temperature (SST) anomalies are the main indicator of ENSO states. Since January 2005 the International Research Institute (IRI) of Columbia University compiles Nino3.4 forecasts from several Dynamical and Statistical models. These models forecast SST anomalies from three to nine overlapping 3-month periods. Tampa Bay Water uses these forecasts to make seasonal rainfall probability forecasts based on a contingency table that was derived using over 100 years of SST anomalies and rainfall data. Given the forecasted state of ENSO, it is then possible to derive the local seasonal rainfall probabilities. These results are then used to make seasonal water resources management decisions such as stream withdrawals and reservoir operations and maintenance shut downs. However, the expected skills of each of the 22 ENSO model forecasts, based on historical performance, are not the same. At times the variation of the forecasts ranges from La Nina (anomalies less than -0.50C) to El Nino (those above 0.50C) conditions making their practical use limited and uncertain. Here, we propose a "predictor-corrector" framework that aggregates ENSO model forecasts based on recent performances of each model compared to observed values of SST anomalies for use in rainfall simulations rather than the simple arithmetic average that the IRI currently provides. The results will reduce the seasonal forecast uncertainty for rainfall and improve resource use decisions.

Austin, Barney

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Numerical Modeling for Environmental Flow Studies: A Case Study of the Brazos River System (TX)

Assessing environmental flow needs in streams, rivers, bays, and estuaries often requires the use of numerical models to simulate water movement, and nutrient and sediment transport. For example, numerical models may be used to determine the relationship between flow and available habitat in streams, which may then be used in developing instream flow requirements. Flow requirements for estuarine health are often related to salinity levels, distributions, and fluxes for which general circulation models of estuarine currents and freshwater inflows are required.

Numerical hydrodynamic models differ in the number of dimensions (1-D, 2-D, or 3-D) in which water movement is simulated, and in how each model represents the physical environment. For typical environmental flow studies, environmental systems are studied holistically using lower-resolution models, with representative portions of the system studied in detail with higher resolution models. For example, two-dimensional models of portions of the Brazos River (TX) were developed to determine mesohabitat suitability for numerous species including the red shiner (Cyprinella lutrensis) and western mosquito fish (Gambusia affinis) under a variety of flow conditions. The results from these models were then extrapolated upward to the entire river system, for which the flow regimes were modeled and characterized with the 1-Dimensional model HEC-RAS. Results from the 1-D and 2-D models of the river were then used as input to a 3-D simulation of the Brazos River estuary, in order to assess the relationship between freshwater inflows, estuarine salinity distributions, and shellfish habitat suitability. Additional 1-dimensional modeling efforts were performed to determine the frequency and duration of water exchanges between the mainstem Brazos River and adjacent oxbow lakes, linking such exchanges to breeding habitat preferences for Brazos River fauna.

This poster presents a case study of the Brazos River-Estuary system, as an example of how INTERA employs numerical modeling in environmental flow assessment projects. INTERA staff have undertaken such efforts in many basins across the US and abroad, and have been deeply involved in the development of the methodology for determining environmental flows in Texas.

Banger, Kamaljit

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Nitrogen Forms in Streams Draining Agricultural, Urban, Mining, and Pasture Sub-Basins of the Alafia River Watershed, Florida

Non-point source pollution is the dominant pathway of nitrogen (N) loss in agricultural but also in urbanized watersheds. Nitrogen is the limiting nutrient for phytoplankton production in the Tampa Bay estuary, Florida, therefore understanding the contribution of different land uses to N loss is essential to devise strategies to prevent coastal eutrophication. In this study we determined the concentrations of inorganic and organic N forms in stream waters draining six sub-basins, ranging in size from 19 to 320 km2, of the Alafia River watershed (total drainage area: 1085 km2). The sub-basins were classified as: one urban (60% residential, 18% forest, 5% cropland), one pastureland (47% pastureland, 27% forest, 3% residential), two agricultural (32–42% cropland, 14–18% residential, 12–13% forest), and two mined land (43–48% mined lands, 2–16% residential, and 12–16% forest). We collected water samples at weekly intervals during April–October 2009 from streams draining these six sub-basins. No significant variation in the pH (7.0–7.3), EC (0.2–0.5 dS m-1), and dissolved oxygen (5–6 mg L-1) were observed during this period in all sub-basin stream waters. Total N (TN) concentrations ranged from 2 to 3 mg L-1 and were greatest in the agricultural sub–basins (2.8–3.0 mg L-1), followed by the urban (2.6 mg L-1), mined (2.3–2.8 mg L-1), and pastureland (2.0–2.3 mg L-1). Organic N forms dominated in all sub-basin stream waters (1.7–2.0 mg L-1; 58–88% of TN) while inorganic N ranged from 0.25 to 1.25 mg L-1 (11–42% of TN). Organic N was greater in pastureland (86–88% of TN) as compared to other sub-basins (58–76% of TN). Nitrate-N was the major inorganic N form in all the sub-basin stream waters except for the pastureland and was greatest in agricultural (0.7–1.0 mg L-1; 85–90% of inorganic N) followed by urban (0.6 mg L-1; 85%), and mined (0.5–0.6 mg L-1; 83–90%) and pastureland (0.1–0.2 mg L-1; 41–65%). In contrast, the proportion of ammonium-N was greater in the pastureland sub-basin (0.11–0.15 mg L-1; 35–59% of inorganic N) than either the agricultural, urban, or mined sub-basins (0.07–0.19 mg L-1; 10–17% of inorganic N). The greater nitrate-N concentration in agricultural sub-basin may represent runoff losses from inorganic fertilizers used in crop production while the increased abundance of ammonium-N in the pastureland may reflect more transformation and loss of mineralized N. Alternatively, lower nitrate-N concentrations in the stream waters may be attributed to high temperature and moisture availability in Florida, which accelerates vegetation uptake and turnover of N, as well as nitrate removal via denitrification. The overall high concentration of organic-N in stream waters is likely the result of abundant organic matter and animal waste in pastureland sub-basin, leaves and grass cuttings in urban sub-basin, and the wastewater disposal in one of the mined sub-basin. The lower loss of N as nitrate-N in urban sub-basin is surprising and contradicts the common assumption that high fertilizer N use results in greater N losses. However, it is important to note the urban hydrology in this watershed is significantly altered due to the presence of a series of retention ponds in urban areas and clay settling ponds in mined sub-basins, so it likely that N forms undergoes a series of transformations before their delivery to streams.

Barnes, Jenifer

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Category: Managing water and energy in a transitioning environment
Session Title: Incorporating Climate Predictions into Water Planning and Management

Potential Impact of Climate Change and Sea Level Rise on the Everglades

With the recent emphasis on climate change and the associated sea level rise, significant questions have been raised as to their impact on the restoration of the Everglades in southern Florida. Projections of precipitation and temperature changes as well as sea level rise are highly uncertain at regional levels and the range of changes demonstrated by the General Circulation Models (GCMs) is significant. Since the investment on the proposed restoration effort is extremely high, understanding the impacts of climate change and sea level rise on the ecosystem response is very important. Until more certain regional climate models and/or statistical downscaling methods become available, a vulnerability analysis of the Everglades system to climate change and sea level rise was investigated using a scenario based approach. A Bayesian technique was used to combine an ensemble of GCMs to produce a probability distribution of potential changes to both precipitation and temperature. Using these ranges as a guide, a regional scale, distributed hydrologic model was used to investigate ecosystem response to climate change and sea level rise using hydrologic surrogates. The performance measures include stage-duration curves, inundation frequencies and an analysis of extremes.

Barreto, Thales

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Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Physiological and Yield Response of Bell Pepper to Automated Soil Moisture Sensor Controlled Drip Irrigation

The objectives of this study were to evaluate the effect of automated soil moisture sensor irrigation control on photosynthetic rate (PH) and yield of green bell pepper. The field experiment was conducted during spring 2009 in Citra, FL. The crop establishment period was characterized by application of 3 mm/day to all treatments during the first 21 days after transplanting (DAT). Irrigation treatments were set at a specific threshold of volumetric-water-content (VWC) which was allotted five irrigation windows/day and bypassed events if the VWC exceeded the established threshold. The target threshold of the treatment was 0.12, 0.08 and 0.04 m3/m3 VWC, for SMS12, SMS8 and SMS4, respectively. The reference treatment was single fixed irrigation of 5.5 mm/day event (TIME). After the onset of irrigation treatments PH was measured with LI-6200 system. At end of the season, the depth of irrigation applied to each treatment was: 21, 103, 133 and 174 mm for SMS4, SMS8, SMS12 and TIME, respectively. The average of PH during the vegetative and reproductive stages was 15.4, 16.4, 23.7 and 24.9 µmol/m2/s for the same order above. There was no difference in PH for SMS12 and TIME treatments, while SMS8 and SMS4 showed a significant reduction in PH due to the reduced irrigation depth. The marketable yield was 15.8, 24.8, 29.1 and 25.4 Mg/ha for SMS4, SMS8, SMS12 and TIME, respectively. High irrigation volume of TIME treatment resulted in appreciable water percolation captured in the lysimeters, which did not occurr in SMS treatments. The SMS12 treatment, in which the threshold was close to soil field capacity significantly reduced the amount of irrigation water, soil water percolation and nitrate leaching.

Baum Haley, Melissa

Authors: **Melissa Baum Haley**, Department of Agricultural Biological Engineering, University of Florida
Michael Dukes, ABE, University of Florida

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Survey of Residential Water-wise Irrigation Practices and Perceptions

Much research has been conducted proving the effectiveness of technology in reduction of lawn/landscape water use. However, studies are primarily conducted in controlled or semi-controlled settings. When attempting to incorporate recommendations into residential arenas, savings are not as significant. In order to effectively change behavior, factors that contribute to perceived attitudes of homeowners must be considered. A mail-out questionnaire was used to determine public awareness, if/why watering restrictions are followed, and influence of water source. Approximately one thousand survey packets were mailed following the Multi-wave Method. The final response rate was 25%, yielding 272 completed and usable questionnaires, evenly distributed amongst the three water sources designations (potable, reclaimed, and well). Each respondent was offered an incentive, to be sent, of either an indoor or outdoor water conservation kit. By analyzing the irrigation practices, the questionnaire can be utilized to determine an irrigation proficiency level. In terms of the measurability of pro-environmental competency, the inference of proficiency level can be attained by regression model and factor analysis. Questionnaire responses were evaluated using SAS. The results presented here represent the survey analysis and the following significant barriers and benefits were identified: Misunderstanding of plant water needs; seasonal scheduling, Terminology in reference to rain shutoff device, Conservation relating to water source, Reliability of rain shutoff device, Expressed room for improvement and interest learning, and Influence of property value or property size.

Becker, Thomas

Authors: **Thomas Becker**, Lee County Extension, IFAS, University of Florida

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Making Every Raindrop Count

Objectives: Recently enacted Florida-Friendly Landscaping™ legislation forbids prohibitions on outdoor practices designed to improve water quality, conserve water and reduce non-point source pollution. Heavy rainfall in Lee County, typically 30-40 inches of rain falls from April to November each year, contributes to the problems of urban fertilizer nutrient leaching and polluting neighborhood stormwater runoff. Homeowners typically can adopt two basic stormwater 'source-control' Best Management Practices (BMPs): rainwater harvesting and earth-shaping filtration techniques using native shrubs, trees, wildflowers and ornamental grasses. Both methods will hold or absorb pollutants including decaying organic matter and roof sediments, soil or rooftop nutrients, heavy metals, petroleum hydrocarbons, pathogens and other common pollutants. In Lee County, over 80% of Florida-Friendly landscapes and yards use one or more of these at-the-source control techniques. As a result, the agent began showing residents 'how to' construct rain barrels for their homes and 'how to' design and plant a rain garden. Methods: Starting in early 2007, the agent created workshops, a homeowner's manual and a 22 minute DVD addressing 'local' rain barrel and rain garden concerns, including proper management and maintenance on both. Results: From February, 2007-October, 2009, 1270 rain barrels were constructed for 1620 Lee County resident. The estimated total water collected to date using the barrels, 840,000 gallons, would fill 57, 28' x 14' swimming pools. Conclusions: After multi-year instruction and outreach, state public policy initiatives, green building and community stormwater initiatives, Lee Counties hands-on rain water source control and rain garden demonstration techniques are helping achieve permanent behavior change by residents and helping to meet stricter watershed and stormwater treatment objectives.

Bena, Daniel

Authors: **Dan Bena**, PepsiCo

Category: Opening Plenary Session
Session Title: Plenary Session

The Water Crisis: Global Scourge, Opportunity, or Both?

This plenary address will provide an industry perspective from a major multinational consumer products company on the impact of the myriad global water crises on its business and on its consumer base. Since the magnitude of the problems we face cannot be solved in the near term, the speaker will share some key insights into a Strategies and Scenarios project the company conducted which looks forward two decades into the future, and how water will impact the success or failure of the company in 2030. In addition, the audience will hear examples of how innovative steps are being taken now to turn what is admittedly a grave crisis into genuine collaborative opportunities for the business, the planet, and the people whose lives depend on it.

Betz, Jasmine

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Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Riparian Rule in Florida and Georgia's Waterways: How a dated system is exhibiting signs of stress

As we enter the twenty-first century, mankind has begun to maximize his demands for potable water. While transboundary water resource management is predicted to become a pressing issue with looming climate change predictions, resolving issues along state, national and international lines continues to be the best method for remediation (1). One source of possible contention is the legal interpretation of riparian rule, which traditionally gives riparian landowners a protected right to withdraw and use water from water bodies adjoining their lands with reasonable riparian use, which includes the stipulation that a riparian landowner may not unreasonably interfere with another riparian's use (2). Water use in Florida is expected to increase by almost 30 percent from 7.5 billion gallons a day in 2000 to approximately 9.1 billion gallons a day in 2020 and Georgia is already experiencing extreme water shortages around the Atlanta area with a metropolitan population explosion (3, 4). Divergence in the interpretation of riparian rule between the states could send water rights negotiations along state lines into a tailspin such as with the decades of litigation surrounding the Apalachicola-Chattahoochee-Flint dispute. In the following article, the significant differences between Florida and Georgia's riparian rule are assessed via analysis of significant court rulings, law reviews and news publications and areas of divergence that warrant remedy to ease future interstate water relations are identified.

Bhadha, Jehangir

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Phosphorus retention characteristics of aluminum-based water treatment residuals for use in permeable reactive barriers

Intensive phosphorus (P) management is necessary to reduce total P loading within the Lake Okeechobee Basin. Permeable reactive barriers (PRBs) are a groundwater remediation technology that utilizes a reactive wall to passively intercept contaminants, such as P from groundwater before being rapidly transported to Lake Okeechobee via ditches. Drinking water treatment residuals (WTRs) are by-products of chemical salts such as aluminum that are ideal for use in PRBs due its affinity for P, availability, and low cost. We hypothesize that the contact time between PRB media and P-laden groundwater to be limited during high rainfall events accompanied by rapid lateral groundwater movement, thus evaluating short-term (99% of P in solution was adsorbed by the Al-WTRs within 2-h of the experiment, suggesting minimal kinetic limitations to P retention in PRBs. The four Al-WTRs were qualitatively classified into cake (65 % solids). The gravel-like Al-WTRs were dry fractionated into four size fractions: > 2.0, 0.25-2.0, 0.045-0.25, and

Bhomia, Rupesh

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Soil nutrient storages in the Stormwater Treatment Areas of the Everglades basin.

Stormwater Treatment Areas (STAs) are constructed to reduce phosphorus (P) loads to the Everglades Protection Area (EPA). Six STAs (45,000 acres) were strategically located to reduce P loads to EPA. These STAs have been in operation for varying time periods ranging from 4 to 15 years and are differentiated into cells having emergent and submerged aquatic vegetation. We have used the existing soil chemical data collected by the South Florida Water Management District to determine the capacity of STAs to store P, nitrogen (N), carbon (C). Relationship between C and N storages relative to P was explored for samples collected during water Year 2007 (May, 2006 – April, 2007). The range of C sequestration with respect to P varied from 444 g C/ g P (STA-5, 9 years) to 594 g C/ g P (STA-2, 8 years) in the floc and top 10 cm soil layer. The range of N sequestration with respect to P varied from 46 g N/ g P (STA-1W, 13 years) to 31 g N/ g P (STA-1E, 3 years) in the floc and top 10 cm soil layer. Surface soil accretion represents only recently accreted material and does not represent total accretion since its operation, especially in STAs operated for longer periods. However, in the recently constructed STAs, the 10 cm soil layer may represent historical TP and TC storage. Understanding the rate of soil accretion and identifying factors responsible for long term stability of this sequestered material forms the next step of this research activity.

Bilenky, William

Authors: **William Bilenky**, Southwest Florida Water Management District

Category: Optimal use of integrated water supplies
Session Title: Use of Reclaimed Water

An Alternative Strategy for Water Supply and Water Resource Development in Florida

The paper explores an alternative water supply development strategy that will result in the reduction of dissolved nutrients in tertiary wastewater discharges while creating a drought resistant sustainable source of potable water supply. It suggests that the use of RO processed wastewater to drinking water standards is absolutely essential in meeting future water supply needs. It estimates that the cost of further treatment to drinking water standards approximately 70% of the cost of desalination of saltwater. It discusses the advantage of RO treatment facilities being co-located, when practical, with tertiary treatment plants to minimize the cost of effluent disposal. The optimal solution to the discharge of effluent concentrate is to return it to the wastewater treatment plant where it is combined with and disposed of with the plant's other effluent. It discusses other locals where RO treated waste water has been used for water supply. The paper discusses the advantages of Regional Water Supply Authorities (RWSA) and rate setting concepts that will better balance revenues and costs and encourage water conservation and why local governments should consider forming RWSA. There is a discussion on the legal ownership of treated wastewater and the terms economically, environmentally and technically feasible when applied to the use of reclaimed water. Finally, the paper discusses the appropriate role of the water management districts in the funding of water resource projects as contrasted with water supply projects and recommends for consideration a project using Howard F. Curren treated wastewater to supplement potable supplies for Tampa Bay Water. It lists a series of areas where additional research should be conducted and provides a recommendation for future water supply development in Florida.

Blanchard, Becky

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Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 2

Working on the Water: Oystermen, Environmental Flows, and Cultural Survival in the ACF Basin

While water management agencies list cultural values among recognized water uses, these are often vaguely defined and excluded from decisions in favor of more easily commensurable environmental and economic values. However, in highly contested watersheds such as the Apalachicola-Chattahoochee-Flint (ACF) basin in the southeastern United States, protracted water conflict creates uncertain decision making processes characterized by venue shifting and coalition politics. As this case illustrates, such crises may provide opportunities for public discourse on water and culture. This poster describes ongoing fieldwork investigating how Apalachicola Bay oyster harvesters articulate and mobilize culture in order to claim rights to freshwater flows in the ACF basin. Working in coalition with environmentalists and the state of Florida, oystermen strive to put a human face on so-called environmental flows. Notably in a region undergoing urbanization and gentrification, this is a rural, working class face. Drawing from theorization of blue-green coalitions and from evidence gathered through interviews and participant observation, I describe the promises and perils of oystermen's political work, as the implications of linking cultural survival and environmental flows for the ACF basin and other linked coastal-watershed systems.

Block, Paul

Authors: **Paul Block**, Intl. Research Institute for Climate and Society-Columbia Univers

Category: Managing water and energy in a transitioning environment
Session Title: Incorporating Climate Predictions into Water Planning and Management

Tailoring seasonal climate forecasts for hydropower operations in Ethiopia's upper Blue Nile basin

Explicit integration of seasonal precipitation forecasts into water resources operations and planning is practically nonexistent, even in regions of scarcity. This is often attributable to water manager's tendency to act in a risk averse manner, preferring to avoid consequences of poor forecasts, at the expense of unrealized benefits. Convincing demonstrations of forecast value are therefore desirable to support assimilation into practice. A dynamic coupled system, including forecast, rainfall-runoff, and hydropower models, is applied to the upper Blue Nile basin in Ethiopia to compare benefits generated by actual forecasts against a climatology-based approach, commonly practiced in most water resources systems. Processing one hundred decadal sequences demonstrates superior forecast-based benefits in 68 cases, a respectable advancement, however benefits in a few forecast-based sequences are noticeably low, likely to dissuade manager's adoption. A hydropower sensitivity test reveals a propensity toward poor-decision making when forecasts over-predict wet conditions. The forecast is therefore tailored to emphasize its skill in predicting the dry tercile, subsequently improving reliability to 96-percent. Such tailoring potentially provides strong incentive to risk-adverse water managers cautious to embrace forecast technology.

Bohrmann, Thomas

Authors: **Thomas Bohrmann**, University of Florida
Mollie Brooks, University of Florida
Andrew Hein, University of Florida
Forrest Stevens, University of Florida
Joseph Luchetti, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Modeling hydrology and its effects on Florida Scrub jay on the Lake Wales ridge

Florida's Lake Wales ridge is one of the few remaining habitats available for the Florida scrub jay (Aphelocoma coerulescens), a threatened species endemic to Florida. While the scrub jay has been the subject of intensive demographic research for more than 50 years, many of the environmental drivers of jay demography are still poorly understood. The long-term goal of our research is to connect climatic and hydrological patterns with resource and disease dynamics, in order to understand the ultimate causes of changes in jay demography. In order to achieve this goal, we are building descriptive hydrological models of pond depth and hydroperiod at Archbold Biological Station, combining long-term weather and groundwater data with shorter-term (20-year) time series on water depth in a subset of 25 ponds on the reserve. We are developing a series of models that range in their detail and level of mechanism from simple statistical models to physical models based on groundwater, infiltration, and evapotranspiration. By building predictive models for the pond data, we will be able to use climate data to extrapolate hydrological patterns spatially over the entire reserve (200 ponds) and temporally both historically (back to the 1950s, when the demographic data sets begin) and into the future, using predictions of future climate patterns.

Bolson, Jessica

Authors: **Jessica Bolson**, University of Miami

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

System dynamics for integrated water resource management: Applying a group model building methodology to test learning from a system dynamics water balance model in South Florida

Water resource management in South Florida is a complex and challenging undertaking. Changes in population, land use, agricultural requirements and climate variability and change contribute to the complexity of future planning. State, regional, and local water managers need scientific guidance in planning to cope with uncertain future challenges. System dynamics approaches can help meet this need by understanding how systems change over time by running "what if" simulations to test certain policies. A stakeholder based system dynamics water model was designed for the South Florida Water Management District. I applied a group model building approach to test the effectiveness of the approach to affect stakeholder thinking about complex management problems. Project outcomes described include the effect of system dynamics group model building on systems learning, the identification of stakeholder needs for information, a description of the scenarios discussed, and additional insights that emerged from the process.

Bongiovanni, Tara

Authors: **Tara Bongiovanni**, Department of Agricultural & Biological Engineering, University of Florida
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Dorota Haman, Professor and Chair, Agricultural and Biological Engineering Department, Univ. of Florida,

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Crop Curves of Sweet Corn Using Eddy Covariance Technique in North Central Florida

Florida's sandy soil, temperature, and rainfall produce unique conditions for crop growth. Throughout a growing season, a crop will experience different water needs, typically shown by a crop curve. Crop curves for water consumption are used for irrigation scheduling to use water more efficiently. Potential or reference evapotranspiration (ET0) along with crop coefficients are required to develop crop curves. In this study, we develop crop curves for sweet corn grown in North Central Florida using three seasons of observations during our Microwave Water and Energy Balance Experiments (MicroWEXs). During the MicroWEXs, we observed micrometeorological, soil, and vegetation conditions. An Eddy covariance system was used to obtain actual crop ET and the Penman-Monteith (PM) method was used to estimate the ET0 for the three growing seasons. The PM method is also employed by the Food and Agricultural Organization (FAO). We compare our daily and weekly values of the crop coefficients (Kc) during the three seasons with those obtained using the FAO methods. We also investigate the relationship of the Kc values to cumulative growing degree days and leaf area index during the seasons. This study demonstrates the use of the eddy covariance technique to estimate Kc for different crop types by providing frequent measurements of ET during the growing season.

Borisova, Tatiana

Authors: **Tatiana Borisova**, University of Florida
Colin Rawls, University of Florida
Shirish Rajbhandary, University of Florida

Category: Optimal use of integrated water supplies
Session Title: Water Conservation and Demand-Side Management

Conservation-oriented residential water rates: state-of-the art practices and future research needs

Implementation of conservation-oriented water rates (i.e., rates that provide economic incentives to conserve water or use it more efficiently) is identified as a top priority by several Florida visionary programs and policy initiatives (e.g., Florida 2030, Conserve Florida Water, and 2010 St Johns River Water Supply Plan). However, a number of questions remain open. What operational criteria can be used by utilities and policy-makers to define or evaluate conservation-oriented rate? Can water conservation be promoted without impacting utilities' revenues? How can higher water rates be implemented with minimum impact on low income/low use customers? Objectives: 1) summarize state-of-the-art practices in conservation rate design; 2) evaluate water rate structures used in Florida; 3) examine barriers for conservation-oriented rate in Florida; and 4) suggest a research agenda to facilitate conservation-oriented rates in Florida. For the first objective, we examine policies that define and evaluate "conservation-oriented" rates in various states and other countries. For objective #2, we evaluate 66 residential water rates used by Florida utilities in 1998 – 2003. Specifically, we compare the rate structures according to: a) water conservation incentives; b) utility revenues; c) water affordability for low-income / low use customers; and d) fairness toward different customer groups. The analysis is based on the dataset by Whitcomb (2005) and Unel (2009). For objective #3, we examine utility managers' attitudes toward conservation-oriented rates (survey by Adams and Borisova 2009) in comparison with other water demand management strategies (such as irrigation restrictions and customer education). Finally, a research agenda is proposed to address remaining gaps in our knowledge about effects of water rates design on water use.

Bottcher, Del

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

Category: Integrating science and policy for improved water management
Session Title: Monitoring and Modeling Hydrologic Processes

Watershed Modeling for Water Resource Assessments

Watershed models have proven to be useful tools for assisting water resource and regulatory agencies in their decision making. A good example is the Federal requirement for total maximum daily load (TMDL) development for numerous listed water bodies in Florida. TMDLs require assessments of water quality and quality responses for predevelopment, existing, and future (abatement strategies) conditions, which can only be achieved through modeling. A summary of such assessments within Florida using the Watershed Assessment Model (WAM) will be presented. Recent studies in the Northern Okeechobee, Upper Peace River, and Rainbow Springs basins will be highlighted.

Brandt-Williams, Sherry

Authors: **Sherry Brandt-Williams**, St. Johns River Water Management District
Robert Godfrey, Idea Integration
Erich Marzolf, SJRWMD

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Reuse Water in the Middle St. Johns River Basin Watershed

Redirecting wastewater treatment plant effluent from direct discharge into rivers and lakes to reuse systems is a valuable practice in this era of water supply concern. It reduces stress on aquifers and reduces nutrient loads to increasingly impaired water bodies. However, reclaimed water can have extremely high phosphorus concentrations. Nitrates and TN are also higher than most rivers, lakes and estuaries can assimilate. Combined with high irrigation rates, reuse can generate substantial nutrient loads to waterbodies. Nutrient impairment harms both natural ecosystems and human uses of these systems. One example of the magnitude of phosphorus loading to the state's waters is found in the Lake Jesup watershed, a large, nutrient-impaired water body along the St. Johns River. A reclaimed water irrigation rate of one inch twice per week has an estimated annual runoff of five metric tons of phosphorus into the lake. This load is equivalent to ~60% of the reduction required under the current TMDL for Lake Jesup. In this poster, quantitative GIS and reclaimed water flows and concentrations are used to estimate nutrient loads and runoff for the entire nutrient-impaired Middle St. Johns River basin. In the current climate of concern about water supply, the use of reclaimed water for irrigation is an important means to reduce potable water demand. However, because of the potential for excessive nutrient runoff due to over fertilization (resulting from the combination of reclaimed water and regular lawn fertilization), recommended fertilizer applications should be reevaluated and consumers educated how they can save money by using less fertilizer. Further, wastewater utilities should be encouraged to improve treatment efficiency so that excessive nutrient loads distributed via reuse within watersheds and springsheds are reduced. Estimated loads presented will be beneficial in prioritizing this initiative.

Breuer, Norman

Authors: **Norman E. Breuer**, University of Miami / Southeast Climate Consortium
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Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Southeast Water Climate: science and stakeholder co-development of a decision support system to reduce climate risk in water management

Climate variability and change are factors that should be taken into account within the water management decision-making environment. The El Niño-Southern Oscillation phenomenon (ENSO) causes variations in precipitation and temperature in the southeastern United States. For ENSO to be taken into account by water managers, reliable scientific information must be available, accessible, accurate, and trustworthy. The Southeast Climate Consortium (SECC) has a history of providing climate information for adaptations in agriculture (www.agroclimate.org). Methodologies and lessons learned during the development of Agroclimate are being used to develop a web-based climate decision support system to mitigate risks in water management. The proposed website, www.sewaterclimate.org, is being built in a consensual manner by scientists from six universities in three states (FL, AL, GA) through an iterative process of consultation, feedback, and co-development with potential end-users. The decision support system will provide quantitative information on impacts of climate (especially El Niño), forecasts on drought and flood, evaporation, lakes levels, and stream flows. Key to the successful use of the decision support system by water managers are a series of tools that are currently under development. These include an evaporation tool, a drought monitor and forecast tool, and a stream flow calculator tool. The tools are planned to consist of interactive screens with default coefficients and pre-run results in a database. Stakeholders may substitute parameters for their geographical area and obtain site-specific outputs upon which to base management decisions. To this downstream interactivity and specificity is added an upstream component linking southeast water climate with regional and national water and drought sites such as the US Drought Monitor and the NIDIS Drought Portal. It is expected that this climate-water decision support system will become an integral reference for the National Oceanographic and Atmospheric Administration's (NOAA) nascent climate services division, and aid improved water management.

Burkart, Christopher

Authors: **Christopher Burkart**, University of West Florida
William Huth, University of West Florida

Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 2

Economic Value of Apalachicola River Flow

The Apalachicola Bay system supports extensive biological (fish and shellfish) resources that are dependent on the flow of freshwater from the Apalachicola River. While many variables affect the health and availability of these resources, one of the more important is a freshwater input that is, in part, determined by artificial control of upstream water flow. The link between variation in river flow and the health of scarce marine and estuarine biological resources suggests that optimal freshwater flow management requires a measure of the economic value generated by those resources. The influence of freshwater input on the economic value of the Apalachicola Bay fishery is estimated using data on market valuation and a survey of consumer willingness-to-pay for changes in the output of the fishery. Output changes include harvest rates, risk of foodborne pathogens, and other elements of harvest quality. Information on the fishery's economic value facilitates the assignation of value to flow rates into the system and can suggest a value-maximizing flow management regime. Deviation from economically efficient flow rates results in a loss of value to fishery consumers and producers. The primary focus is on oyster harvest, in particular the effects of salinity and temperature on both optimal oyster growth and coincident growth of the pathogen Vibrio vulnificus. Freshwater flow into the estuary has influences on both of these factors. Future work will involve measuring tradeoffs between upstream recreation value associated with Lake Seminole and flow value in the Apalachicola Bay fishery, with the aim of formulating regional value-based measures to inform surface water management. The perspective provided by this study is expected to contribute to the ongoing policy debate surrounding water resource allocation in the Apalachicola-Chattahoochee-Flint (ACF) river basin.

Cady, Pamela

Authors: **Pamela Cady**, University of Rhode Island
Thomas Boving, PhD, URI Dept of Geosciences
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Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

A Riverbank Filtration Demonstration Project on the Banks of the Kali River in southwestern India

Riverbank Filtration (RBF) is a water pre-treatment system used for decades in the temperate climates of Europe and the Unites States, but is mostly untested in monsoon climates where we find much of today's need for low cost, sustainable and safe water. By pumping a RBF well, river water is induced to flow through porous riverbed sediments. On the path towards the RBF well, dissolved and suspended contaminants, as well as pathogens, are removed or significantly reduced in number due to a combination of physical, chemical, and biological processes. A RBF demonstration system of four in-line wells was installed perpendicular to the Kali River in rural southwestern India. This 200 m3/second river receives polluted effluent from municipal discharge from a city of 53,000 and from one of India's largest paper mills. Currently residents of small downstream communities have no reliable source of safe water and largely depend on the polluted river for their water needs. This study assesses the RBF's capabilities in meeting the Indian drinking water standards, specifically in mitigating bacterial and metal contaminant loads. Additionally, silica and environmental isotopes are used to determine the percent contribution of surface water and groundwater to the RBF system, permitting calculation of percent change in pollutants in the river water, groundwater, and RBF water. Additionally, data from hydraulic and conservative tracer tests are used to determine travel times in the RBF system.

Carriger, John

Authors: **John Carriger**, Florida International University
Gary Rand, Florida International University
Tham Hoang, Florida International University

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 1

South Florida Water and Soil/Sediment Quality: Use of the U.S.EPA Ecological Risk Assessment Framework to Assess Potential Risks.

An overview of the application of the U.S. EPA's Ecological Risk Assessment (ERAs) framework to pesticide and metal exposures in South Florida ecosystems will be presented. ERAs were conducted for South Florida with a history of contaminant exposures to determine sites where potential risks exist and the trophic groups which might be at greatest risk. Investigations at the Ecotoxicology &; Risk Assessment Laboratory at FIU in aquatic and terrestrial ecosystems were also conducted to investigate the potential for contaminants of interest to cause adverse effects to populations of native species in South Florida. We examined the potential for: contaminants (pesticides, copper and other metals) to cause acute and chronic effects in phytoplankton, fish, invertebrates including the Florida apple snail, and also for the application of mosquito control insecticides to produce adverse effects in different life stages of butterflies. Recent work incorporated survival analysis from the public health and engineering fields to examine acute toxicity; spatial risks of contaminants; and realistic outdoor exposures with microcosms to investigate bioaccumulation and trophic transfer of copper.

Cathey, Anna

Authors: **Anna Cathey**, University of Florida
Rafael Munoz-Carpena, University of Florida
Gregory Kiker, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Global Sensitivity Analysis of a Rainfall-Runoff Model in a Largely Ungauged Watershed, Okavango Basin in southern Africa

The Okavango Basin and Delta comprises a unique hydrologic system in southern Africa that delivers an important flood pulse for wildlife and humans from humid Angola to arid Namibia and Botswana. The Angolan portion of the Basin contributes that vast majority of the rainfall and occupies 60 percent of the 192,500 km2 system. Hydrologic monitoring in Angola was suspended because of a civil war that took place between 1975 and 2002. As a result rainfall and flow data is unavailable for much of the contributing watershed. A hydrologic model of the Okavango Basin is especially important as management decisions concerning development in post-war Angola arise. The Pitman model, which is embedded in the GIS user interface SPATSIM, has been used to model the river flow in the Okavango River. This is a rainfall runoff model that was calibrated on 12 years of data and tested on an additional six years of data. Global uncertainty and sensitivity analyses were conducted through this research in order to quantify model reliability along with parameter importance. Each of the 41 input parameters in the Pitman model is examined for first and higher order sensitivities and the total model uncertainty is determined. The Morris Method is a qualitative sensitivity analysis technique that is used to screen the input parameters in order to detect those that are the most sensitive. The variance based extended FAST quantitative uncertainty and sensitivity analysis method is then used on the subset of most sensitive parameters. This global uncertainty and sensitivity analysis of the Pitman model in the Okavango Basin will aid managers, scientists, and modelers in making decisions regarding the risk of development scenarios and allocating monitoring resources as well as improve our overall understanding of the system.

Cavalieri, Ronald

Authors: **Ronald Cavalieri**, AECOM USA, Inc.
Kim Hoskins, Lee County Utilities
Marc Stonehouse, CDM, Inc.

Category: Optimal use of integrated water supplies
Session Title: Managing Integrated Water Supplies

Development of an Integrated Water Resources Master Plan for Lee County Utilities

This paper presents the alternative water resource configurations that will be evaluated and optimized for development of the Lee County Utilities (LCU) Integrated Water Resources Master Plan (IWRMP). The LCU is a large and complex public utility, which owns and operates a potable water supply treatment and distribution system; a wastewater collection, conveyance and treatment system; and an irrigation quality water distribution system. The utility includes six water treatment plants, seven remote potable water storage tanks and booster pumping stations, eight regional wastewater treatment plants, nearly 800 wastewater collection pump stations, and over 2,300 miles of buried infrastructure. The service area population is currently about 230,000 and is expected to grow considerably over the 20 year planning horizon. Generally, public utilities such as LCU have sought the least expensive source of water to satisfy their customer's needs. Because of higher treatment costs for surface water and brackish groundwater, most utilities (including LCU) have relied primarily on fresh groundwater for their water supply. However, the stress of Florida's rapidly growing population, and increased demands on environmental resources, have led to restrictions on further development of fresh groundwater withdrawals. The majority of future water needs must now be met through development of alternative water supply sources such as surface water, brackish groundwater, expanded use of reclaimed water, stormwater, seawater, and improved storage opportunities. The sustainability and reliability of the LCU future water supplies and construction of an integrated, flexible, and diverse water resource system are major objectives in the development of the IWRMP. The IWRMP will serve as the road map that the LCU will follow in order to ensure that reliable and sustainable water supply and sanitary sewer services are provided within LCU service areas. The scope of work for the project includes population and demand projections, water resource characterization, evaluation of improved storage opportunities including ASR and surface water storage, development of hydraulic models for pipe network analysis, determination of water quality goals and treatment options for each potential water resource and end use, development and evaluation of alternative water resource configurations including modeling for optimization of the recommended alternative, and an IWRMP Report. The Report will identify the water resource infrastructure improvements that will be needed to meet the LCU customer requirements in a timely and cost-effective manner.

Chakraborty, Debolina

Authors: **Debolina Chakraborty**, University of Florida
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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Tool to Evaluate Soil Phosphorus Release and Potential Effect on Water Quality

With excessive use of fertilizers, soil phosphorus (P) in agricultural lands has increased over years, contaminating adjacent water bodies. Lake Okeechobee has experienced accelerated eutrophication due to excess P loading in upland soils. Spodosols, which form the predominant soil order in Lake Okeechobee Watershed (LOW), are characterized by sandy textures, fluctuating water table, and spodic (Bh) horizons that underlie A and E horizons. Bh horizons could act as P sinks due to their high Al and Fe content. Environmental risk of P loss from soil horizons can be evaluated from P saturation ratio (PSR; molar ratio of P to [Al+Fe]), and soil P storage capacity (SPSC; calculated based on threshold PSR for a soil). SPSC is the amount of P that can be added to a given volume or mass of soil before the soil becomes an environmental concern. The objective of this study was to evaluate the efficacy of SPSC in prediction of P retention and release from Spodosols of LOW and hence its utility for hydrologic management to minimize water quality degradation. Eight Spodosol sites from the LOW were sampled by horizon. Water soluble P was determined using 1:10 soil:water ratio. Soils were analyzed for P, Fe and Al in Mehlich 1, Mehlich 3 and oxalate solutions at 1:4, 1:8 and 1:50 soil:solution ratios, respectively. Results indicate that surface horizons have minimal P retention capacity, thus enhancing P mobility from the site. Bh horizons have greater P retentive capacity. Hence depth to the spodic horizon is important for evaluating P mobility; soils with deep spodic horizons have greater susceptibility for P loss. The nature of fertilizer application and land-use patterns affect soil P dynamics. SPSC has potential to aid in prediction of P release from LOW soils and to forecast P loading levels that would jeopardize water quality.

Chandler, Ron

Authors: **Ron Chandler**, University of South Florida

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Stakeholder Engagement Processes

Human Lifespan Development and Our Relationship with Water

Attaining actual sustainability that is a relationship with Earth's hydrosphere continuous with its natural laws requires a psychosocially mature society. In "Human Lifespan Development and Our Relationship with Water" Chandler asserts that our predicament is that we are a psychosocially rudimentary society wielding tremendous technological "solutions" at problems that are best or perhaps can only be corrected through psychological processes. In no other facet of sustainability is this predicament more problematic than in our relationship with water. Drawing on human lifespan development and organizational psychology Chandler discusses the apparent stage of the collective human psyche in the context of water sustainability. Psychosocial phenomenon including but not limited to group think, externalization of responsibility, magical thinking, and belief perseverance are characteristic of our collective psychosocial stage. Chandler discusses the symptoms produced by these phenomenon in an effort to shift our attention to the source of our behavior rather than on the more obvious symptoms caused by it. Finally he explores possible strategies that we can develop and implement individually and as agents of change within our various groups toward advancing our psychosocial maturity and resolving water sustainability.

Cheesman, Alexander

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Phosphorus Composition in Wetland Substrates

Anthropogenic eutrophication threatens the ecological functioning of many inland waterways and wetland systems. Yet at the same time, wetlands offer a potential solution acting as a means of sequestering and storing excess nutrients at the landscape level. The ability of wetlands to sequester and stabilize excess nutrients, is dependant upon the specific forms produced as a result of biogenic processes. Organic compounds, are suspected as being a major component of the sequestered phosphorus within natural and artificial wetlands, but processes regulating the forms and stability in the environment are not well understood. We applied 31P nuclear magnetic resonance (NMR) spectroscopy to investigate the forms of phosphorus found across a large geographical and hydrogeomorphic range of wetland types. This information provided incite; not only into the role of organic phosphorus within wetlands, but into the influence of vegetation and biogeochemical parameters on the chemical forms present. This information provides a basis for more detailed studies on the role of biological processes in determining the forms and cycling of organic phosphorus found within aquatic systems.

Chu-Agor, Maria Librada

Authors: **Ma. Librada Chu-Agor**, Department of Agricultural & Biological Engineering, University of Florida
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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Global sensitivity and uncertainty analysis of SLAMM for the purpose of habitat vulnerability assessment and decision making

Climate change coupled with land use change was known to have adverse effects on coastal habitats, which are sanctuaries to endangered wildlife. In particular, sea level rise associated with climate change can drastically affect wetlands and beaches which are important habitats for shoreline dependent organisms. Recent studies used SLAMM (Sea Level Affecting Marshes Model) to simulate wetland conversion and shore-line modification for the purpose of habitat vulnerability assessment and decision making. However, there were concerns regarding the validity and suitability of the model due to the uncertainty involved in selecting many of the model's empirical input parameters. The objectives of this study were to use a state-of-the-art screening and variance-based global sensitivity and uncertainty methods to: (1) identify the important input parameters that control the model's output uncertainty (2) quantify the model's global output uncertainty and apportion it to the direct and higher order contributions of the important parameters and (3) evaluate the consistency between model assumptions and model response. SLAMM was parameterized to simulate the changes in the coastal habitats of a selected site in the Eglin Air Force Base (Florida) for different IPCC sea level rise scenarios using data collected from different databases. The screening method of Morris for a qualitative ranking of the input parameters was then carried out followed by the variance-based method of Sobol for quantitative sensitivity and uncertainty analyses. The model structure was then evaluated by comparing the results of the uncertainty/sensitivity analyses with the response of the model. Preliminary results showed that elevation, tidal range, historical sea level rise trend, and accretion rate were the predominant parameters that influenced the uncertainty in the prediction of changes in coastal habitats. Results of the uncertainty/sensitivity analyses conformed to the conceptual basis of the model. This study represents an indispensible first step towards the integration of SLAMM with meta-population models to further assess habitat vulnerability for specific shoreline-dependent organisms.

Clement, Prabhakar

Authors: **Prabhakar Clement**, Department of Civil Engineering, Auburn University

Category: Integrating science and policy for improved water management
Session Title: Monitoring and Modeling Hydrologic Processes

Are Groundwater Models Reliable Tools for Reconstructing Historical Contamination Scenarios?

This presentation will be based on a NRC study that was recently completed by a National Academy panel (see: http://www.nap.edu/catalog.php?record_id=12618). This project involved a groundwater contamination problem at the Camp Lejune (CLJ) Marine Base in North Carolina where residents were exposed to harmful chemicals, such as PCE, TCE and other waste products, since the early 50s. In 1982, a routine water quality survey completed at the site indicated the presence of several volatile organic compounds including PCE and TCE in the drinking water. Further investigations revealed that there are several waste disposal facilities located on-site that have discharged TCE and other waste products into groundwater systems. In addition, there was also an off-site dry cleaning facility located close to the Tarawa Terrace in-take well locations that disposed PCE into the subsurface environment. In late 1980s, concerns raised by CLJ public lead to an epidemiological study to evaluate the potential associations of utero and infant exposures to the VOCs and childhood cancers and birth defects. The study included births occurring during the period of 1968-1985 to women who were pregnant while they resided at the base. Since there was no monitoring data available for the study period (1968-1982), researchers used reactive transport models to reconstruct the historical concentration levels. In this presentation, I will first briefly review the details of the contamination problem and the modeling results. Later I will use the field study to answer the following questions: 1) Are reactive transport modeling tools sufficiently reliable for reconstructing historical VOC contamination at field sites? 2) What are the benefits of using reactive transport models for resolving policy problems related to a groundwater risk/exposure assessment problem? Finally, we will use this example to address a rhetorical question--how much complexity is too much complexity?

Cornejo, Camilo

Authors: **Camilo Cornejo**, University of Florida
James Heaney, University of Florida

Category: Optimal use of integrated water supplies
Session Title: Water Conservation and Demand-Side Management

EZ Guide: A Water Conservation Planning Tool for Florida

The University of Florida and the Conserve Florida Water Clearinghouse EZ Guide (http://conservefloridawater.org/ez_guide.asp) is a spreadsheet based tool that can assist water utilities and water management districts in performing analyses and developing water conservation plans as part of a consumptive use permit application or water supply planning effort. This spreadsheet-based tool was developed to better address the needs of utilities with limited technical capacity to complete the more data intensive online Guide. The element of simplicity that the EZ Guide offers does not pertain to the complexity of its calculations but rather to the number and types of inputs and a simple interface that allows transparency in terms of how inputs equations that are used. Furthermore, data and the results of calculations performed are condensed and displayed in tabular formats. In addition to being inclusive of the original Guide's methodologies and calculations, the EZ Guide has additional features: 1) use of the Uniform Gross Per Capita Measure methodology to calculate gallons per capita per day (gpcd);. 2) water audit/water loss calculations that are consistent with the 2009 AWWA M36 Manual recommendations; 3) a calibrated water budget that accounts for water produced and billed by sector, as well as system losses; and 4) a methodology based on land use to estimate water use by sector when metered data is not available. All these features are intended to work closely with the consumptive water use permit requirements from the water management districts. This updated tool should be very helpful in developing quantitative assessments of current water use and water conservation potential.

Cowie, Gail

Authors: **Gail Cowie**, Georgia Environmental Protection Division

Category: Integrating science and policy for improved water management
Session Title: Integrating Science and Policy for Improved Water Management

Water Planning in Georgia: Improving Information and Increasing Participation

Georgia adopted its first statewide water plan in February 2008, as authorized by the 2004 Comprehensive State-wide Water Management Planning Act. Georgia's State Water Plan was developed over a three-year period through a transparent process that relied on extensive public involvement. The Plan is a blueprint that significantly changes the way that decisions about water are made across the state. It establishes a flexible framework for regional planning and is expected to improve our ability to balance demands on the state's water resources. The plan has three major elements that build toward more sustainable water management. The first is resource assessments, supported by enhanced monitoring and databases, to evaluate water available for use and the capacity to assimilate wastewater. Models are being developed to describe current conditions in terms of groundwater sustainable yield and surface water availability and quality. These models will be used to analyze future conditions and practices to meet future needs. The second critical element is regional water planning. The State Plan establishes a framework for development of regional plans spanning the state, including areas that do not yet show evidence of resource stress. Regional plans will specify the water management practices to be implemented to meet future needs. State law requires that, once regional plans are adopted, water withdrawal permits and state grants/loans be consistent with their provisions. Thirdly, regional plans must be reviewed and revised every three to five years, providing an opportunity for adaptive responses to changing information and conditions. This paper will provide an overview of Georgia's State Water Plan and the steps taken to date to implement its provisions. It will focus on actions to improve information on water resources and activities to increase participation in long-term planning for the state's water future.

Crandall, Christy

Authors: **Christy Crandall**, U.S. Geological Survey

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 1

Simulation of Nitrate Concentrations in Three Upper Floridan Wells, Southwest Georgia using Groundwater flow and particle Tracking Techniques

A regional-scale groundwater flow model was used to establish boundary conditions for a local-scale model focused on 3 Upper Floridan aquifer monitoring wells in southwest Georgia. The local-scale model was calibrated using measured groundwater-levels in 127 wells and 19 stream reaches and was used to 1) define the area contributing recharge to each well, 2) estimate advective transport, and 3) simulate the occurrence of nitrate. The Upper Floridan aquifer in this area is vulnerable to nitrate contamination due to agricultural land use, irrigation, and karst features. Fertilizer sales data, compiled by county nationwide from 1945 through 2001, was used to develop a nitrogen input function for the model. Nitrogen transport was simulated in the model using volume-weighted particles. The mean observed nitrate-N concentration in a background monitoring well was 0.99 mg/L, and concentrations ranged from 0.55 to 0.83 mg/L, between 1993 and 2007. Simulated nitrate-N concentrations in this well over the same period ranged from 0.55 to 0.83 mg/L and the mean simulated nitrate concentration was 0.76 mg/L. The mean nitrate-N concentration collected from 1993 to 2007 from monitoring well CP-18A was 8.68 mg/L; concentrations ranged from 4.70 to 12.73 mg/L. Simulated concentrations ranged from 5.77 to 9.44 mg/L. The mean simulated nitrate-N concentration was 7.39 mg/L. The mean observed nitrate-N concentration in monitoring well CP-21A was 4.74 mg/L from 1993 to 2007; concentrations ranged from 4.12 to 6.00 mg/L over the same period. Simulated nitrate-N concentrations ranged from 2.87 to 5.03 mg/L and the mean nitrate concentrations was 4.06 mg/L. Recharge water to these wells ranged from less than 3 days to more than 41 years based on particle tracking.

Dalrymple, Omatoyo

Authors: **Omatoyo Dalrymple**, University of South Florida
Yogi Goswami, University of South Florida
Elias Stefanakos, University of South Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Development of a robust mechanistic model for photocatalytic disinfection of water

Solar photocatalytic systems are becoming a viable option for water disinfection and offer huge energy savings. They are particularly adaptable for applications in remote and rural areas, where energy supply may be prohibitive. In addition, TiO2 is abundant and relatively cheap and photocatalysis does not produce potentially harmful byproducts such as those produced during chlorination and ozonation. However, design methodologies for photochemical disinfection systems have lagged far behind their chemical detoxification counterparts. This is in part due to the lack of reliable models that aptly describe the inactivation process. The mechanism of inactivation for common indicator organisms such as E coli is still heavily debated. Most of the previous analyses have been based on empirical models, but there is no reason to believe that these models can be extrapolated beyond the range of values for which they have been calibrated. Further, the available models do not adequately and consistently describe photocatalytic disinfection, largely because they are rooted in conventional disinfection which is based on the chemistry of homogeneous reactions. We propose the first robust mechanistic model for the disinfection of bacteria in drinking water which can be used to design large-scale systems. The model is based on the oxidation of membrane lipids within a compartmentalized micro-reactor system with the propagation of radical chain reactions leading to organism inactivation. We define the reaction mechanisms, the reaction kinetics and the conditions under which the model can be considered valid.

Davis, Jim

Authors: **Jim Davis**, Sumter County Extension, IFAS, University of Florida

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Watering Smart &; Efficiently in The Villages

The state of Florida is number two in the nation for water use. Florida also has one of the fastest growing retirement communities in the United States, The Villages. The Villages is an expanding retirement community with an estimated population of 65,000 people in Sumter County. In 2008, The Villages was the fastest growing micropolitan area in the United States. In the United States, the average resident uses about 150 gallons of water a day. Half of the water used by each resident goes directly into the landscape. Due to this rapid rise in population and development, water conservation has taken a center stage in The Villages. Many new residents from other states moving to The Villages are unaware of the potential damage they can cause to our fragile water supply by watering inefficiently. Inefficient watering wastes our most precious limited resource and contributes to pollution. Excess water can carry harmful pollutants such as pesticides, oils and grass clippings into our rivers, lakes and other water bodies. The goal of this project was to reduce the total water usage used in the landscape for new residents moving to The Villages. This will be achieved by demonstrating and educating to new residents on how to operate their irrigation controller, proper irrigation maintenance, principles of Florida Friendly Landscaping and choosing the right plant for their area. Visual media aids and hands-on demonstrations of irrigation clocks and equipment were incorporated in this project. Pre and post tests were distributed to attending residents to examine behavior change. After attending the workshops, 80% of the new Village residents will have in increased their knowledge on water conservation practices to water more efficiently in their landscape.

Davis, Hal

Authors: **Hal Davis**, U.S. Geological Survey
Richard Verdi, U.S. Geological Survey

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 1

Influence of Salinity on the Variation of Freshwater Flow at the Coastal Spring Creek Springs Group and the Interconnection of Flow at Spring Creek Springs Group and Wakulla Springs, Wakulla County, Florida

The Spring Creek Springs Group is composed of 13 springs located in a tidal estuary in north-central Florida. In June 2007, the U.S. Geological Survey installed a gaging station to monitor stage, water velocity, precipitation, and conductance in Spring Creek, which connects these springs to the Gulf of Mexico. Salinity was calculated from conductance and used to separate flow into a freshwater and saltwater component. Spring flow was variable, but could be grouped into periods of similar characteristics, each lasting several months. There was an net inflow of saltwater into the Upper Floridan aquifer through the spring vents of about 50 ft3/s and net outflow of freshwater of about 40 ft3/s for the three periods of June 2007 to March 2008, June to September 2008, and July to September 2009. In contrast there was a net outflow of saltwater and freshwater from the aquifer of about 250 ft3/s and 550 ft3/s, respectively, in the periods from March to June 2008 and September 2008 to July 2009. Groundwater computer model simulations indicate that the variability of spring flow over months is governed predominately by the salinity of the water in the spring vents. When salinity increases in Spring Creek Springs, water density increases and a higher equivalent freshwater head results. This head then exceeds the head in the more inland Wakulla Springs, resulting in increased flow at Wakulla Springs and decreased flow at Spring Creek Springs. When salinity is low, the equivalent freshwater head at Spring Creek Springs is lower than at Wakulla Springs resulting in discharge shifting back to Spring Creek Springs. An approximate 9-inch rise in sea level since the 1930's may be causing long-term salinity increases in Spring Creek Springs and the cause of an observed increase in flow at Wakulla Springs over this same period.

Davis, Stacia

Authors: **Stacia Davis**, University of Florida
Michael Dukes, University of Florida

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Irrigation Using ET Controllers: A Cooperator Study In Southwest Florida

Conservation of water resources is important for urban areas all over the country, and on average, half of municipally-supplied potable water is used for residential landscape irrigation. As a result, it is essential to determine better methods to manage residential irrigation so that landscapes receive water based on needs while eliminating excess water loss due to over-irrigation. One method currently being explored in southwest Florida is the implementation of "smart" technologies that manage landscape water needs. One such technology is an ET controller that schedules irrigation by maintaining a theoretical soil moisture balance where water loss occurs through evapotranspiration (ET) and irrigation is supplemental to rainfall. A total of thirty-six cooperators from Hillsborough County were chosen from three locations in the county. Locations were selected based on high percentages of outdoor water use and population estimated from historical trends. Twenty-one of the cooperators were selected to receive Toro Intelli-sense controllers (Riverside, CA) that utilize the WeatherTRAK ET Everywhere service (Hydropoint Datasystems, Inc., Petaluma, CA). The ET service sends daily ET estimations and rainfall information to the controllers via satellite signal. These cooperators were granted exemptions from day-of-the-week watering restrictions to allow the controllers to work as efficiently as possible. The remaining cooperators, termed the comparison group, were asked to maintain their current irrigation practices. Preliminary results showed that both groups irrigated more than its own average historical water use in all locations. These results were explained based on dry conditions with less than normal rainfall totals. Additionally, the ET controller group irrigated more than the comparison group in two of three locations. However, the ET controller group generally had higher turfgrass quality ratings than the comparison group in these locations suggesting cooperators in the comparison group were willing to sacrifice landscape quality for unknown reasons.

Delesantro, Joseph

Authors: **UF Chapter AWRA student members UF Chapter AWRA student members**, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Student Driven Research by the University of Florida Chapter of the American Water Resources Association

Interdisciplinary research involves graduate and undergraduate students in exploring many facets of water resources while providing opportunities for presentation and publishing. Students gain hands on experience and learn valuable field and laboratory techniques. Some past and current projects conducted by the UF Chapter of the American Water Resources Association (AWRA) include coastal dune lake investigation, a study of particulate matter metal distributions from hurricane Katrina storm flows, and on campus creek restoration. Coastal dune lakes are fresh water basins that are delicately perched above the coastal salt water fringe, making them unique ecosystems. Recent development has put these lakes under a constant threat of deteriorating water quality, and salt-water infiltration. The objectives of the project were to: (i) Investigate the current condition of the lakes; including water quality, and land-use practices surrounding them. (ii) identify pertinent issues concerning the lakes, and provide recommendations that will help decision makers develop a sound lake management plan in the future. Hurricane Katrina and the failure of the levees surrounding New Orleans generated a significant detained volume of storm-water within the urban area of New Orleans. A large mass of storm-entrained particulate matter was deposited throughout inundated areas in New Orleans. This study examined the distribution of metals for post-Katrina surficial PM deposits recovered from 15 sites in New Orleans. Remediation of Bartram-Carr creek can help mitigate the negative impacts of storm-water running off of roads, parking lots, roofs, and landscaping into water bodies. Pollution, flooding and erosion can be reduced by proper management of storm-water. A segment of the creek was surveyed to evaluate the flow of water. Plant species and macroinvertabrate species were also surveyed in order to provided an assessment of water quality. Remediation work has included Invasive species removal and the planting of native species. An educational kiosk will be created to describe the creek and the rehabilitation.

Dinkins, Kimberleigh

Authors: **Mark Zivojnovich**, HydroMentia
Kimberleigh Dinkins, HydroMentia, Inc.

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Algae Based Water Treatment Systems for Biomass Recovery and Fuel Production

Algae are being investigated for large scale production of biofuel, with much research focused on phytoplankton as single species. However, multiple environmental benefits may be recognized through the use of large-scale, algal based, water treatment technologies when biomass residuals are able to be converted to biofuel. The Algal Turf Scrubber® (ATS™) is a treatment process that uses periphytic algae to reduce nutrient pollutants (nitrogen and phosphorus) from stormwater runoff and natural water bodies. Naturally occurring algal species are cultivated through system design and operational processes, which includes routine harvest of the algal biomass. Harvesting maintains the system in an accelerated growth phase, thereby increasing nutrient removal potential, and creating a sustainable process area. Commercial scale ATS™ systems have been shown to achieve production rates of 20-40 dry g/m2-d of algae, while providing phosphorus areal removal rates up to 200 lbs/ac-yr and nitrogen removal rates up to 4,000 lbs/ac-yr. These high removal rates allow for greater nutrient reduction in a smaller footprint than other biological water treatment technologies. Periphyton based systems such as the ATS™ are unique in that they offer high rates of algal productivity even in low nutrient waters. From a water treatment perspective, periphyton based systems offer high areal removal rates and sustainability. Cultivated algal biomass has the potential to add an energy benefit to these systems, which would offset treatment costs, thereby making restoration efforts more affordable to communities charged with such efforts.

Divine, Rachel

Authors: **Rachel Divine**, Department of Agriculture Education and Communication
Hannah Carter, Assistant Professor Department of Agriculture Education and Communication
Paul Monaghan, Assistant Professor Department of Agriculture Education and Communication

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Factors associated with farmer adoption of Best Management Practices in the Suwannee River Water Management District of North Florida

By 1998, the nitrate problem in the Suwannee River Basin was a well-documented concern. The nitrogen readings in the Basin were consistently higher than in comparable water bodies in the region and agriculture was cited as a major contributor. The Suwannee River Partnership (SRP) was created in 1999 as a response to a need for collaboration between multiple political and private entities to solve the nitrogen problem. The main goal of the Partnership is to improve water quality and reduce water usage within the Suwannee River Water Management District (SRWMD) without regulations. The Partnership uses a watershed approach and seeks a balance between protecting natural resources and sustaining the agricultural economy. The purpose of this research was to identify and describe all factors that contribute to farmer adoption or rejection of Best Management Practices (BMPs). BMPs are scientifically proven to be the most effective, practical means of preventing or reducing pollution from non-point sources like agriculture. The researcher also assessed the communication channels used by farmers in the SRWMD and how the SRP uses these channels as well as its programs and materials to encourage BMP adoption. A qualitative method was used in this study to provide a deep understanding of farmers' perceptions of BMPs and the SRP. Participants were interviewed using a semi-structured format. Participants included SRP staff members and dairy, poultry and field crop farmers in the SRWMD. The results to date show that money and trust are the most important factors contributing to farmer adoption of BMPs. The majority of farmers want to participate in a BMP program because of the economic savings BMP participation provides. Farmers do not want to waste their inputs. Farmers generally trust the one-on-one relationships that the SRP provides which encourages them to adopt.

Dix, Nikki

Authors: **Nikki Dix**, University of Florida
Edward Phlips, University of Florida
Richard Gleeson, Guana Tolomato Matanzas National Estuarine Research Reserve

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Oysters as Indicators of Trophic Status in Highly Flushed Estuaries

With ever-increasing coastal development, a main focus of estuarine research has become predicting the consequences of nutrient enrichment in coastal ecosystems. In this study, two regions within the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR) in northeast Florida were compared to investigate how well-mixed estuaries with strong tidal influence respond to different nutrient load scenarios. Various water quality sampling regimes were utilized to capture spatial and temporal variability in physiochemical parameters. Since traditionally monitored water quality parameters such as nutrient and phytoplankton concentrations often do not provide a clear indication of trophic status in estuaries with short water residence times, response to nutrient enrichment in this system was measured at the level of benthic primary consumers. Oyster population structure was examined within each region using measurements of oyster density, size, and condition. Results were related to regional and seasonal differences in nutrient concentrations and food availability. Nutrient, chlorophyll a, and particulate organic carbon concentrations were positively related to oyster biomass, abundance, and condition. This study demonstrates that oysters are promising bioindicators of water quality in highly flushed estuaries.

Dourte, Daniel

Authors: **Daniel Dourte**, Department of Agricultural & Biological Engineering, University of Florida
Todd LeVasseur, University of Florida department of Religion

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Cropping Systems for Food and Water Security in India: Productivity and Groundwater Responses to Farm Management

Groundwater depletion is threatening livelihood security and macro-scale economic growth in numerous regions of India. An agricultural 550 hectare subwatershed in Andhra Pradesh was selected for analysis because it is illustrative of the common regional problem of groundwater decline and increasing vulnerability of the farming systems that are dependent on irrigation from groundwater. Farmers can manage two water balance components: evapotranspiration (through choices in crop selection, irrigation management, tillage/mulching) and runoff/infiltration (through choices largely in irrigation management, tillage/mulching). This analysis estimates the groundwater balance (recharge – irrigation withdrawals) of the watershed in response to farm management consisting of various combinations of crop selection, irrigation management, and tillage. The objective is to find management options for improving groundwater supply. The Soil and Water Assessment Tool (SWAT) is being used to simulate the water balance in the watershed. Channel flows and changes in reservoir volumes are being monitored for calibration of SWAT under existing farm management. Combinations of crop selection, irrigation management, and tillage are being simulated to find options of farm management (and their extent) that show promise for improving groundwater supplies. Improvements to the infiltration description of SWAT (to include surface storage in Green-Ampt infiltration as a variable head) are being tested to reduce uncertainty in runoff in a region having highly episodic rainfall and potentially large surface storage resulting from tillage management. Participation of farmers in the study area has provided information about farm management decision making and preferred cropping systems. This has allowed for more realistic groups of farm management options to be simulated. Sensitivity analyses suggest surface storage should be included in Green-Ampt infiltration for improvement of representation of infiltration in croplands having non-negligible surface storage. Groundwater balance results for various farm management options will be presented.

Dukes, Michael

Authors: **Melissa Baum Haley**, Department of Agricultural Biological Engineering, University of Florida
Michael Dukes, University of Florida

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 2

Evaluation of Sensor Based Residential Irrigation Water Application on Homes in Florida

A residential irrigation study to determine the effects of sensor-based irrigation on residential in-ground irrigation water application in Southwest Florida will be presented. The primary objective of this project was to determine if an automatic irrigation system in the residential environment, when receiving feedback from a bypass sensor could reduce irrigation water application while maintaining acceptable turfgrass quality. Research conducted on actual homes (n=58) in Pinellas County, FL. Experimental treatments evaluated were (1) automatic time based irrigation set and operated by the cooperator, (2) an automatic timer with the integration of a soil moisture sensor, (3) an automatic timer with a rain sensor, and (4) an automatic timer with a rain sensor along with educational materials including a run time schedule given to the cooperator. Outdoor water use, semi-annual turf quality ratings, and weather data was collected for the homes over a 26-month period. In addition to elapsed weekly irrigation water use, hourly use was recorded and fraction of total household use (indoor vs. outdoor) was calculated. The total cumulative savings were calculated compared to the meter only treatment. The soil moisture sensor treatment yielded the greatest savings; with 65% less water applied for irrigation than the meter only treatment. Although the rain sensor plus educational materials treatment initially showed substantial savings the saving were not as great during the second year of data collection, the total average irrigation savings was 45%. Lastly, the rain sensor treatment yielded a 14% savings over the MO treatment. These results were similar to what was found in associated the plot study. Results presented include irrigation water application cumulative and event reduction based on experimental treatment. Irrigation practices relative to plant-water needs as determined through a soil water balance, and watering day compliance observations.

Edmonds, Katherine

Authors: **Katherine Edmonds**, River Basin Center, University of Georgia
Laurie Fowler, University of Georgia

Category: Integrating science and policy for improved water management
Session Title: Integrating Science and Policy for Improved Water Management

Preserving Water Quality through Effective Use of the Antidegradation Policy: Guidelines for the State of Georgia

Under the Clean Water Act (CWA), the antidegradation policy requires states to develop a three-tier system to protect water quality. The three tier designation process for all waters within the state includes: tier one which affords waters the lowest level of protection, tier two which applies to higher quality waters, and tier 3 or Outstanding Natural Resource Water (ONRW) which provides waters with the highest level of protection. Occasionally states also develop criteria for a tier 2.5 designation that provides protection but still allows for some degradation for social and economic purposes. I focus specifically on tier 3 and tier 2.5, and the correlation between the two designations as a means to protect waters without losing the potential for social and economic growth. Through case studies of individual state policies, I will determine which states have been successful in preserving water quality as a result of their policies. I will also review the federal antidegradation policy, which provides vague guidelines, to determine why the ONRW designation is currently underutilized and widely ineffective in preserving water quality. By drawing from successful states, my objective is to develop recommendations for changes in the antidegradation policy on several levels, including the state, regional, and federal level. These policy recommendations will help create equality among states' antidegradation policies and preserve our nation's most precious waters. Ultimately I will focus on the potential for the State of Georgia to develop an effective antidegradation policy. Currently Georgia has no ONRW waters designated nor a functional designation process. The Statewide Water Management Plan, developed by the Georgia Water Council, mentions the necessity to develop a new stream designation, tier 2.5. Georgia has an opportunity to develop a more protective antidegradation policy with the addition of tier 2.5 and some effective changes to the tier 3 designation.

Erickson, John

Authors: **John Erickson**, University of Florida
Lynn Sollenberger, University of Florida
Jeffrey Fedenko, University of Florida
Arkorn Soikaew, Uniiversity of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Water Use of Potential Tall Grass Biofuel Crops in Florida

The U.S. Government has set a goal of producing 21 billion gallons of liquid fuels from cellulosic feedstocks by 2022. Due to its favorable climate, the southeastern U.S. is expected to be the epicenter of cellulosic feedstock production. However, the implications of biofuel crop production for water resources in the region are not well understood. In the present study we collected data on water use, crop yields and crop water use efficiencies for three tall grass species grown in North Central Florida. First year results showed that water use during the peak growing season was comparable for energycane and giant reed (7-8 mm/day), both of which were greater than elephantgrass (4-5 mm/day). However, yields for giant reed were generally less than those of either elephantgrass or energycane. These results indicated that selection of crop species will not only affect yield potential, but may also affect water resources in the southeastern U.S. Ongoing work is focused on water use and yield data of mature stands, as well as crop responses to variable climate conditions.

Estes, Carole

Authors: **Carole Estes**, Southwest Florida Water Management District

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

FARMS: An Agricultural Water Conservation Program as Part of the SWUCA Recovery Strategy.

The Southern Water Use Caution Area (SWUCA) Recovery Strategy is the blueprint for the Southwest Florida Water Management District's response to reduced flows in the Upper Peace River, lowered aquifer and lake levels, and salt-water intrusion. A number of actions are identified in the SWUCA Recovery Strategy to manage these resource concerns. The Facilitating Agricultural Resource Management Systems (FARMS) program is designed to encourage agricultural conservation of groundwater primarily in the SWUCA, but available to growers district-wide. FARMS is an agricultural best management practice (BMP) cost-share reimbursement program that encourages both water quantity and water quality BMPs. It is a public/private partnership developed by the District and the Florida Department of Agriculture and Consumer Services (FDACS) tasked with the goal of reducing Upper Floridan aquifer withdrawals by 40 million gallons per day (gpd) by 2025. FARMS projects generally involve two types of groundwater conservation; the offset of groundwater use through the use of an alternative water supply, or the reduction in groundwater use through precision irrigation management, or both. Since the program's beginnings in 2003, the District has approved 78 projects with a projected reduction in groundwater use of nearly 13,500,000 gpd. Forty eight projects are complete and operational and, despite being in the midst of a drought, actual groundwater reduction or offset has averaged more than 6,000,000 gpd. FARMS is just one of the tools the District uses to encourage all water users to conserve in order to assure adequate resources for the future.

Farrell, Mark

Authors: **Mark Farrell, P.E.**, Water Resource Associates

Category: Optimal use of integrated water supplies
Session Title: Managing Integrated Water Supplies

Market Forces as a Water Use Management Tool

We all recognize that much of the state of Florida is being designated a Priority Water Use Caution Areas by the water management districts in response to current or projected water supply shortages. The future of water supply is being proposed to be managed by increased conservation and the development of alternative water supplies. Each method has its benefits and shortfalls. Conservation is a temporary fix as water demand grows due to population growth and alternative water supplies are costly and have new and challenging environmental impacts. So where can sources of water be developed as an environmentally and economically alternative? That answers may lie in the redistribution of the vast water supply that has already been allocated by the water management districts. The voluntary redistribution of previously permitted, environmentally acceptable water supplies can provide new users with a choice of developing alternative supplies or acquiring the use of existing permitted supplies through a voluntary market exchange. Is this a new and untried concept, no it is not? California has been actively purchasing seasonal and annual water quantities from agriculture and others for decades to supplement public supply. They do this because it is a win –win for both public supply users and the agricultural interests. Does this concept interfere with the role of the water management districts? Not if the role of the water management districts is to protect and manage our water supplies. Market exchange of water supplies does not involve any diminishment of the criteria for issuing a water use permit. This is not western water law that allows water rights to be exchanged without regulation. Examples will be given to show the mechanics of an orderly and regulated water exchange process that allows the districts to manage the water supply as prescribed by Florida statutes and allowing a market alternative to new users.

Felter, Liz

Authors: **Liz Felter**, Institute of Food and Agricultural Sciences, University of Florida
Paul Monaghan, University of Florida

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 2

Can Social Marketing Educate Consumers About Complicated Behaviors?

Orange County, Florida is facing a looming water crisis. The St. Johns River Water Management District has determined that the county, which includes metropolitan Orlando, will reach the limit of its consumptive use permit in 2013 and no new groundwater withdrawals will be permitted. This will mean that population growth beyond the current 1.2 million residents will have to secure water from other sources. While the immediate response has been to seek withdrawals from surface water in the St. Johns River watershed, there is also a renewed effort to conserve existing water resources. For many households in the region, the largest waste of water is not in the home but outdoors, in the landscape. Homes with an automatic irrigation system waste the most water. Survey research has demonstrated that homeowners across Florida have a difficult time meeting the demands of their homeowners associations to keep their yard green while understanding the maintenance needs of their lawns and the technology of their irrigation system. The most common response for homeowners is to set their irrigation timer and forget it, not making adjustments based on rainfall or the water needs of the landscape. Traditional public education programs used by County Extension offices face a daunting task when confronted with these complicated behaviors and attitudes. This paper will detail a community based social marketing approach to unraveling the complexities of landscape irrigation and providing homeowners with simple instructions for changing behavior. It will demonstrate that when communities participate in water conservation efforts, they are more likely to change attitudes and increase knowledge among their neighbors and ultimately motivate behavior change.

Frank, Kathryn

Authors: **Kathryn Frank**, University of Florida

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Public Private Partnerships

Multipurpose and Compromise Projects: Avoiding Conflict and Restoration in the Everglades

Multipurpose and compromise water projects strive to simultaneously meet diverse water resource management needs such as water supply, flood control, recreation, and ecological health. The latest orthodoxy of collaborative watershed management (and integrated water resources management on the international front) promote such multipurpose and compromise projects, because they resolve conflict, enhance political support, and can represent efficient win-win solutions to problems. There are inherent problems with such multipurpose and compromise projects, however, as found in a study of over six decades of planning and implementation for restoration of the Everglades wetlands of South Florida. Such projects perpetuated the technocratic-bureaucratic water management paradigm preferred by the South Florida Water Management District and the U.S. Army Corps of Engineers rather than advance consideration of "softer," but less politically palatable, approaches such as immediate legal reservations of water for the natural environment (as allowed by Florida law), water conservation, and growth management that could have greater long-term environmental benefits. The multipurpose and compromise projects also had significant challenges during implementation as development interests dominated at the expense of environmental interests, in some cases exhibiting project "capture." Despite a history of failure of multipurpose "restoration" projects to deliver ecological improvements, beginning with the Central and Southern Florida Project authorized in 1947, the approach continues with implementation of the Comprehensive Everglades Restoration Plan of 2000. This presentation will examine the environmental traps of multipurpose and compromise projects, why governance continues to promote them, and what restoration leaders can do to avoid the traps while still seeking the environmental benefits of hard infrastructure modifications, coordinated management, and governance capacity building.

Franklin, Mica

Authors: **Mica McMillan**, Aquatrols Corporation
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Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Surfactant Use May Remediate Effluent-Water Induced Soil Hydrophobicity

The use of effluent water on landscapes and in agriculture to reduce fresh water consumption has increased in recent years. However, it has recently been reported that the use of effluent water can increase water repellency in soils (Wallach et al., 2005). Soil water repellency (SWR) reduces water movement into and through soils, creates preferential flow paths, increases leaching of pesticides and fertilizers, reduces water use efficiency and significantly reduces turfgrass and crop quality. Soil surfactants have been used in the horticulture and turfgrass industries to aid water movement through a soil profile and reduce soil water repellency. The objective of this study was to determine if two novel surfactant technologies addressed the issues of SWR on a golf course in Florida, USA that had been irrigating with effluent water for more than five years. Two surfactant treatments, an alkyl-polyglycoside blended with an ethylene oxide-propylene oxide block (APG) and a methyl capped ethylene oxide-propylene oxide block (MC) soil surfactant, were applied monthly. Turfgrass quality, localized dry spot (LDS), volumetric water content (VWC) and soil water repellency (SWR) data were collected and analyzed over a two year period. Overall, surfactant treatments improved turfgrass quality, reduced LDS, increased VWC and reduced SWR when compared to the control treatment. The APG chemistry significantly enhanced turfgrass quality, reduced LDS and increased VWC when compared to the MC treatment. The MC chemistry significantly reduced SWR when compared to the APG chemistry. Based on these results, surfactants are an effective tool to maximize water use efficiency, improve the aesthetic appearance of turfgrass and ameliorate SWR but the surfactant chemistry determines the extent of the benefits. This study also determined that water repellency was severe on an effluent irrigated golf course but the cause of the hydrophobicity may not necessarily be attributed to effluent water usage.

Friedman, Melissa

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Characterizing Riparian Forest Communities in an Urban and Urbanizing Area in West Central Florida

Over the last century, Florida's population grew from approximately 500,000 to more than 16,000,000 people. This growth has not only fragmented and deforested riparian plant communities but has also significantly altered hydrological processes, resulting in changes in compositional and structural attributes of those communities, and hence the ecosystem functions and services they provide. In order to begin to understand how urbanization is altering riparian habitats, we established 97 fixed radius .10th acre plots that occurred within 50 ft. of flow lines, water areas, and water bodies in the city of Tampa and its surrounding watershed. Data collection followed the methodology described by the i-Tree Software Suite User's Manual, 2006 and included metrics for ground, shrub, and tree strata. Patterns in these data were identified using multivariate analyses methods and plant communities were classified by and compared to the 2009 Florida Natural Areas Inventory (FNAI) "Guide to the Natural Communities of Florida". A total of 12 community types were identified, 9 of which have been described by FNAI and included basin swamps, bottomland forest, depressional marsh, floodplain swamp, hydric hammock, mesic hammock, and tidal swamp. The remaining 4 are newly emerging or have not been identified as a community in this area before, and include Brazilian pepper, disturbed riparian –unmanaged, pasture, and urban-managed. Natural and emergent riparian communities differed not only in their composition and structure, but also by the presence of urban land cover, principally impervious surfaces and managed lawns. Additional work is needed to determine how emergent and natural riparian communities differ functionally. The results of this study can be used by natural resource managers to assess current community types in this area and to target future conservation and restoration efforts. In addition, this information can be used to inform policy makers about the ecological importance of riparian habitats and the potential effects of urbanization on these habitats as they develop strategies for future planning and development.

Friedman, Kenneth

Authors: **Kenneth Friedman**, University of Florida, Conserve Florida Water Clearinghouse
James Heaney, University of Florida, Conserve Florida Water Clearinghouse

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Optimal Indoor Water Conservation Planning for Single Family Homes

Traditional water supplies are reaching their sustainable limits in Florida. Several areas in the state are currently looking at alternative water supplies, reuse water, and water conservation to ensure that ample future water is provided. Although this initiative is a step in the right direction, current water conservation plans are often qualitative and do not measure how well the plan is working, or how much water was saved from implementing it. Residential water use is normally measured using a single meter that records total water use that is the sum of indoor and outdoor water use. This study addresses methods to estimate the indoor component of total water use. Residential indoor estimates are used in conservation planning when determining how many homes need to have water using fixtures upgraded to reduce water use. This usage is often estimated based on the assumption that the minimum month of water usage represents the indoor usage for a utility or a customer since that month should have no irrigation taking place. In warm climates like Florida, this assumption may be invalid since irrigation takes place year round. Also, indoor water use may vary seasonally in areas like Florida due to part-time residents and tourists. Utilizing a case study utility, a component method for estimating indoor usage based on number of residential accounts, number of people per house, and per capita water usage was shown to be more reliable than minimum month assumptions in Florida. Number of people per house was shown to be constant with time, while per capita usage decreased slightly in recent years due to more efficient fixtures. The results of this study are general methods which can be applied toward a utility specific indoor water conservation plan for single family homes in Florida.

Gardner, Lisa

Authors: **Lisa M. Gardner**, University of Florida
K. R. Reddy, University of Florida
Todd Z. Osborne, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Carbon Pool Dynamics in a Phosphorus-Impacted Wetland (Everglades, FL)

Wetlands function as a major sink of carbon, but also release C through microbial respiration. Human disturbances, such as hydrologic changes and nutrient additions, often increase the rate at which wetland C is released to the atmosphere. In water conservation area 2A (WCA-2A), a managed hydrologic unit within the Everglades, a historically P-limited wetland is receiving high concentrations of P. The goal of this study was to determine if anaerobic respiration and the character of the C pools differed between P-enriched areas and unenriched areas of the wetland. Results indicate unenriched soils (0-10cm) store the most TC (μ=3341g C m-2) and organic C represents >97% of the TC at all sites. Anaerobic CO2 and CH4 production was significantly greater in the un-enriched detritus than all other sites (p

Gaughan, Andrea

Authors: **Cerian Gibbes**, University of Florida
Stevens Forrest, University of Florida
Andrea Gaughan, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Linking climate to landscape: Investigating the response of vegetation to precipitation variability in a semi-arid catchment area of southern Africa

Understanding how inter- and intra-annual precipitation affects seasonal vegetation dynamics is critical for assessing potential impacts of climate variability on vegetation structure and composition. This is especially true in semi-arid and arid ecosystems where water is a limiting resource and where varied species respond to timing, frequency, and intensity of rainfall in different ways. This study presents an analysis that correlates the response of photosynthetic activity with inter- and intra-annual precipitation variability in a regional catchment of southern Africa at a monthly time-step over the years 2000-2009. We estimate monthly precipitation using the Tropical Rainfall Monitoring Mission 3B43 dataset and monthly vegetation responses using the MODIS 13A1 normalized difference vegetation index (NDVI) product as a proxy for vegetation productivity. We present a time-series model that accounts for monthly lag and seasonal effects that estimates NDVI "greening" response to precipitation. Initial analyses show that the highest correlation between NDVI and precipitation is measured at a one month lag. However, the coupling between precipitation and vegetation varies by vegetation type. We present a comparison of model results across vegetation types in the catchment area. In addition to identifying the months of prior rainfall that are important to NDVI greening, a Geographic Weighted Regression (GWR) is used to predict NDVI after the peak of the growing season. GWR provides a useful tool to elucidate the rainfall-vegetation relationship by minimizing the effects of unmeasured, spatially-varying factors. Our research contributes to climate-land studies by examining how vegetation types respond to precipitation variation at multiple spatial and temporal scales and is a vital component to understanding shifting dynamics of dryland ecosystems.

Gerena, Susan

Authors: **Susan Gerena**, Interflow Engineering
John Loper, Interflow Engineering

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Evaluation of Hydrologic Restoration Scenarios for Flatford Swamp in Southwest Florida using an Integrated Model

This is a continuation of a poster presented at the 1st UF Water Institute Symposium in 2008 by John Loper, An Integrated Model of a Hydrologically Altered Watershed in Southwest Florida, which focused on developing a calibrated model for the Upper Myakka River Watershed. This presentation focuses on Flatford Swamp, a 4.5 square mile area located within the Upper Myakka River Watershed that is severely hydrologically impacted. Impacts include significant tree mortality within the swamp. The Myakka River Watershed Initiative (MRWI) is a comprehensive watershed study and planning effort that has set forth goals to restore the now altered hydroperiods to historical conditions and to find a use for the excess water flows. A potential use is as a possible alternative water supply source. Six scenarios were devised and tested using a calibrated water budget model to determine their viability in restoring the swamp to historical conditions. The scenarios were simulated using the calibrated existing conditions integrated groundwater / surface water model MIKE SHE / MIKE 11 as the basis for each scenario. The existing conditions model was prepared for Myakka River Watershed Initiative: Water Budget Model Development and Calibration, [Interflow, 2008] for SWFWMD. The 6 scenarios included: eliminating the use of plastic mulch from farms and using cover crops on fallow fields, installation of horizontal wells around the perimeter of the entire swamp, passively diverting water from the four major inflows to Flatford Swamp, passively diverting water from two of the major inflows into the Flatford Swamp, constructing conveyance improvements through the swamp, and directly pumping from the three areas within the swamp. Based upon the recommendations of this study three scenarios were selected for further investigation.

Geurink, Jeffrey

Authors: **Jeffrey Geurink**, Tampa Bay Water
Donald Polmann, Tampa Bay Water

Category: Optimal use of integrated water supplies
Session Title: Managing Integrated Water Supplies

Current and Future Challenges Managing a Public Water Supply System with Conjunctive Use: The Tampa Bay Water Experience

With utilities in Florida increasingly dependent on surface water sources for potable supply, utility managers will face great challenges in maintaining reliability. As a wholesale utility, Tampa Bay Water provides drinking water to more than 2.4 million people through six member governments. Ground water, surface water from rivers, a 15-billion gallon off-line reservoir, and desalinated seawater compose the regional conjunctive supply system. By 2012, Tampa Bay Water expects its delivery mix to be more than 50% surface water on a long-term average basis. Rainfall in Florida is highly seasonal and exhibits substantial annual swings. Studies show that changes in global climate patterns affect short- and long-term rainfall cycles. Uncertainty in future rainfall patterns, rainfall totals, and related streamflow characteristics hinders managers from ensuring future supply reliability. Deliberate conjunctive use of ground water and surface water, as hydrologic conditions cycle wet and dry, is an agency strategy to improve reliability. Application of the latest scientific knowledge base and tools improves understanding of reliability and provides transparency in decision-making for conjunctive use. As resources are brought to bear in this challenge, appropriate expertise and experience among a team of agency staff, consultants, and academicians, plus powerful networked data management and computational capabilities, play key roles. Over a decade, Tampa Bay Water has developed scientific tools to take on the reliability challenge. Examples are the Integrated Hydrologic Model (IHM) and the Water Shortage Mitigation Plan (WSMP). IHM simulates the physical, hydrologic processes of surface-water and ground-water flow and the dynamic interaction between them. The WSMP provides an objective basis for a hierarchy of water use and conservation phases, with constraints and triggers couched in risk management and derived from real data. Using these tools within a Monte Carlo framework, Tampa Bay Water is pursuing deliberate conjunctive use to understand and to improve water-supply reliability.

Goswami, Debashish

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Wendy Graham, University of Florida
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Mary Christman, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Effects of cattle exclusion best management practice on Phosphorus and Nitrogen discharges in the Lake Okeechobee basin

A study was conducted in a beef-cattle ranch to evaluate ditch fencing and culvert crossing as a best management practice (BMP) to reduce nutrient loadings within the Lake Okeechobee basin. The BMP was implemented within a 170 m ditch section in a ranch. The loadings and concentrations of Total Phosphorus (TP) and Total Nitrogen (TN) were compared for one pre-BMP (June-October, 2005) versus three post-BMP periods (June-October, 2006-08). During the pre-BMP period, P loading was 123.10 kg higher at downstream as compared to that at upstream from the BMP site. During the post-BMP periods in 2006 and 2008, downstream loadings of P were 17.31 and 88.03 kg lower as compared to those at upstream from the BMP site. Downstream P loading was 35% higher than that for the upstream during the pre-BMP period while downstream P loadings were 32 and 11% lower during the post-BMP periods of 2006 and 2008, respectively. There were net reductions of N loads at the BMP site during 2006 and 2008. Unusually dry conditions during 2007 resulted in the addition of P and N at the BMP site, probably due to the release of P and N from soil and aquatic plants. Considering the variability in rainfall and flows during the study period, three scenarios for P reductions were considered: conservative, moderate and liberal. The conservative estimate was the average P reduction for all the three post-BMP periods. The moderate estimate excluded the post-BMP2 when P was added at the BMP site. The liberal estimate considered only post-BMP3 when the P loading reduction was highest. The economic analysis of the BMP indicated that the cost for per kg of P removal for the conservative, moderate and liberal scenarios were $22.05, $12.93, and $7.74, respectively per kg of P.

Greco, Stacie

Authors: **Stacie Greco**, Alachua County Environmental Protection Department
James Myles, Alachua County Enviromental Protection Department
Paul Davis, Gainesville Regional Utilities
Anthony Dennis, Alachua County Health Department

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Public Private Partnerships

Crossing Agency Lines to Improve Water Quality in Gainesville's Urban Creeks

Communities struggling to meet water quality standards must form interagency partnerships to leverage funds, staff time, and knowledge if they want to find effective solutions. Stakeholders in the Gainesville area have worked together extensively for over five years creating a Basin Management Action Plan (BMAP) to serve as a roadmap for meeting Total Maximum Daily Loads. The BMAP requires large load reductions for fecal coliform bacteria in Hogtown and Tumblin Creeks and Sweetwater Branch. It is known that common sources of fecal pollution include public and private wastewater infrastructure, septic systems, waste of domestic and wild animals, and transient communities. It is difficult to reduce loads when the source locations and causes are unknown. To address this challenge, a "Hot Spots" Partnership has been formed from the Orange Creek BMAP working group. Alachua County Environmental Protection (ACEPD) investigated the urban creeks and conducted a reconnaissance of the stormwater collection systems discharging to areas with elevated fecal coliform concentrations. Gainesville Regional Utilities has used these results to thoroughly investigate their wastewater infrastructure in areas identified as suspect. The Alachua County Health Department inspected septic systems adjacent to impacted creeks. To address the ever moving source of pet waste, ACEPD conducted a social marketing campaign designed to motivate citizens to scoop, bag, and trash dog wastes at home and in the community. Several fecal coliform sources have already been identified and eliminated, as a result of these multiple agencies working together to solve a community level problem.

Guzha, Alphonce

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Providing Environmental Services from an Agricultural Impoundment in South Florida

The Florida Ranchlands Environmental Services Project (FRESP) aims to design, test and evaluate a market-based program to pay for water storage and phosphorus (P) retention environmental services on ranchlands. The project contributes to the Northern Everglades and Estuaries Protection Program (NEPP) goal to reduce phosphorus loadings to Lake Okeechobee from contributing watersheds. Eight pilot sites were identified and instrumented for quantifying water storage and nutrient retention. Results from a study for a storm water impoundment site are presented here. The site is a 1000 hectare impoundment within a cattle ranch in southwest Florida. Water was pumped from a public canal into the impoundment and outflow was measured at the downstream and returned back into the canal. Nutrient concentrations in the inflow and outflow water were measured. Water budget analyses for one year (July 2008 to July 2009) show total water inflow of 336 cm (205cm pumped from the canal and 131 cm rainfall). Discharge amounted to 112 cm (33%) while losses to evapotranspiration and seepage accounted for 42% (141cm) and 18% (60cm) respectively. An estimated 23 cm (7%) of water was still stored in the impoundment at year end. The maximum surface water storage in the impoundment was 80 cm and use of impoundment for water storage reduced the canal flows by 13%. Approximately 6.3 metric tons of P was pumped into the site and 2.7 metric tons was discharged, indicating a removal of 3.6 metric tons (58% P treatment efficiency) from canal water which would have been discharged to Lake Okeechobee. A nitrogen (N) treatment efficiency of 37% was also achieved. Results from this pilot site indicate that agricultural impoundments can be used as nutrient removal and water storage sites, and therefore help achieve NEPP water quality goals and provide additional income to the landowners for providing these services.

Heaney, James

Authors: **James Heaney**, U. of Florida

Category: Optimal use of integrated water supplies
Session Title: Water Conservation and Demand-Side Management

Cyberinfrastructure for Demand Side Management of Urban Water Supply

Efforts to manage the demand for urban water date at least to the late 1950's when Hirshleifer, DeHaven, and Milliman (1960) argued that the need for the California Water Project could have been avoided if water markets were created that would allow the scarcity value of water to be determined. This pioneering work has been followed by a steady stream of journal articles advocating the use of pricing mechanisms to manage the demand for water including using conservation rate structures that increase unit charges as customers use more water. At present, the majority of public water utilities in Florida have conservation rate structures. However, questions remain regarding the extent to which these rates actually reduce water demand. One notable feature of the many studies of the economics of water demand is that they have been macro-scale, cross-sectional, studies of entire utilities or selected customers. DeOreo, Heaney, and Mayer (1996) and Mayer et al. (1999) demonstrated the value of using a micro-scale, process oriented, approach to understanding the nature of urban water demand. Residential water use was measured at 10 second intervals for four weeks in 1,200 homes in 12 North American cities. These 10 second flow traces were converted into individual water using events, e.g., toilet flushes. Extensive customer survey data were also collected so that the observed water use behavior can be related to causative factors. The major shift during the past 15 years from macro scale (entire utilities), low frequency (annual) measurements to micro scale (individual customers, high frequency (seconds) measurements of water use has generated the need to develop cyberinfrastructure to manage this information in more efficient ways and to develop new analytical tools to evaluate these data sets of unprecedented size and complexity. This presentation will describe the state of the art in this area and indicate opportunities for greatly expanding research in these areas.

Heffernan, James

Authors: **James Heffernan**, Florida International University

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 2

Scales of variability in Florida Springs

Florida's karst springs are notably stable ecosystems, with chemistry, temperature, hydrology, and biotic activity exhibiting minimal changes over periods of weeks to months and years. However, springs chemistry also varies at longer time scales, in response to natural hydrologic variation and anthropogenic forcing. The biotic activity of springs ecosystems, converesely, exhibits marked variation over the course of the day. These two divergent scales of ecosystem variability can provide important insight into the workings of springs ecosystems, their potential responses to future chemical and hydrologic change, and the appropriate responses to understand and manage those responses. Specifically, we show that dissolved oxygen, and its responses to decadal scale variation in hydrology, vary considerably over time and among springs. This variation has important potential implications for organisms adapted to particular oxygen environments. At shorter time scales, diel variation in nitrate concentrations reflect assimilation of nitrogen by springs vegetation. Quantification of that diel variation provides insight into the mechanisms of the N cycle in springs, and its relationship to ecosystem metabolism. We show that the relationship between metabolism and the N cycle exhibits distinct responses to seasonal and event-driven changes in the light environment, highlighting the importance of ecological processes for the export of nutrients from spring-fed river systems. Thus, at both long and short time scales, springs exhibit variation that can provide scientific insight, but also must be incorporated into policy and management aimed at assessing and protecting the integrity of springs ecosystems.

Hendricks, Gregory

Authors: **Sanjay Shukla**, University of Florida
Gregory Hendricks, University of Florida
Zane Helsel, Rutgers University
Robert Gilbert, University of Florida
James Knowles, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Water Use for Three Biofuel Crops in South Florida

High fuel prices and a strong national interest in greater energy independence and conservation have made biofuels important for the foreseeable future. Southern west Florida has good potential for biofuel crop production. Large-scale production of biofuel crops is likely to affect the water and related land resources in the nation, including Florida. The effect on water supply is especially important for southwest Florida due to already stressed surface and ground water resources. Information needed to evaluate the water requirements of biofuel crops and their impacts on regional water supply is lacking. The water use for three energy crops, switchgrass, sweet sorghum, and sugarcane are being quantified at the Southwest Florida Research and Education Center (SWFREC). Six lysimeters located at the SWFREC (Immokalee, FL.) are being used to collect the data needed to compute crop evapotranspiration (ETc). Each lysimeter (4.9 X 3.7 X 1.4 m) is equipped to measure water input, output, and storage. The lysimeters are surrounded by a buffer area that is planted with sugarcane and sweet sorghum. Seepage irrigation is being used to grow the biofuel crops and is being managed based on the measured soil moisture. Soil moisture (0-70 cm) and groundwater depths are measured to quantify unsaturated and saturated zone storage. The irrigation, runoff, and drainage volumes are being measured using flow meters or pressure transducers. Climatic parameters including rainfall are measured at a nearby weather station. Preliminary data for the average ETc collected over 120 days for sweet sorghum, switchgrass, sugarcane was 593 mm, 547 mm and 504 mm, respectively. This data will be used in conjuction with reference ET values to determine crop coefficients for each crop. The study is continuing for two years to better quantify the water use for the three crops and conduct watershed-scale water supply analyses.

Herd, Kenneth

Authors: **Kenneth Herd**, Southwest Florida Water Management District

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Public Private Partnerships

"Can We Talk?" Southwest Florida Water Management District's Utility Outreach Program

The Southwest Florida Water Management District's (SWFWMD's) development and implementation of a Utility Outreach Program (UOP) will improve communication with the 170 water supply utilities within the District. SWFWMD has traditionally used regulation and cooperative funding to manage and influence water management decisions. Efforts toward enhanced collaboration are showing promise in making water management more effective and better integrated in the future. The SWFWMD's UOP will provide a "two way street" of communication allowing SWFWMD to better inform utilities of key programs and learn about specific challenges that utilities are facing. The program began in 2008 during the development of Polk County's Comprehensive Water Supply Plan. Since the plan encompassed the County's 17 municipalities, buy-in was needed from the municipalities in order for the plan to effectively guide long and short-term water supply planning. Also underway in 2008, were communications with the municipalities of East Pasco County and the City of Plant City to assist with their respective water supply planning efforts. A Utility Outreach Manual (UOM) will serve as a key communication resource in moving the UOP forward. The UOM will provide a concise description of each SWFWMD program/tool, its relevance to utilities and where to obtain more information. The UOM will cover topics such as: water demand projection GIS model, water conservation, 20 year water use permits, cooperative funding along with over a dozen other SWFWMD programs. One potential benefit of the UOP will be a more streamlined water use permitting (WUP) process as many of the UOP programs relate in some way back to the WUP. Given current economic conditions, state and local governments must strive to work more efficiently and share resources when possible. SWFWMD's UOP is a step in that direction.

Horton, Radley

Authors: **Radlley M. Horton**, NASA Goddard Institute for Space Studies

Category: Opening Plenary Session
Session Title: Plenary Session

Climate Hazard Assessment and Risk Management in the Southeastern United States

Climate variability and climate change in the Southeast present a range of hydrological, ecological, agricultural and infrastructural impacts. Climate impacts are driven both by: 1) long-term mean variables, such as temperature, precipitation and sea level, and 2) extreme events, such as cold air outbreaks, heat waves, intense precipitation events, droughts, and coastal storm surges. Methods have been developed that allow for policy-relevant climate forecasts and projections; sound risk management demands that uncertainty estimates are incorporated into the planning process. As important, from an impacts perspective, is research on system vulnerabilities. By linking specific climate hazards and impacts through stakeholder-driven assessments, adaptation strategies can be developed that minimize climate risk and leverage potential climate and societal benefits. Given the aforementioned uncertainties, monitoring/ reassessment and flexible adaptation strategies should be built into the planning process throughout the water sector and beyond.

Hurst, Marc

Authors: **Marc Hurst**, Independent Geological Services, Inc.

Category: Integrating science and policy for improved water management
Session Title: Monitoring and Modeling Hydrologic Processes

Water Table Buffering in Florida's Green Swamp

Surface water and water table elevations in Central Florida's Green Swamp area are strongly influenced by a water table buffering mechanism, which is somewhat analogous to the chemical concept of buffered solutions. The degree of drawdown or mounding of the water table resulting from small changes in rates of pumping or recharge are significantly limited due to interaction with an underlying confined aquifer through a leaky confining unit. Because typical head differences between the two aquifers are very small, rates and directions of leakage through the confining unit that separates them are sensitive to relatively small changes in potential of either aquifer. Leakage counteracts deviations from the buffered head relationship between the two aquifers by producing water from, or draining water into, the confined aquifer, which is a much larger and more transmissive reservoir than the unconfined aquifer. Observations of anomalous head relationships at sand mines in the region indicate the significance of the water table buffering mechanism, which forces water table elevations to track water potentials in the underlying confined Floridan Aquifer System much more closely in the Green Swamp area than in other places. The region's extensive wetland systems have developed in an environment characterized by limited range of water table fluctuation maintained by water table buffering. The extreme sensitivity of surface water levels in the Green Swamp area to Floridan Aquifer System drawdown should be carefully considered in planning for water supply development in the region.

Hwang, Syewoon

Authors: **Syewoon Hwang**, University of Florida
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Jose Hernandez, University of Florida
Christopher Martinez, University of Florida
James Jones, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Assessment of Mesoscale Dynamical Downscaling Model (MM5) for Regional Climate Simulation in the Tampa Bay region

This research analyzes the temporal and spatial variability of historic precipitation in Tampa Bay region and evaluates the ability of the mesoscale downscaling model (MM5, Grell et al., 1994), to reproduce this variability. The long term goal of this effort is to evaluate the utility of using MM5 to downscale GCM forecasts and climate change scenarios for improving water management decisions in the Tampa Bay region. Cumulative probability distributions were constructed using observed daily and monthly rainfall at each station, and the spatial correlations between the 53 stations were analyzed for each month using covariance and variogram analysis for both observed data and MM5 predictions. MM5 was run to predict precipitation at 9x9 and 27x27 km2 spatial resolutions and 6-hour temporal resolution over the 23 year period from 1986 to 2008 using the NCEP/NCAR reanalysis data set as initial and boundary conditions. The raw precipitation predictions were then bias-corrected at each observation station using the cumulative probability distribution mapping approach (Wood et al., 2002). Daily and monthly precipitation totals were estimated over the Alafia and Hillsborough River watersheds using the bias-corrected point precipitation and observed variogram functions. MM5 performance was assessed by cross-validating predicted daily and monthly point and total watershed precipitation for each month. Variograms from the bias-corrected daily precipitation predictions in general indicated that MM5 overestimates the strength of the spatial correlation and underestimates the variance of precipitation compared to the observed data, especially in the summer months when convective storms dominate. The simulations for each month reproduced the daily mean point precipitation values with an average error of -0.0641 in (Jul.) to 0.0214 in (Oct.) with an average RMSE of 0.6834 in (Mar.) to 0.9449 in (Sep.) over the 53 rain stations. Monthly mean point precipitation values were reproduced with an average error of -0.7110 in (Jun.) to 0.2732 in (Aug.) with an average RMSE of 1.8154 in (Mar.) to 5.1194 in (Sep.) over the 53 stations stations. Point kriging the bias-corrected daily precipitation fields over the watersheds reproduced the observed rainfall with an average RMSE of 0.3550 in (Jan.) to 0.6977 in (Sep.) over the 53 stations. Block kriging the bias-corrected daily precipitation fields over the watersheds reproduced the observed block kriged rainfall with an average RMSE of 0.3104 in (Feb.) to 0.5932 in (Sep.) over the 23 years. In all cases actual kriging errors were well predicted by the kriging standard deviation estimate. In the next phase of this research the methodology developed here will be used to produce spatially distributed bias-corrected precipitation estimates from downscaled MM5 predictions that use GCM forecasts and IPCC scenarios as boundary conditions. These precipitation fields will be subsequently be used in a hydrologic model to predict streamflow response to climate fluctuations and climate change scenarios in order to improve the operation of water supply reservoirs in the region.

Irizarry-Ortiz, Michelle

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Category: Managing water and energy in a transitioning environment
Session Title: Incorporating Climate Predictions into Water Planning and Management

Historical Trends in Florida Temperature and Precipitation

Climate change investigations should always be preceded by understanding the trends in historical climatic and other associated environmental data. Historical temperature and precipitation data for south Florida weather stations with the longest and most complete records have been analyzed for structural changes. The analysis includes tests for the significance of trends and change points in both the mean and variance. The primary data investigated included long term records of precipitation and temperature. A comprehensive collection of statistics for these two variables has been analyzed to investigate if there is a consistent regional trend that may be present in the state-wide historical data. Trend detection was carried out for the entire period of record at each station as well as for the period from 1950 to 2007 to determine if there has been any local acceleration in trends consistent with those reported by the IPCC (2007) for global temperature. The analysis shows no significant region-wide linear trends in either averages or extremes of temperature and precipitation. Notable exceptions include increasing trends in both the number of hot days in a season, and minimum daily temperatures since the 1950s at a large proportion of the stations analyzed. Multi-decadal trends in median (across stations) annual temperature anomalies have been detected in the datasets. This nonlinear trend pattern in annual temperature is characteristic of the global trend. Future work includes the attribution of this nonlinear trend pattern to either natural climate variability associated with climate teleconnections or anthropogenic factors such as land use changes. Multi-decadal trends in south Florida precipitation patterns have been reported previously (Trimble et al. 2007).

Jackson, C.

Authors: **C. Rhett Jackson**, University of Georgia

Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 1

Applying a Broad View of Hydrologic Connectivity to ACF Basin Water Resources Management

Rivers move not only water, but also sediment, nutrients, carbon, toxins, energy, and organisms. Complete assessments of river health and effective management of water resources both require a broad view of physical, chemical, and biological water quality and a comprehensive examination of hydrologic connectivity. Many of the contested issues in the ACF basin political conflicts look different when viewed more broadly. For example, in the Apalachicola River, trapping of sediment in Lake Seminole coupled with maintenance of relatively natural peak flow regimes has resulted in downstream channel degradation with well documented negative ecological effects. Rather than focusing on minimum flows, a better way to achieve desired ecological conditions may be to manage channel geomorphic conditions more directly and to construct artificial fish passage on Woodruff Dam. Furthermore, a comprehensive view of connectivity also reveals paradoxes in resource management. If one were to focus solely on downstream flows, the development of Atlanta has resulted in a net addition of water to the system (by compacting soils and reducing transpiration). Few downstream users, however, would likely trade the increased amount of water for the degraded quality.

Jamison, Mark

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Araceli Castaneda, PURC, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Managing Water and Energy in a Transitioning Environment

Reset for Regulation and Utilities: Leadership for a Time of Constant Change

This paper describes a process for a reset of regulation and water utilities in today's environment of constant change. "Reset" means that we develop fresh perspectives and knowledge about the future, all the while holding in trust the wisdom of the past. The paper examines three juxtapositions. The first is to focus on next practices, not best practices. Best practice is about following in someone else's footsteps, whereas next practice is about going into areas where no one has gone before. The second is focusing on why rather than focus on what. Asking "What should we do next?" emphasizes practice whereas asking "Why have certain practices been successful?" searches for underlying needs and context. The third juxtaposition is between leading and leadership. A leader provides direction, which is proper when the right direction is known. In contrast leadership mobilizes people to tackle difficult and often ambiguous problems and circumstances.

Jerauld, Mike

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Factors controlling long-term phosphorus removal in six large constructed treatment wetlands in the Everglades basin, Florida

Over the past 15 years, the South Florida Water Management District has constructed 6 treatment marshes, called Stormwater Treatment Areas (STAs), to capture the phosphorus (P) from agricultural runoff before it enters the Everglades, an oligotrophic wetland susceptible to anthropogenic eutrophication. Because of the massive investment to construct these 18,000 ha wetlands, it is important to evaluate their long-term sustainability and to identify the STA components, processes and parameters that regulate P retention. Period-of-record hydrologic and water quality data are analyzed here to evaluate the impacts of various factors on treatment performance. Outflow P concentration was jointly controlled by areal P loading rate and inflow P concentration. Phosphorus mass removal effectiveness (PMRE) was not correlated with estimated wetted area*time, depth distribution or hydraulic residence time. Water column P forms were removed differentially in the STAs, but the composition of the influent TP pool did not predict PMRE. Removal of P was well correlated with the removal of calcium (Ca) but not correlated with Ca loading. Of the wetland components currently manageable by the District, only the areal P loading rate was found to affect outflow concentrations. The highly stochastic nature of the currently available datasets is a limiting factor in the illumination of process-level P dynamics that may be necessary to explain the apparent variability.

Johnson, Nathan

Authors: **Nathan Johnson**, University of Florida
Dr. Gregory Kiker, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Model Evaluation and Climate Variability Application to the Systems Dynamic STELLA© the Apalachicola Chattahoochee Flint (ACF) Basin

The ACF-STELLA model was created during the comprehensive study of the Apalachicola Chattahoochee Flint watershed in the mid-90's. It was created as a shared vision model to assess the hydrologic regimes of the river under different forecasted demand datasets to determine a viable allocation strategy for the river system. However, since 1989 there has been ongoing negotiation, discussion, mandated compromise, litigation and still no permanent water management plan has been adopted. Unlike a more physical based watershed model, this model uses system dynamic processes on a STELLA© platform. Reaches have been simplified into the Chattahoochee, Flint, and Apalachicola with local inputs and grouped external inputs. The model was then overlain by human constructs and dam release logic under the Interim Operation Plan (IOP) as well as the Revised Interim Operations Plan (RIOP). Unimpaired flow datasets from 1939-2001 produced by the Army Corps of Engineers derived from original USGS datasets force the model. Evaluation techniques have been used to test the model in terms of accuracy of simulated data compared to measured flow through the use of the coefficient of determination (R2), the Nash-Sutcliffe efficiency (NSE), root mean squared error of monthly totals of daily streamflow, and graphical techniques. Moreover, drought in the southeast United States in 2006-2008 has recently brought a greater surge of attention to water management in the ACF as escalating water use conflicts intensify pressure for good policy and water distribution. Climate variability was incorporated into the ACF-STELLA model using established ENSO indicators using Wilcoxin rank sum tests and other statistical methods.

Jones, Pierce

Authors: **Pierce Jones**, Program for Resource Efficient Communities, University of Florida
Barbra Larson, University of Florida
Dave Bracciano, Tampa Bay Water
Gene Boles, University of Florida
Eleanor Foerste, UF/IFAS Osceola County Cooperative Extension

Category: Managing water and energy in a transitioning environment
Session Title: Managing Water and Energy in a Transitioning Environment

Land Development, Water and Accounting for Greenhouse Gas Emissions in Florida

In June 2008 Governor Crist signed HB 697 that amended Florida's Local Government Comprehensive Planning Act, requiring that local governments integrate energy efficiency and reduced greenhouse gas (GHG) emissions into various required comp plan "elements". As groundwater availability for public supply declines, water utilities are looking to alternative water supplies. In addition to higher costs associated with the development, operation and maintenance of alternative water supplies, HB 697 suggests that GHG emissions be considered. This presentation discusses the energy-water nexus of alternative water supplies, associated carbon footprint of various supply strategies (as well as quality impacts) and potential impact on Florida land development patterns in master planned communities. More specifically, the presentation considers how HB 697 could impact conservation strategies including better land design practices to maintain native vegetation and drainage, low impact development (LID) as well as resource-efficient landscape design, plant material selection and irrigation.

Kanapaux, William

Authors: **William Kanapaux**, University of Florida

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Assessing Visitor Impact on Coastal Habitats in South Carolina's ACE Basin

This poster reports initial data from a visitor impact study of an ecologically sensitive barrier island ecosystem first opened to the public in July 2008. The study combines social, spatial and ecological data in an adaptive management framework to analyze visitor impact on the site, with a focus on two species of concern: loggerhead turtles (Caretta caretta) and least terns (Sterna albifrons). The study site, Botany Bay Plantation, is located on Edisto Island, South Carolina. It comprises 4,687 acres (1,897 hectares) of beach, tidal marsh, agricultural fields, forest and brackish and freshwater ponds. The plantation simultaneously serves as a wildlife management area, a heritage preserve and a beach destination for vacationers and local residents. About 50,000 people visited the site in its first year of public access. Botany Bay Plantation serves as important habitat for a number of wildlife species. Such coastal habitat is under increased pressure from development and subsequent fragmentation on Edisto Island and neighboring barrier islands. The site is also under pressure in its dual roles as a wildlife management area and a tourist attraction. The amount of vehicle and foot traffic now on site far exceeds traffic at any time when the property was privately owned. I report on data from summer 2009 field work, the start of a two-year study. The data include visitor-use surveys, spatially defined beach-density surveys, beach turnover counts, visitor check-in logs, loggerhead nesting data, least tern nesting data and interviews with management staff and stakeholders. Descriptive statistics and qualitative analysis are presented. These analyses are used to examine the tensions between conservation of a diminishing coastal resource and public access to it. They also set the stage for developing a simulation model to help manage visitor impact on site.

Kane, Andrew

Authors: **Andrew Kane**, University of Florida Aquatic Pathobiology Laboratory
David Reese, Department of Small Animal Clinical Sciences, College of Veterinary Medicine, University of Florida
Joan Browser, Southeast Fisheries Science Center, National Marine Fisheries Service, National Oceanographic and Atmospheric Administration

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 2

Fish Deformities and Stress in the St. Lucie Estuary System

The St. Lucie Estuary, located in Southeast Florida, is threatened by increasing residential and commercial development, industry and agriculture. Construction of extensive agricultural and urban drainage projects has substantially altered the St. Lucie watershed, and the effects of these anthropogenic changes are associated with the distribution, quality, and volume of freshwater entering the estuary. Chemical contamination emanating from regional industry, agriculture and golf courses also contributes to stress on this estuary that serves as a vital component of the environmental and economic well-being of Martin, St. Lucie and surrounding counties. The health of the fish that live in potentially impacted waters can serve as a biotic index to integrate the effects of multiple stressors. This study reports observations of physical deformities from fish collected in the St. Lucie River and adjacent waterways from 2006 September to 2008 February. Thirty-four fish with deformities were archived frozen and digitally photographed and radiographed to generate observational data. Eleven species of fish, representing 7 taxonomic families, were observed; black margate and pinfish were the two most common species. Deformities primarily included missing or deformed dorsal fin spines or pyterygiophores, with or without concave defects along the dorsal surface. The prevalence of these anomalies in the field-sampled population in the St. Lucie system was approximately 0.18%. These deformities may be developmental/genetic, and/or associated with a variety of other etiologies including trauma, parasites, infection or environmental chemical exposure. There is no direct evidence, however, making such a link at this time. A website has been developed to provide details of the study for other investigators and to allow input from complimentary disciplines [http://aquaticpath.epi.ufl.edu/deformities]. Ongoing studies are focusing on histopathology, as well as examination of water and sediment data to explore relationships between deformities within the different fish species and various environmental stress agents.

Kaplan, David

Authors: **David Kaplan**, Department of Agricultural & Biological Engineering, University of Florida
Rafael Muñoz-Carpena, UF Agricultural and Biological Engineering
Yongshan Wan, South Florida Water Management District
Marion Hedgepeth, South Florida Water Management District
Dick Roberts, Florida Park Service (Retired)

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Linking River, Floodplain, and Vadose Zone Hydrology to Improve Restoration of a Coastal River Impacted by Saltwater Intrusion

Floodplain forests provide unique ecological structure and function, which are often degraded or lost when watershed hydrology is modified. Restoration of impacted ecosystems requires an understanding of surface water, groundwater, and vadose (unsaturated) zone hydrology in the floodplain. Soil moisture and porewater salinity are of particular importance for seed germination and seedling survival in systems impacted by saltwater intrusion, but are difficult to monitor and often overlooked. This study contributes to the understanding of floodplain hydrology in one of the last bald cypress (Taxodium distichum [L.] Rich.) floodplain swamps in southeast Florida (USA) by investigating soil moisture and porewater salinity dynamics in the floodplain of the Loxahatchee River, where reduced freshwater flow has led to saltwater intrusion and a transition to salt-tolerant, mangrove-dominated communities. Twenty-four dielectric probes measuring soil moisture and porewater salinity every 30 minutes were installed along two transects perpendicular to the river—one in an upstream, freshwater location; the other in a downstream tidal area. Data collected over four years quantified the spatial variability and temporal dynamics of vadose zone hydrology and showed that soil moisture can be closely predicted based on river stage and topographic elevation (coefficient of efficiency = 0.83). Porewater salinity rarely exceeded tolerance thresholds for bald cypress upstream, but did so in some downstream areas, explaining observed vegetation changes. The results offer a methodological and analytical framework for floodplain monitoring in other locations where restoration success depends on vadose zone hydrology and provide relationships for evaluating proposed management scenarios for the Loxahatchee River. (Additional authors: Fawen Zheng, SFWMD and Rob Rossmanith, FPS)

Katz, Brian

Authors: **Brian Katz**, U.S. Geological Survey
JK Bohlke, USGS
Hal Davis, USGS
Dale Griffin, USGS
David Toth, SJRWMD

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 1

Integrating Information on Spring Water Age, Water Quality, and Land Use to Better Understand Vulnerability of Springs to Contamination

Multiple chemical tracer techniques have been used to better understand groundwater flow paths and the chronology of nitrate contamination in Florida's spring systems. Transient tracers (chlorofluorocarbons, sulfur hexafluoride, tritium, and helium-3) along with lumped-parameter models were used to assess average residence times of groundwater discharging to springs in several spring basins. Data for tracers in most sampled springs were consistent with exponential and binary mixing models that represent mixtures of water in the Upper Floridan aquifer recharged after the early 1960s. Groundwater residence times were roughly proportional to spring magnitude, dissolved oxygen concentrations, and the calcite saturation index. Trends in elevated nitrate-N concentrations (above background levels of 0.1 mg/L) and nitrogen isotope data in spring waters were related to the location and amount of nitrogen loading from various sources in the different springs basins. For example, temporal trends in nitrate concentrations in most springs in the Suwannee River basin were consistent with fertilizer usage over agricultural areas throughout the basin during the last few decades; whereas trends in nitrate concentrations in springs in the Wakulla Springs basin were related to the land disposal of treated municipal wastewater and fertilizers applied at a sprayfield farm site about 15 km upgradient from the studied springs. Low nitrate-N concentrations in studied spring waters in the St. Johns River basin were related to complex mixtures of old and young groundwater, with elevated nitrate-N concentrations likely contributed from recent recharge (

Kerr, Debora

Authors: **Earl Fox, MD, MPH**, Florida Public Health Institute
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Daniel Parker, MSP, Florida Department of Health
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Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Public/Private Partnerships: the Role of Public Health in Water Sustainability Policy Development for Decision Makers

Climate change is a significant threat to public health across a national/international scope. Variability in climate change can lead to changes in freshwater quantity, quality and safety. Coastal areas remain most vulnerable to such impacts. It is imperative to develop and implement policies to mitigate natural and human influences on climate change and to respond to new challenges of adaptation at the regional and local level to reduce health risks. Promotion of environmental policies that prepare for climate change and adaptation can reduce health burdens and other uncertainties through information and education, partnership and collaboration of both private and public sectors. A sustainable policy making approach that considers total cost accounting, life cycle assessments, conservation of natural resources, and zero waste will educate and empower citizenry on the true costs and limited nature of our resources while providing more sustainable decision-making guidance for policymakers. An approach that begins with water is both timely and effective. Sustainable decision-making and climate change adaptation sensitive policies will allow a better overall assessment of the various uses of our water, a shifting away from wasteful practices, and promotion of long term economic and public health savings. Such a model can also be applied to policy decisions on other critical issues in the state. The public health sector is best positioned for this initiative as they are tasked with protecting drinking water, considered a trusted provider of information by the public, and are at the nexus of regulatory, policy making, and service provisions. With the establishment of a Florida Public Health Institute-Health Policy Bureau, public health professionals can better elaborate on the health outcomes of current trends in Florida, provide decision makers with neutral public policy considerations with perspective in safe water and climate change adaptation, and promote greater collaboration toward sustainable, livable communities.

Khare, Yogesh

Authors: **Yogesh Khare**, University of Florida
Christopher Martinez, Assistant Professor, Agricultural &; Biological Engineering Department, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Detection of trends in stream flow, base flow and nutrient concentrations in the Alafia River

Determination of long term and seasonal trends is important in order to study the impact of land use and climate change on discharge variables and nutrient concentrations. The objective of this study was to determine yearly and seasonal trends in discharge variables and several water quality parameters in the Alafia River watershed. The data was obtained from U. S. Geological Survey discharge gage stations and Environmental Protection Commission of Hillsborough County (EPCHC) water quality gage stations. Gages were selected based on length of time series and were grouped into 3 pairs based on their locations. Station 1 (North Prong Alafia River near Keysville) and station 2 (South Prong Alafia River) are on the upstream side of station 3 which is on main Alafia River. The study period ranged over the years 1974-2007. Non-parametric trend detection techniques namely Mann-Kendall test and Seasonal Kendall test were used for analysis. In all, three discharge variables (stream flow, base flow and percentage base flow) and four water quality parameters (Total Phosphorus, Total Kjeldahl Nitrogen, Ammonium and Nitrite/Nitrate Nitrogen concentrations) were tested. Yearly as well as seasonal stream flow, base flow and percentage base flow did not show any significant trend at any location. Seasonal Total Phosphorus (TP) and Ammonium concentrations decreased considerably at all stations, while Nitrate/Nitrites concentrations decreased at two of the three locations, station 1&;3. On the other hand, Total Kjeldahl Nitrogen (TKN) concentration increased at station 2&;3. Water quality parameter trends (except TKN trends) at North Prong Alafia River and the main Alafia River were similar. Impact of land use and climate change on discharge variables is minimal. Amongst the water quality parameters Total Kjeldahl Nitrogen showed adverse trends and hence needs a due consideration.

Kincaid, Todd

Authors: **Todd Kincaid**, GeoHydros, LLC
Brent Meyer, GeoHydros, LLC
Jon Radtke, Coca-Cola North America

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 1

Modeling Karstic Controls on Watershed-Scale Groundwater Flow in the Floridan Aquifer of North Florida

The Coca-Cola Company has sponsored the development of a steady-state, dual-permeability, 3D groundwater flow model for the Western Santa Fe River Basin (WSFRB) of north-central Florida. The model specifically addresses key karstic features including springs, swallets, mapped caves, and tracer-defined groundwater flow paths that are known to exert significant controls on groundwater flow and the degree of groundwater / surface water mixing. The model has been released to the public in order to help resource managers and planners minimize land use impacts on the quality and quantity of groundwater in the WSFRB. The model was independently calibrated to two separate datasets describing groundwater levels and individual spring discharges under high-water and low-water conditions using the same permeability framework but different recharge configurations. More than 1000 model runs were performed with variations in matrix conductivity and conduit pattern and dimensions. The final model-simulated conditions matched or very nearly matched observed conditions at more than 175 monitoring wells and 13 springs in the WSFRB. Final results revealed that groundwater flow is controlled by sets of dendritic conduit systems that deliver water to the largest springs from as far as 40 km across the basin. Simulated groundwater velocities range from 10-4 m/day in the matrix to as much as 10+3 m/day in the conduits. Simulated travel-times reveal that springs vulnerability is determined by proximity to the conduits rather than to the actual springs. The broader significance of the modeling results, however, is the knowledge that plausible karstic groundwater flow conditions can be reasonably simulated if key karst features, such as springs, swallets, caves, and traced flow paths, are included in the model framework. Predictions derived from models constructed in this manner will be more representative of actual conditions in the aquifer than those derived from models based on traditional porous-media assumptions and techniques.

Kipp, Mary

Authors: **Eleanor Foerste**, UF Program for Resource Efficient Communities
Jennison Kipp, UF/IFAS Program for Resource Efficient Communities
Pierce Jones, Director, UF/IFAS Program for Resource Efficient Communities
Dave Bracciano, Tampa Bay Water

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Accounting for the Carbon Costs of Alternative Water Supplies in Florida

Florida's local governments and water utilities are faced with many challenges related to providing a sustainable water supply for a growing population. As freshwater availability for public supply declines, the demand for alternative sources grows. Costs associated with the development of alternative water supplies are extensive and varied, including permitting, capital, operation, maintenance and now, mitigation for greenhouse gases (GHG). This study looks at the energy-water nexus of alternative water supplies and calculates the carbon footprint of various supply strategies including surface water, reservoir (rainwater capture), desalination, reclaimed and groundwater pumping in one region of Florida. Data from Tampa Bay Water and others will be used to analyze the energy costs and carbon footprints of the various alternative water supply strategies. It provides a compelling argument for cost avoidance through conservation strategies including better land design practices to maintain native vegetation and drainage, low impact development (LID) as well as resource-efficient landscape design, plant material selection and irrigation.

Kippax, Victoria

Authors: **Lisa Sorgini**, Siemens Water Technologies

Category: Managing water and energy in a transitioning environment
Session Title: Managing Water and Energy in a Transitioning Environment

Issues, Trends and Technologies dealing with Wastewater Management and Biosolids

Focus will be on water and energy. The issue surrounding wastewater management and biosolids. Wastewater is a huge energy consumer in the water industry. There is also an environmental component here. As communities grow, there is more and more waste to manage. Thus, the need to reduce it.

Lisa will discuss the overall trend and technologies and references associated with this issue/challenge.

Further information: A municipality's primary goal in relation to water and wastewater is to provide adequate conveyance and meet regulatory requirements. The focus for wastewater has been focused on discharge limitations and ease of use. However, more and more communities are taking a holistic approach to treatment, looking at biosolids and energy.

Roughly 2-3% of the world's energy bill is spent treating and distributing water and wastewater. In the USA, on average, roughly 30% of a municipalities energy bill is spent on these services. At a wastewater treatment plant alone, up to 60% of energy usage is attributed to aeration, and the majority of plants know that they over aerate to ensure their treatment goals are met.

Siemens is investing in technologies that will help communities meet regulations, but also reduce the overall footprint of a plant, reduce waste sludge generation, and reduce the need for aeration – thus, reducing overall energy usage. The goal is better performance and ability to meet regulations while achieving lower life cycle energy costs.

Kisekka, Isaya

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Michael Duke, University of Florida, Agricultural and Biological Engineering Department
Bruce Schaffer, University of Florida, IFAS Tropical Research and Education Center
Jonathan Crane, University of Florida, IFAS Tropical Research and Education Center

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Evaluation of Evapotranspiration-Based Irrigation Scheduling Technologies in a Tropical Fruit Orchard in South Florida

Evapotranspiration (ET)-based irrigation scheduling technologies were investigated in a carambola orchard irrigated with micro-jets. The objectives of this study were to: 1) evaluate water savings with ET-based irrigation technologies using real-time and historical weather data to schedule irrigation, and 2) evaluate the effect of ET-based irrigation scheduling on net CO2 assimilation (A), transpiration (E), stomatal conductance (gs), stem water potential ( ) and fruit yield, Four treatments namely: 1) real-time ET-based irrigation scheduling operated through a Toro-Intelli-Sense-612 controller (T1), 2) historical ET-based irrigation scheduling operated through a Rain-bird ESP-12-LX-plus timer (T2), 3) typical irrigation schedule for carambola in south Florida (76 mm/ week) (T3), and treatment 4 (T4) a non irrigated treatment were replicated three times and evaluated for differences in water applications and physiological plant responses. Results indicate T1 and T2 applied 68% and 70% less water compared to T3 respectively. Treatment 1 maintained the highest average weekly soil water content (?) of 29% while T4 maintained the lowest ? of 24%. There were no significant differences in among treatments, all treatments averaged -0.8 MPa. There were also no significant differences in carambola fruit yield among treatments. However, there were some significant differences in E and gs among treatments with T2 registering the highest E and gs while T4 registering the lowest. Across treatments, there were no significant differences in A, all treatments averaged 4.7 µmol m-2 s-1. Results suggest that adopting ET-based irrigation scheduling technologies could provide tropical fruit growers with several benefits including: reduced water volumes applied and consequently reduced energy inputs without negatively affecting the physiology of the plants.

Knight, Robert

Authors: **Robert Knight**, Wetland Solutions, Inc.

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Engineered Wetlands for Mitigation of Groundwater Nitrate Contamination in Florida

Nitrate nitrogen concentrations in the Floridan aquifer have reached excessive levels over much of the state due to rising anthropogenic nitrogen loads. While mostly below the drinking water standard of 10 mg/L, existing groundwater nitrate concentrations are more than 1 mg/L (about 50 times over background) under much of the state and are resulting in impairment of surface water resources and especially artesian springs and spring-fed rivers. A comprehensive effort will be needed to effectively lower nitrogen loads and to reduce elevated groundwater nitrate concentrations. Constructed treatment wetlands offer a viable, cost-effective alternative for reducing nitrogen loads from a variety of cultural practices such as stormwater management, municipal wastewater treatment and disposal, on-site sewage disposal systems, agricultural runoff control, and industrial/agricultural wastewater management systems. This presentation describes an overview of the issues related to nitrogen management in the state's surface and groundwater resources and actual case histories indicating the technological and cost effectiveness of constructed wetlands to deal with these loads.

Knight, Ph.D., Robert

Authors: **Robert Knight**, Wetland Solutions, Inc.

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 2

Whole Ecosystem Metabolism as an Indicator of Spring Impairment and Recovery

Springs are uniquely adapted for ecosystem-level studies. Their relatively constant flows, chemistry, and water temperature allow use of powerful analytical tools for assessing whole ecosystem metabolism, including primary productivity and community respiration. These tools have been utilized in Florida's artesian springs over the past half century to quantify and demonstrate their significance among Florida's many natural wonders. Recent studies have found that springs impacted by rising nitrate nitrogen concentrations and by a variety of other human-induced stressors have altered levels of ecosystem metabolism. Documentation of biological impairment and eventual recovery of impacted springs must be comprehensive across trophic levels, sensitive to impacts, reproducible, and cost effective to implement. Whole ecosystem metabolism measurements are an effective information and management tool that meets these goals.

Koski, Katrina

Authors: **J. L. Wison**, New Mexico Institute of Mining and Technology
Katrina Koski, New Mexico Institute of Mining and Technology

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Influence of Phreatic Conduit Floods on Matrix Storage in Confined and Unconfined Karst

Conduits are common features in some karst aquifers, providing most of the flow capacity, but relatively little of the storage. These conditions are found, for example, in the unconfined Floridan aquifer of the United States and on the Yucatan Peninsula of Mexico. Karst conduits respond quickly to precipitation events, propagating floods that might originate with a sinking stream and eventually discharge to a spring. As the flood passes, water moves from the pressurized conduit to the surrounding rock matrix where it is stored; then, as the flood passes some of the stored flood water returns to the conduit. The amount, pattern and nature of storage is strongly influenced by the presence of an overlying water table and natural recharge. We investigate this influence using mathematical models, with implications for speleogenesis, contaminant sequestration, and aqueous geochemistry.

Kurz, Marie

Authors: **Marie J. Kurz**, University of Florida
Jonathan B. Martin, University of Florida
Veronique de Montety, University of Florida
Matthew J. Cohen, University of Florida
Chad R. Foster, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Pore water chemistry in a spring-fed river: Implications for hyporheic control of nutrient cycling and speleogenesis

Hyporheic exchange is important for nutrient cycling in rivers, but little is known about the magnitude of this process in karst systems or its influence on speleogenesis and the formation of river channels. We use three pore-water depth profiles to assess nutrient and carbonate processing in the hyporheic zone of the Ichetucknee River (north-central, Florida). The Ichetucknee River is sourced from six major and numerous small springs which discharge from the karstic Floridan Aquifer. Order of magnitude increases in nitrate concentrations since the mid 20th century have been implicated in a recent proliferation of algae in the river. Nitrate concentrations decrease downstream and exhibit diel variations, along with specific conductivity and calcite saturation state. These patterns reflect in-stream processing, but hyporheic exchange should also influence the overall dynamics of nutrient and Ca fluxes in the river. Our depth profiles extend through unconsolidated sediment to solid carbonate of the Floridan Aquifer at 116, 121, and 181cm below the river bed. The profiles were taken ~10m from the stream banks and midway across an ~100m wide section of the river. Dissolved organic carbon (OC) immediately decreases to values below detection limits while dissolved inorganic carbon increases. This suggests the remineralization of solid OC in the upper sediments causing observed decreases in dissolved oxygen and pH and increases in NH_4^+. The lower pH drives dissolution of the carbonate sediment, causing increases in specific conductivity, alkalinity and calcium concentrations. Phosphate concentrations also increase probably as a result of carbonate mineral diagenesis and/or OC remineralization. Decreases in nitrate concentrations indicate denitrification occurs in the pore water. Most of these reactions appear to occur in the upper 60cm of sediment, below which many concentrations return to groundwater levels, suggesting influence of groundwater from the Floridan Aquifer at the base of the sediment.

Lagerwall, Gareth

Authors: **Gareth Lagerwall**, University of Florida
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Raphael Muñoz-Carpena, University of Florida, Agricultural and Biological Engineering Department

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Application of various ecological algorithms to accurately predict Typha domingensis (Cattail) dynamics throughout the Everglades

The Transport and Reaction Simulation Engine (TARSE) is a flexible, user-defined, module that was initially created to simulate phosphorus dynamics in the everglades. It is a plug-in module requiring a hydrologic driver, from which it obtains values for stage and flow. Due to its user-defined nature, TARSE enables the user to define the complexity of the relationships between its constituents. As an object oriented code base, TARSE allows for additions where necessary, without much change to the existing code. As such, TARSE was selected as the module to use, with the Regional Simulation Model (RSM) as the driver. To test the various ecological algorithms, it was decided that cattail dynamics would be modeled over the WCA2A region at increasing levels of complexity. The two ecological algorithms used are a standard Habitat Suitability Index (HSI), where each cell in the mesh has a probability of cattails existing within them based on various suitability factors; and a diffusionary-front type algorithm, whereby cattails slowly spread across cells with favorable conditions. The three main factors affecting cattail spread are hydrology (depth, and hydroperiod), nutrient concentrations (specifically phosphorus), and fire disturbance. As such the increasing levels of complexity include a stochastic population; a population influenced solely by water depth; a population influenced by a combination of depth and phosphorus concentration; and an interaction with a competing species such as Claduim jamaicense (Sawgrass). The different algorithms and complexities are analyzed and compared to determine the one best suited for application in the rest of the everglades system.

Lauretta, Matthew

Authors: **Matthew Lauretta**, University of Florida
Thomas Frazer, University of Florida
William Pine, University of Florida
Eric Nagid, Florida Fish and Wildlife Conservation Commission

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Increased nutrient loading in Florida's spring-fed, coastal rivers: effects on habitat and faunal communities.

Long-term research on spring-fed rivers along Florida's central gulf coast indicates that rapid, large-scale changes in aquatic vegetation composition and biomass have occurred in several systems over the last decade. Aquatic macrophyte abundances have precipitously declined coincident with marked increases in nutrient loading rates and periphyton associated with the plants. The potential broader-scale consequences of nutrient over-enrichment on the ecological health and integrity of coastal rivers is currently unknown. The goal of this project was to provide the complementary fish and invertebrate data necessary to identify and characterize broad-scale ecological impacts associated with vegetative habitat loss. Our specific objectives were to quantitatively characterize the fish and invertebrate assemblages in two coastal rivers with contrasting vegetative habitat structure, and to quantify the food habits of fishes so that trophic relationships could be established. Invertebrate assemblages associated with submersed aquatic vegetation differed considerably between rivers with dissimilar vegetative habitats, while invertebrates assemblages associated with sediments were comparable in composition. Freshwater and saltwater fish abundances and biomass were significantly greater in river reaches where submersed aquatic vegetation was most prevalent, and the fish community structures were distinctly different between rivers. Crustaceans were found to be an important food source for fishes in both systems, and substantial differences were observed in the composition of crustaceans consumed in each river. This research suggests that large-scale changes in vegetative habitat may impact faunal community structure, abundance, biomass and trophic interactions in spring-fed, coastal rivers.

Lee, Mengshan

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Wei Lee, Florida International University

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Miami-Dade Water Conservation Plan: Part I Senior Retrofit Program

Senior retrofit program is one of the Miami-Dade Water and Sewer Department (MDWASD) water use efficiency plans. MDWASD has implemented the plan for sustainable and healthy water resource management. The senior retrofit program started in late 2006, which offered low income senior families not only to save their water use but also to save money on their water bills by installing high efficiency appliances. A total of 423 senior families were selected to participate in the program. The data presented in this report are for the period from October, 2005 to September, 2008. The single family residences identified were retrofitted with high efficiency toilets, showerheads and aerators. The new model of dual flush toilets help customers save water by difference in water quantities used in each flush. For the showerheads, the new one has a flow rate of 1.5 GPM which could reduce water demand by at least 32% during 8 minutes at shower bases. Aerators were installed in kitchen and bathroom faucets and equipped with needle and bobble spray patterns, both of which hold consistent high pressure at lower water flows. For the senior families participating in this program, the average water consumption was reduced from 98.36 GPD in 2005 to 94.72 GPD in 2006 and to 81.36 GPD in 2007. The customers who constitute the top 10% of the highest water use in this group have reduced their average water use from of 403.67 GPD in 2005 to 322.12 GPD in 2007. The customers representing the 10% lowest water use also reduced their average water consumption from 18.29 GPD to 16.44 GPD in 2007. Relative to water use in year 2005, the overall water use decreased by 3.7% in 2006 and by 17.29% in 2007. The data indicate that the water savings in 2006 was not significant perhaps during the first year of program the customers needed to adjust to the new appliances and change their water use habits.

Leitman, Steve

Authors: **Steve Leitman**, Waters Without Borders

Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 2

A Southern-Fried Water Fight: Stumbling Towards the Limits of Water Availability in Apalachicola-Chattahoochee-Flint Basin

On July 17, 2009 Judge Paul Magnuson released a major decision from the United States District Court in the Middle District of Florida regarding the waters of the Apalachicola-Chattahoochee-Flint (ACF) basin. He ruled 1) that the Corps of Engineers did not have the authority to allow the amount of the water supply withdrawals currently being drawn from Lake Lanier for Metropolitan Atlanta, and 2) that Georgia has three years to address and resolve the issue of the authority for water supply withdrawals from Lake Lanier. If this is not done, then the current means of providing water supply to millions of people would be illegal. This decision follows nearly two decades of Florida, Georgia and Alabama and the Federal government being at odds over water management in the basin. In the past two decades in the ACF basin, there have been multiple lawsuits between the three states and the Federal government, the establishment of the first interstate Water Compact in the U.S. since the passage of the major environmental laws, several major droughts, the designation of several species as endangered by the Federal government, and a barrage of negative press releases by the States about each other. In this talk I will examine what went wrong between being in the promising situation of establishing an Interstate Water Compact to the current situation of a judicial decision that could upend supply for Metro Atlanta and why the current situation is so clouded. In closing I will examine the progress toward meeting the three year time frame, my expected outcome from the process and my recommendations on what could be done to move the process forward.

Liebowitz, Dina

Authors: **Dina Liebowitz**, University of Florida
Matthew Cohen, University of Florida, School of Forest Resources and Conservation
James Heffernan, Florida International University
Thomas Frazer, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 2

Exploring Alternative Controls of Algal Proliferation in Florida's Spring System

Florida's spring ecosystems are changing dramatically, yet the ecological drivers of these changes remain ambiguous. Nuisance algal overgrowths have been reported in many of Florida's more than 700 springs, demonstrating a dramatic shift in the ecosystems from states dominated by submerged aquatic vegetation (SAV) to states dominated by benthic algae. These changes are causing stakeholder concern, as algal overgrowth can be detrimental for human health, recreation, aesthetics, and wildlife. Nitrogen enrichment has been widely implicated in due to marked concentration increases, therefore existing management practices target nutrient enrichment as the cause of algal overgrowth. However, regional data remains equivocal regarding the prominent role of nutrients in spring degradation, and ecosystems theory supports the notion of multi-causal drivers of systems, therefore alternative causes of algal proliferation should be examined. Here we explore alternative explanations for the abundance of nuisance algae, focusing on the hypothesis that "top-down" invertebrate herbivore grazing is a key factor dictating patterns of algal proliferation in Florida's springs. The first stage of this work involves observational field surveys which test if the hypothesized negative relationship (increased aquatic invertebrate biomass associated with decreased filamentous algae biomass) exists on an ecosystem scale, and whether declining dissolved oxygen (DO) levels may lead to grazer exclusion and subsequent release of algal control. We selected eight springs representing contemporary gradients in nitrogen, algal abundance, and dissolved oxygen (DO), and we quantitatively sampled filamentous algal biomass, invertebrate grazer biomass, and physical and chemical metrics to determine the existence of a signal in the field. We will present the outcome of eleven months of data collection, and discuss plans for in situ experimental verification of causal mechanisms and potential biomass thresholds.

Lindsey, Angie

Authors: **Angie Lindsey**, Florida Center for Public Issues Education in Agriculture and Natural Resources

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 2

Effective Issues Management: A Critical Analysis of the St. Johns River Water Management District It's Your River Campaign

In past research, issues management within public relations has been assigned various definitions. However, most definitions include the element that issues management embodies bringing together different parties in the public policy arena, to determine resolution or consensus on a certain issue. Given this, issue management programs can include tactics that foster the understanding and conversion between two parties and enables them to share their ideas. For the purpose of this study, the Public Affairs Council issues management model will be utilized. This model includes six steps that organizations take when managing a certain issue. The St. Johns River Water Management District developed the multimedia It's Your River campaign to inform stakeholders/general public of their role in the health of the St. John's River. In this study, the issue is the health of the St. John's River, and the different parties are the general public and St. Johns River Water Management District. Using the Public Affairs Council issues management model as a guide, this study with critically analyze the St. Johns River Water Management District's It's Your River integrated marketing campaign. This campaign utilized several mediums including print, television and Internet. This study will critically analyze these pieces using the issues management model to determine if this campaign was effective in managing the issue of the health of the St. John's River.

Llewellyn, Janet

Authors: **Janet Llewellyn**, Florida Department of Environmental Protection

Category: Managing water and energy in a transitioning environment
Session Title: Adaptive Water Management Strategies for a Transitioning Environment

Framework for Action: Water Management and Climate Change in Florida

Climate change will have profound effects on Florida water resources and is posing new challenges for the state's unique water management system. Florida is likely to face changed rainfall patterns, more intense tropical storms, more frequent or more severe droughts, higher sea levels, greater saltwater intrusion into aquifers, saltier estuaries, and heightened demand for water, more severe water shortages, and many changes in the state's varied ecosystems. Eighteen million Floridians, using 6.7 billion gallons of water a day, depend on reliable sources of water for cities, for industry, and for agriculture. Eleven thousand miles of coastline (more than any other state but Alaska) are threatened by rising sea levels. The two-fifths of American flood insurance policies held by Floridians are additional evidence of the state's vulnerability to the more frequent, or more intense, rainstorms that may be one result of global climate change. Water managers must consider climate change effects on the reliability of Florida's water supply, the state's economy, the health of the population, and natural resources in the state, as well as how greenhouse gas emissions from water management activities in Florida contribute to global climate change. The Florida Department of Environmental Protection, in partnership with the five regional water management districts, is beginning to address these issues through a new "Framework for Action: Water Management and Climate Change in Florida." The Framework creates a new high-level DEP/WMD Steering Committee to oversee the implementation of eighteen broad recommendations in the Framework. The Steering Committee is beginning its work and progress to date will be reported at the "Sustainable Water Resources" Symposium.

MacNair, Doug

Authors: **Doug MacNair**, ENTRIX Inc.
Lauren Elmore, ENTRIX Inc.

Category: Managing water and energy in a transitioning environment
Session Title: Adaptive Water Management Strategies for a Transitioning Environment

Can you afford to ignore climate change? Developing adaptive management strategies in an uncertain environment

Water resource managers are increasingly being expected to develop effective strategies for adapting to climate change. Uncertainty about the timing and extent of climate change and its potential effects on water supplies, infrastructure, and the environment make it difficult to identify appropriate preparations and response schedules. Effective response strategies must be evaluated according to their costs and impacts, which is particularly challenging, given competing demands for limited resources. A successful climate change response strategy includes cost-effective analysis of specific risks and benefits over time. Designing and/or implementing adaptation strategies too early may be unnecessary and expensive, while waiting too long may result in unacceptable declines in reliability and undesirable environmental and social effects. As the state of knowledge regarding future climate change increases, water resource managers must adapt to this changing information, while also determining when and how to implement specific strategies. Managers can benefit from utilizing a model to determine when a specific time or "tipping point" has been reached, thereby indicating the need to change from a "business as usual" approach, to active adaptation. This presentation demonstrates the development and use of a climate change adaptation tool for resource managers that analyzes the potential value of different climate change adaptation strategies. The model is a high-level, strategic planning tool that provides a systematic and transparent framework for collecting, organizing, and evaluating the multiple, and uncertain, impacts of climate change. We illustrate the model using publicly available data from several southeastern U.S. water management organizations.

Martin, Jonathan

Authors: **Jonathan Martin**, University of Florida
Jason Gulley, University of Florida
Elizabeth J., Screaton

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 2

Characteristics and effects of flow reversals at Madison Blue and Peacock springs (Florida) during river flooding

Flooding within the Suwannee River watershed causes water elevations at spring vents to exceed the elevation of groundwater, forcing river water into springs. Flood waters have lower pH and higher dissolved organic carbon concentrations than groundwater, so these flood reversals should alter groundwater chemistry. The magnitude of reversals, the rate of subsequent discharge of flood waters, and how changing groundwater chemistry influences water-solid reactions have not previously been assessed. During a flood in April 2009, we monitored flow into Madison Blue Spring and Peacock Spring in northern Florida using automatically recording conductivity-temperature-depth sondes that had been installed at four locations within conduits sourcing the springs. We also collected grab samples during and after the flood to measure water chemistry and to calculate calcite saturation index (SI) for the water. Prior to the flood, the groundwater had specific conductivity about 280 µS/cm at Madison Blue Spring and about 400 µS/cm at Peacock Spring. The flood water had specific conductivity about 50 µS/cm. At both locations, flood water penetrated more than a kilometer into the conduits in a matter of hours. During the flood recession, the increase in conductivity was distinct at each sonde, reflecting complex mixing of flood water within the conduits and surrounding aquifers. Saturation index was around -4.5 with respect to calcite for flood water in the Suwannee River near Peacock Spring and conduits at Peacock Spring, indicating dissolution occurred during the flood and for several months during the recession. This dissolution occurred from spring vent end of the conduit rather than from upland zones as is commonly assumed for the formation of most caves. Other chemical effects from such reversals could include changes in the redox potential of groundwater as microbial communities remineralize organic carbon dissolved in the flood water.

Marzolf, Erich

Authors: **Erich Marzolf**, St. Johns River Water Management District

Category: Optimal use of integrated water supplies
Session Title: Use of Reclaimed Water

Use of Reclaimed Water to Offset Fertilizer Applications: A Cost-Effective Pollution Prevention Management Practice?

Attempts to limit increasing withdrawals of high quality groundwater have led to the increased use of treated wastewater for irrigation throughout Florida and the U.S. From a water quality perspective, removing point source wastewater effluent discharges to waterbodies has been responsible for substantial nutrient load reductions and concomitant improvements in water quality. However, the rerouting the effluent as irrigation water via reclaimed water has increased nutrient inputs onto other areas of the landscape. This reuse has helped offset the demand for potable water, however the delivered nutrient load has often not been quantified, thus, fertilizer applications have not been accordingly reduced. Thus, in many locations with reuse, nutrient loading occurs at excessive rates due to the combination of reclaimed water and fertilizer. In a recent homeowner survey within a portion of the Wekiva Springs springshed, reuse customers were found to fertilize their lawns more frequently than residents irrigating with potable water (UCF 2009). As pollution prevention is generally considered more cost-effective than pollutant removal from the environment, reducing fertilizer inputs of nitrogen and phosphorus equivalent to the loads delivered via reuse seems to be reasonable management practice. The data needed to develop a fertilizer offset are the reuse nutrient concentrations, and irrigation rates. Wastewater utilities have the concentration data and even for unmetered customers, a general idea of water use. The remaining data need is the irrigated area, which homeowners could supply or could be estimated by the utility. For watersheds with existing nutrient TMDLs, the implementation of a fertilizer offset program should be a cost-effective management practice for utilities. While for homeowners, reduced fertilizer costs can help offset increasing water costs. Optimizing reuse from both a water and nutrient perspective will accomplish two important goals, preserving valuable potable water supplies and reducing nutrient pollution to waterways.

Mathews, Ashley

Authors: **A Loren Mathews**, University of Florida
Edward J. Phlips, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Measurements of Primary Production in the Caloosahatchee River / San Carlos Bay Ecosystem

Urban and agricultural development in and around the Caloosahatchee River and Estuary has drastically altered the flow, supply, and quality of water in this system for more than two hundred years. Recently occurring algal blooms have brought attention to nutrient issues and processes affecting biomass accumulation there. The major purpose of this project was to measure primary production rates in the Caloosahatchee River and Estuary system in order to create an empirical model that can be used to predict the response to changes in nutrient load. Primary production rates in terms of oxygen evolution were measured at four sites (one each in the upper estuary, middle estuary, lower estuary, and San Carlos Bay) using simulated in situ light:dark bottle incubations involving a flow-through raceway. Key water quality parameters such as temperature, salinity, dissolved oxygen, photosynthetically active radiation (PAR light), and macronutrient levels (nitrogen, phosphorous, and silica) were also determined at each site for their direct and indirect affect on primary production. The structure and abundance of the phytoplankton was determined to identify shifts in primary producer communities.

Mazur, Roy

Authors: **Roy Mazur**, Southwest Florida Water Management District

Category: Optimal use of integrated water supplies
Session Title: Managing Integrated Water Supplies

Linking Land Use and Water Supply Planning

The presentation will be a discussion of integrating regional water supply plans of the water management districts with the plans and projects of local government utilities through a collaborative planning process. The presentation will detail a process focused on collaboration between the water management districts and local utilities. Tools such as regulatory incentives and financial assistance along with planning assistance in linking growth managemnet and utility CIP planning will be discussed in the context of Florida growth management and water supply legislation. The presentation will identify the need to integrate land use and water supply planning and identify ideas to link regional water supply plans with those of local water utilities.

McCready, Mary

Authors: **Mary McCready**, Miami-Dade County Extension, IFAS, University of Florida
Laura Vasquez, Miami-Dade County Extension
Don Pybas, Miami-Dade County Extension

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 2

Irrigation Control to Conserve Water in Miami-Dade County. A Collaborative Effort between Miami-Dade Water and Sewer Department and Cooperative Extension.

In 2006, Miami-Dade County developed the Water Use Efficiency Plan to promote water conservation. This plan utilized conservation strategies including; rebate programs and irrigation system assessments. The Florida Yards &; Neighborhoods (FYN) Water Use Efficiency Program started in 2006 with a grant from the South Florida Water Management District (SFWMD) to conduct irrigation assessments at homeowners associations (HOAs) and provide them with free soil moisture sensors. In 2007, the program was funded by the Miami-Dade Water and Sewer Department (MDWASD) and the number of HOAs to be targeted was increased. In 2007, 10 HOAs participated and 50 participated in 2008. The Urban Conservation Unit (UCU) was developed in 2008 at the Extension Service, through funding by MDWASD, to expand the program to 200 single family homes (SFH) and 25 HOAs in 2009. The UCU provides the irrigation assessments and distributes the soil moisture sensors and educational materials. In 2010 the program will target 35 HOAs and 120 SFHs. In addition to providing the irrigation assessment, the UCU conducts a second visit to each site to ensure that the soil moisture sensor has been installed and is programmed correctly. Since the program began, 192 participants have received irrigation assessments, educational materials pertaining to proper irrigation and landscape maintenance based on IFAS recommendations as well as soil moisture sensors to control the irrigation system. This program is assisting the county to reach its water conservation goals. In general, homeowners are interested in irrigating more efficiently but are in need of education on how to improve their irrigation practices. While this program requires a lot of time and hands-on-work with each individual SFH and HOA, the estimated water savings from the educational materials and irrigation control technology will offset the necessary inputs to the program.

McVay, Robert

Authors: **Robert D. McVay, P.E.**, Florida Rural Water Association

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Water and Energy Saving Opportunities for Small and Medium Water Systems in Florida

The Florida Rural Water Association (FRWA) works cooperatively with USEPA, the Department of Environmental Protection and the State's five (5) water management districts, in providing technical assistance to small and medium water wastewater systems. This technical assistance is provided by direct contacts with its 1225 member systems that include 9.7 million customers. FRWA assistance includes board training and providing technical advise to system operators and managers in areas that include asset management, environmental compliance, development of water and wastewater rates, and in the efficient operation of water and wastewater facilities. As utility budgets have shrunk due to current economic conditions, utility managers have taken more interest in opportunities available to them for reducing O&;M costs. In work with member utilities, FRWA generally finds that cost saving opportunities are directly linked to identifying customer water use patterns, pricing water at its full cost of production and incorporating the benefits of energy reduction into asset management programs. Most recently FRWA partnered with the Southwest Florida Water Management District in performing water system audits on 12 water systems that had extremely high per capita water use. The FRWA work scope included comprehensive meter efficiency evaluations and analysis of the current rate structure for encouraging water conservation. FRWA's work indicates those opportunities for supply side water conservation is often underemphasized and that significant opportunities for conserving water go undetected. FRWA recommends incorporation of simple water accounting procedures and the adoption of best management water conservation practices. These programs can often be implemented at a very low cost and provide immediate and significant returns in operating cost reductions, enhanced system reliability and improved treatment. Topics covered in this presentation will be: 1.) Benefits to small utilities resulting from effective water conservation practices, 2.) Setting water conservation goals, 3.) Identifying water conservation maturity levels, 4.) Using basic, intermediate and advanced water conservation measures, 5.) and 6.) Incorporating general conservation practices. Results from the "The Water Audit Study" performed for the Southwest Florida Water Management District will be used to demonstrate how these principles can be successfully applied to achieve supply side water conservation benefits. These benefits provide the utility system with the awareness that leads to an integrated supply and demand side approach to water conservation.

Meeks, Leah

Authors: **Leah Meeks**, Department of Agricultural Biological Engineering, University of Florida
Michael D. Dukes, Associate Professor

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Evaluation of Accuracy and Longevity of Expanding-Disk Rain Sensors

Typical homes in Florida have in-ground irrigation systems utilizing automated timers that have been shown to increase outdoor water use. As the drought continues and water conservation becomes more crucial, Floridians must find a way to decrease the amount of water used for irrigation without damaging their aesthetic landscaping. One way to reduce irrigation waste is the installation of rain sensors, which appear to offer water savings at a relatively low cost. Rain sensors bypass the irrigation cycle of an automatic irrigation system controller after a predetermined amount of rain has fallen. In 1991, Florida became the first state to have a rain senor statute requiring that any newly installed automatic lawn sprinkler system must also install, maintain, and operate a rain sensor device. The Florida statute was updated in 2009 to include all automatic irrigation systems regardless of installation date and stricter enforcement and penalties. The University of Florida Agricultural and Biological Engineering Department is testing rain sensors currently on the market to determine the performance and reliability of expanding-disk rain sensors. Expanding-disk rain sensors operate with hydroscopic disks inside the sensor device that swell and contract depending on climatic conditions. Rainfall and dry-out settings can be adjusted depending on the climate and soil characteristics of an area. Four brands at a variety of settings are currently being tested to investigate set point accuracy, performance among brands, accuracy over time, and size changes in hydroscopic disks. The rain sensors are located in an open area on the University of Florida campus where data loggers record when the rain sensor would interrupt the cycle of an automatic controller. Results relating to water savings, accuracy, and longevity will be reported.

Million, Jeff

Authors: **Jeff Million**, Environmental Horticulture Department, University of Florida
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Joseph Albano, U.S. Hort. Res. Lab, USDA

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

CCROP – A web-based decision support tool for managing water and nutrients in container nurseries

CCROP (Container Crop Resource Optimization Program) is a web-based decision support tool that simulates growth and nutrient and irrigation requirements of woody ornamental plants grown in containers. CCROP is designed to assist growers and other industry stakeholders select best management practices which maximize efficient use of water and fertilizer resources and minimize environmental impact. Inputs for CCROP include daily weather data uploaded from the Florida Automated Weather Network (FAWN) and critical management practices (e.g. plant date, container size and spacing, fertilizer, pruning, etc.). Daily and summary output includes plant growth, evapotranspiration, irrigation requirement, plant nutrient demand and uptake, nutrient leaching and runoff. A real-time irrigation tool recommends a daily amount of irrigation water to apply which is based upon resupplying water lost through evapotranspiration.

Min, Joong Hyuk

Authors: **Joong-Hyuk Min**, University of Florida
James Jawitz, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Water and Phosphorus Budget Modeling of a Historically Isolated Wetland in the Lake Okeechobee Basin: Management Scenario Evaluation

Many of the historically isolated depressional wetlands in the Lake Okeechobee basin have been ditched and drained for agricultural purposes. The hydrologic and biogeochemical role of these wetlands as a runoff retention system has been highlighted in proposed restoration schemes to minimize export of phosphorus (P)-rich surface flow via the ditch/canal network from the upland cattle ranches to the downstream water bodies (i.e., Lake Okeechobee). This work develops and implements a hydrologic model-based framework to consider restoration (hydrologic manipulation) and predict P fate and transport in the wetland-upland ecosystem. A two-year water budget analysis was tested against the measured hydroperiod of a ditched depressional wetland of about 2 ha and integrated to a P mass balance model. Net P retention in the water column was simulated using first-order kinetics (k-C* model) and daily inlet and outlet P fluxes were calculated based on the simulated flow pathway quantifications. The integrated model was applied to evaluate multiple management scenario combinations based on two passive hydrologic manipulations (increased ditch outlet elevation and increased ditch backflow condition through downstream discharge control) and two active upland source control practices (fencing and direct manure removal at two different areal scales).

Mitchell, Jennifer

Authors: **Jennifer Mitchell**, University of Florida
James Jawitz, University of Florida Soil and Water Science

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Phosphorus loading of two isolated wetlands in the Okeechobee Basin

The phosphorus load to Lake Okeechobee consistently exceeds the mandated total maximum daily load (TMDL) of 140 Mtons annually. Excess P loading to the lake is a concern because of algal blooms and a shift in trophic status from eutrophic toward hypereutrophic. One proposed practice for reducing P loading is restoration of isolated wetlands that historically have been ditched and now drain directly to Lake Okeechobee. This study examines hydrologic restoration of an approximately 1.1ha ditched wetland in the Okeechobee basin. The ditch draining the wetland was blocked with a 30-cm dam and the water and nutrient budget of the wetland was monitored and compared to a similar, ditched wetland in the same cow-calf pasture that was not dammed. It is hypothesized that the load exported from the restored wetland will be less than that of the ditched wetland. Ditch discharge was measured every 30 minutes with an acoustic Doppler velocimeter (ADV) allowing both backflow into the wetlands and discharge from the wetlands to be determined. Two automatic water samplers were installed in each wetland, one in the center of the wetland and the other in the ditch. Samplers were programmed to sample when the attached pressure transducers detected a proscribed change in water level and/or every 24 hours both to measure P export and to detect changes in P concentration as a response to rewetting or drawdown in the wetland. Backflow from the ditches into the non-dammed wetland does contribute to a rise in wetland water level. Results of this study will help to determine P sequestration rates that can be expected with restoring isolated wetlands and the effectiveness of this practice to reduce loading to Lake Okeechobee.

Mo, Weiwei

Authors: **Weiwei Mo**, University of South Florida
Qiong Zhang, University of South Florida

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Water Embodied in US Economic Sectors and Water Efficiency Improvement

Introduction Water consumption is growing rapidly with the global and national population growth and economic development. As a result, water use and conservation has been hot topics for quite a long time. The previous researches either estimated total water consumption based on national scale, or assessed specific products in details using data intensive process analysis. Frequently, the indirect water consumption is simply neglected. However, considering water associated with materials, it is important to evaluate water consumption on a life cycle basis and assess the total water consumption for each economic sector. This can be challenging because it is hard to use traditional process analysis and evaluating each sector in detail. A more labor and time saving approach needs to be developed. The results should be able to depict a whole picture of the water consumption in US economy. The objective is to identify the sectors which are most embodied-water intensive and their water paths by developing an embodied water model. The results can be used by decision makers to set target sectors or paths for water conservation. Methodology Instead of assessing each economic sector in detail, input-output analysis provides interactions and monetary transaction among different sectors. Thus it is perfectly fit for developing the embodied water model. The US economic sectors are classified based on the North America Industrial Classification System. The water supply sectors will be identified. Using the US commodity-by-commodity direct coefficient matrix, both direct and total water intensity can be calculated for each sector. The total embodied water intensities of the water intensive sectors will be broken into different water paths. Expected Results The sectors with the highest total embodied water intensities and paths with highest water intensities will be identified. Possible ways for conserving water for these embodied water intensive sectors will be identified and described.

Morales, Miguel

Authors: **Miguel Morales**, University of Florida
James Heaney, University of Florida, Department of Environmental Engineering Sciences

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Estimating Nonresidential Water Use within a Water Audit

This poster presents a new methodology to estimate nonresidential (NR) water use based on evaluation of parcel level customer attribute and water use billing databases. The Florida Department of Revenue (FDOR) and County Property Appraisers (CPA) databases provide the heated building area and customer classifications for every NR parcel in the State of Florida. Linking this parcel level attribute data with parcel level water use billing data provides a major improvement in our ability to estimate NR use. Existing methods typically use the number of employees as the best single indicator of the "size" of the activity. Employee data is available periodically through the U.S. Census or private surveys. Census data is not available at the parcel level and survey data are expensive to collect. Evaluation of alternative measures of size that are contained in the FDOR/CPA databases and customer billing data indicate that heated area is the best single measure of size to use across the 57 NR two-digit FDOR land use categories. Only a few Florida water utilities are known to have merged FDOR/CPA databases to their customer billing database. The base case for this analysis is Hillsborough County Water Utility that provides a relatively large sample of 1,857 NR parcels of which 65% are commercial, 8% are industrial, and 27% are institutional. Monthly water use data for four years from 2003 to 2006 were analyzed to estimate average and peak water use coefficients expressed in gallons per month per square foot of heated area for each of the FDOR NR land use categories. Knowing these water use coefficients and the total heated area for each FDOR category, it is simple for any utility estimate the total water use for each FDOR sector, and through the use of a calibrated model, carry out a water audit.

Moss, Charles

Authors: **Charles B. Moss**, University of Florida
Alfonso Flores-Lagunes, UF Food and Resource Economics Department

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 2

Modeling the Stochastic Nature of Agricultural Production Functions: Implications of State-Dependent Specifications for Water Use

The concept of risk is endemic to agricultural production. Plagues and droughts date from primeval stories to more recent experiences of the dustbowl era. However, systematic analysis of the effect of weather fluctuations on production decisions is less evident. Moss (2009) provides an overview of agricultural decision making under risk and uncertainty, but most of the models presented deal more with the decision of selecting among risky alternatives than production decisions involving input selection. A more complete model of decision production decisions under uncertainty can be found in the stochastic production function proposed by Just and Pope (1978). This formulation allows for the analysis of the effect of input decisions on the riskiness of production (modeled as the squared deviation). The Just and Pope formulation measures risk as dispersion around an average production function. An alternative approach is to measure the variation in the production function itself using a Quantile regression specification for the production function. The later specification the shape of the production function (and hence the marginal physical product of inputs) to shift with random variations in production. The purpose of this study is to evaluate the implications of each specification in modeling optimizing behavior under weather fluctuations. Ultimately, we intend to develop a specification of irrigation decisions consistent with this stochastic specification.

Muller, Stuart

Authors: **Stuart Muller**, University of Florida
Rafael Muñoz-Carpena, Agricultural and Biological Engineering Department, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

A Novel Water-Quality Model for the Southern Everglades

Water quality in the southern Everglades is an important determinant of the conditions within Florida Bay, into which much of the Everglades flow empties. Water quality conditions in the region are also an important indicator of the downstream effects of upstream water management decisions. Modeling of the region is therefore important to facilitate informed management of the entire system. To that end, a generic modeling tool for simulating the biogeochemical processes that drive Everglades water quality (RSE) has been integrated with a flow and transport model for the variable-density, linked surface-water and groundwater hydrology of the southern Everglades (FTLOADDS). Testing of the new tool is presented, and an application to the region surrounding Taylor Slough to determine nutrient loading to Florida Bay is discussed.

Murch, Renee

Authors: **Renee Murch**, INTERA, Inc.
Patrick Tara, INTERA, Inc.
Doug Munch, St. Johns River Water Management District
Xinjian Chen, St. Johns River Water Management District

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Utilization of Artificial Neural Networks (ANNs) for Hydrologic Modeling Applications

In recent years, the application of artificial neural networks (ANNs) to model hydrologic processes has become an increasingly attractive alternative to other types of statistical models. ANNs can be an efficient way of modeling hydrologic processes in situations where explicit knowledge is not available or the system is just too complicated to represent numerically. Two applications of ANNs for hydrologic modeling are presented: a salinity model and a spring flow model. The networks were trained, validated, and utilized as predictive tools to develop time series for periods of interest where observed data was not available.

ANNs were effectively utilized in order to develop a statistical model for the prediction of top and bottom salinity at the mouth of the Manatee River. A total of six ANNs were developed based on flow regime and flow location (top or bottom). Total ungauged flow, recorded stage, and nearby lake discharges were utilized as input data for each of the ANNs. The ANNs consistently out-performed the multiple linear regression models and were therefore utilized in predictive mode to develop top and bottom salinity time series from 1982 through 1984. The resulting predictive time series was utilized by the Southwest Florida Water Management District to support MFL development for the Manatee River.

ANNs were also successfully applied to estimate the discharge from White Springs. White Springs, located in Hamilton County, is of particular of interest because it is a first magnitude spring with historical significance. In recent years, flow reversal in White Springs has occurred, making it particularly difficult to quantify the spring flow. Using the best and most complete data available, two statistical models were developed to develop a flow time series for White Springs: a multiple linear regression and an artificial neural network (ANN). Using nearby stage and well data, two ANNs were developed to estimate White Springs discharge. The networks were trained using all available White Springs flow data. Validation of the networks demonstrated that the networks were able to successfully estimate the direction of flow. Utilization of both networks to determine average spring flow for 1993 through 1994 resulted in comparable results, with the ANNs out-performing the multiple linear regression models during the training period.

These studies suggest that feed-forward back propagation ANN based modeling can be effectively applied as an alternative approach to other statistical models for the estimation of hydrologic variables. And, as with any modeling technique, careful selection of explanatory variables is essential to achieve optimal performance.

Norton, Stuart

Authors: **Stuart Norton**, Department of Environmental Engineering Sciences, University of Florida
Michael Annable, Professor

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Evaluation of Trace Metal Mobilization during Managed Aquifer Recharge

The implementation of Managed Aquifer Recharge (MAR) techniques, such as Aquifer Storage and Recovery (ASR) and Artificial Recharge (AR), is being constrained by the recent finding of trace-metal mobilization. The introduction of treated surface waters into anoxic aquifers leaches metals from native minerals, thereby leading to the mobilization of arsenic, molybdenum, iron and other trace metals. A January 2006 change to the Primary Drinking Water Standard (PDWS) has caused many Florida ASR facilities to be out of compliance with respect to arsenic. In an effort to offset groundwater withdrawals, and reduce the impact of saltwater intrusion, several of Florida's water management districts are planning large-scale AR projects, which may also generate arsenic concentrations in the aquifer above the 10 µg/L limit. The viability of these critical water management tools has been impacted by this technical challenge. To evaluate trace-metal mobilization during MAR we have initiated a 3-year research program that will confirm the geochemical response that occurs during ASR and AR; identify the mechanism controlling the fate and transport of arsenic and predict the long-term impact of arsenic mobilization through numerical modeling. A continuous core of the primary storage interval for southwest Florida ASR sites, the Suwannee Limestone, has been collected. Intact core column experiments are underway to support the development of 3-D reactive transport models. The reactive transport code PHT3D has been selected to simulate ASR and AR processes. This model couples the contaminant transport model MT3DMS with the geochemical model PHREEQC. A model calibration to existing ASR datasets is used to simulate long term (10 years) operation of ASR and AR systems. The model may also be used to investigate ASR and AR operational approaches for managing arsenic mobilization.

Obeysekera, Jayantha

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Winnie Said, South Florida Water Management District

Category: Managing water and energy in a transitioning environment
Session Title: Incorporating Climate Predictions into Water Planning and Management

Water Resources Management in a Changing Climate

Incorporation of uncertain climate projections with inadequate spatial and temporal scales has become a challenging task for water resources planners and managers. In south Florida where major changes to the water resources system are being formulated and implemented, climate change may have significant implications. In South Florida, there is significant evidence that intra-decadal and multi-decadal natural events such as El Nino-Southern Oscillation, and Atlantic Multidecadal Oscillation influences rainfall regime via teleconnections. Climatic changes due to anthropogenic alterations, including global warming will make the projections of future climate extremely difficult as the standard methods of applying stationarity principle will not be acceptable for future planning of water resources management. Due to the flat topography of the coastal belt and the high transmissivity of the coastal aquifers, the impact of the projected sea level rise due to climate change on water supply, flood control and the Everglades Restoration is a significant concern to water managers. In order to understand the utility of General Circulation Model (GCM) projections for the south Florida region, a validation of such models as well as the downscaled climate projections was carried out by comparing them to an observational dataset. Using probabilistic projections derived by applying a Bayesian approach for combining multi-model ensembles of GCMs, reasonable estimates of precipitation and temperature projections were obtained for biasing historical data for climate change investigations. A sensitivity analysis conducted using biased precipitation, temperature, and sea levels with a regional-scale hydrologic and water management model demonstrated that there is a significant potential for impacts on the operations of current water management system as well as future projects designed to restore the Everglades ecosystem.

Olmsted, Thomas

Authors: **Thomas Olmsted**, University of Florida
Michael Dukes, University of Florida

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Investigating Different Irrigation Management Strategies on St. Augustinegrass

These are first year results of a study looking at different irrigation strategies and the amount of water applied and their ability to keep irrigation water within the root zone of a turfgrass to lessen deep percolation past where the roots can extract it. Ten St. Augustinegrass plots have soil moisture measurement sensors installed at 5 different depths from 7.5 cm to 37.5 cm to track the change in volumetric moisture content over time at each depth. Each plot has a different irrigation management strategy that varies the amount of water applied, varies the number of irrigation events during the week, or divides the irrigation runtime into smaller timed segments. For many of the treatments, the irrigation scheduled event is controlled by a soil moisture sensor or a rain sensor. On the soil moisture sensor controlled treatments, the scheduled irrigation event is by-passed if the soil moisture is above a set threshold value. Rain sensors will interrupt an irrigation event if a rain amount greater than the rain sensor setting occurs slightly before or during an irrigation event. These treatments were compared to a timed treatment based on University of Florida Institute of Food and Agricultural Sciences recommendation.

Opsahl, Steve

Authors: **Julie McEntire**, J. W. Jones Ecological Research Center
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Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 1

Nutrient and organic carbon sources and sinks in Lake Seminole: Implications for water quality in the ACF system

Lake Seminole is formed at the confluence of the Chattahoochee and Flint River watersheds and serves as the source water for the Apalachicola River/Bay system. Nutrient concentrations are characteristically different based on differences in land use, numbers of waste-water treatment plants and the large reservoirs in the Chattahoochee River basin, and groundwater delivery of excess nitrate from agriculture in the Flint River basin. We observed significant differences in nutrient concentrations among rivers including higher NH4+ concentrations in the Chattahoochee and higher TN and NO3- concentrations in the Flint. Although the Chattahoochee River passes through large urban centers, we did not observe higher PO4- levels. Instead, the relatively low PO4- concentrations in the Chattahoochee River may be due to the presence of large reservoirs which serve as sinks for PO4-. Organic matter transported within the Flint River appeared to reflect the flushing of regional wetlands during high flows and a dilution of DOC by ground water during low flows in the river. In contrast, DOC concentrations in the Chattahoochee River did not correlate to discharge suggesting reduced interactions with flood plains or the influence of increased water residence time in multiple upstream reservoirs. We used a mass balance approach to estimate export and retention of nutrients and DOC during passage through the reservoir. Influxes of NO3- and PO4- usually exceeded export and the reservoir retained as much as 88% of the NO3- load and 90% of the PO4- load at certain times. Only occasionally did the reservoir serve as a substantial source of NO3- and PO4- rather than a sink. In contrast, Lake Seminole frequently appeared to be a sink for DOC. These findings carry broad implications for nutrient delivery into Apalachicola Bay and the important roles played by Lake Seminole and upstream reservoirs.

Ouyang, Ying

Authors: **Ying Ouyang**, St. Johns River Water Management District

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Characterization of Shallow Groundwater Quality: A Pre- and Post-Constructed Wetland Comparison

Constructed wetland (CW) is a promising engineering technique for removal of excess nutrients and certain pollutants from wastewaters. This study characterized shallow groundwater quality for conditions with and without a CW. A shallow groundwater monitoring network with three wells was initiated in a row-crop production area of the Lower St. Johns River Basin in Hastings, Florida in 2003. This row-crop production area was then converted into a CW for stormwater treatments in 2006 without altering the monitoring wells, which provided a unique opportunity for estimating impacts of the CW on shallow groundwater quality. A total of six years (three years for pre-CW and another three years for post-CW) data were used for statistical analysis. Results showed that based on averaged values from all of the wells, there were significant differences (a = 0.05) between the pre- and post-CW for nutrients (i.e., nitrate and nitrite, total Kjehldahl nitrogen, and potassium); for cations (i.e., total aluminum (Al), calcium, magnesium, manganese); for physical parameters and anions (i.e., oxidation-reduction potential (ORP), pH, water level, and sulfate); and for heavy metals (i.e., nickel (Ni), and zinc (Zn)). Based on comparisons from each well, there were significant differences (a = 0.05) between the pre- and post-CW for Al, ORP, water level, and Ni. Results further revealed that among the significantly different water quality parameters, most of them had higher contents after the establishment of the CW except for Al, pH (slightly), Ni, and Zn. This study suggested that CW had discernable impacts on biogeochemical processes and thereby on shallow groundwater quality.

Overdevest, Christine

Authors: **Lisa Christiansen**, University of Florida
Christine Overdevest, University of Florida
Treavor Boyer, University of Florida

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

Understanding Stakeholders in the St. Johns River

The effectiveness of plans to address water supply issues, such as in the Saint Johns River Water Management District (SJRWMD), depends in part of stakeholder acceptance of and support for agency decisions and scientific findings. Yet currently stakeholders' views on the desirability of surface water withdrawals and the science behind are polarized. Social science research on polarized attitudes among stakeholders suggests the individuals and groups often interpret scientific information through their own cultural worldviews or lens (Kahan et al, 2007; Sabatier 1998). Better understanding of these worldviews and associated beliefs about impacts and interpretation of scientific information of stakeholders in the St. Johns is the topic of this research. This poster reports preliminary data on beliefs and expectations about impacts of surface water withdrawals and interpretation of scientific information across stakeholder groups. The specific objectives of this work are: (1) to identify cultural worldviews stakeholders hold; (2) to examine how salient beliefs about impacts of surface water withdrawal vary among stakeholders; and (3) to understand how stakeholder salient beliefs about alternative water supply sources cluster. This research is the preliminary step in a larger project to understand to what extent attitudes toward alternative water supply sources are driven by cultural identities. The work will be accomplished by a stakeholder surveys, workshops, and analysis of findings.

Padowski, Julie

Authors: **Julie Padowski**, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Assessing Hydrologic Vulnerability in Urban Systems

Securing adequate water supply for the future is an increasingly critical concern in the urban United States. This concern was clearly expressed in the 2008 American Water Works Association "State of the Industry" report of the top priorities and issues facing the water industry in the US. A survey of water suppliers found that the industry's top-ranked concern, for both the short- and long-term future, is the availability of adequate quantities of clean or treatable water to meet both current and prospective needs in an increasingly uncertain future. The amount of water available to an urban area is a product of both the local environmental context and the overlying anthropogenic framework for water supply regulation and distribution. To better understand the drivers of source water vulnerability in urban areas, this study quantified the relationship between water production and urban consumption in the 262 largest US cities (all those with population greater than 100,000). Water availability for each urban area was assessed by spatial analyses of climatic and hydrologic data, and was broken into two components: naturally available water from local rivers, lakes, or aquifers, and managed water available from the construction of reservoirs, aqueducts, or imported sources. The baseline water vulnerability of each city was quantified as a ratio of local consumptive demands to natural water production. The effect of hydraulic infrastructure was evaluated as changes in vulnerability through the incorporation of artificial water production. Comparisons both between baseline (natural) vulnerabilities and incorporated (anthropogenic) vulnerabilities allow sources of vulnerability not necessarily captured by local hydrologic conditions to be identified and therefore better express the range of vulnerability faced by US cities.

Pais, Annie

Authors: **Annie Pais**, Florida's Eden

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Public Private Partnerships

With the Ichetucknee as their classroom, students at Fort White inaugurate a new model for education with hands-on environmental labs, integration of science and humanities skills, and advocacy for long-term water sustainability.

Offering students an understanding of their local environment through hands-on experience and an integrated curriculum can have wide-ranging impacts on sustainable use of water resources. Florida's Eden is partnering with civic, educational, business and government organizations to create a new education model for national replication, completing its pilot phase in Fort White, Columbia County. Sustainable water use is ultimately a socio-political problem. The general public does not understand the science of water systems, feels increasingly disconnected from the natural environment, and is not engaged in advocacy for water sustainability. In the absence of political consensus, regional conflicts arise and undemocratic water control systems are instituted; neither leads to long term care of water systems. The Ichetucknee Educational Model at Fort White addresses these underlying issues. Students gain direct environmental experience, learn the scientific method, and utilize the communication skills offered by the humanities. This model utilizes the "asset-based" approach, wherein a perceived lack of resources is remedied by identifying hitherto undervalued or unrecognized local assets. The prime environmental asset is Ichetucknee Springs State Park. Students, faculty, staff, and talented and concerned citizens make up the human assets. The Park becomes the classroom. Hands-on ecology labs are matched with "Learn and Serve" projects. The humanities are integrated throughout as students learn to communicate complex scientific information in words, film, and graphics. Students study the social and political dimension of environmental issues and become advocates in their own right. Impacts include rising attendance, graduation rates, and test scores. Students make classroom materials, teach other students, create a teaching website, and engage the public through environmental projects, displays and a virtual tour of Ichetucknee Springs State Park. Florida's Eden utilizes student work in our Water Awareness Campaign, and is committed to institutionalizing the program at Fort White and preparing it for national replication.

Palenchar, John

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James Heaney, UF, Conserve Florida Water Clearinghouse

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Targeting Residential Irrigation for Conservation

This study uses single family residential (SFR) data from Alachua County Property Appraiser, Florida Department of Revenue and the Gainesville Regional Utilities billing data to show how trends in home construction and in-ground irrigation have led to higher potable water use in study area homes built after the late 1980's. The Alachua County Property Appraiser's database is used to extract detailed information on irrigable area, impervious areas, pervious areas, and the presence of in-ground irrigation in the study parcels. This information is used in conjunction with a novel approach for hydrograph separation of indoor base, peak monthly and average annual irrigation from single metered monthly billing records. The result is a standardized method for calculating irrigation application rates from single-metered billing data in Florida. A k-means clustering algorithm is used to determine irrigator target groups. Monthly average and peak month irrigation water use coefficients are presented as inches of water per unit of irrigable area for three classes of users: Minimal/Offline, Mid-range, and Upper. The percentage of accounts that substitute potable water with alternative sources is estimated for the study area. Finally, the disaggregated irrigation use is then compared using property appraiser groupings denoting in-ground irrigation and year built. The result is a standardized method for utilities to determine current SFR irrigation water use, potential for savings, and an optimal strategy for implementation of irrigation BMP's.

Park, Joseph

Authors: **Joseph Park**, South Florida Water Management District
Jayantha Obeysekera, SFWMD
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Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Florida Extreme Tidal Levels for Water Management Planning

Climate forced sea-level rise will impact coastal aquifer sustainability and management, and will also affect the performance and management of coastal drainage water control structures. Long-term consequences of these effects can be anticipated to a certain degree based on model analysis. A less scrutinized process are extreme events in coastal sea-level, which may have more of an impact in the near-term than mean sea-level rise, notably in low-elevation areas such as South Florida and the Gulf Coast. We analyze long-term tidal records at three Florida stations in order to extract statistics of extreme water levels. Correlations are assessed with respect to epoch and the Atlantic Multi-Decadal Oscillation (AMO), and probability distributions of the events are estimated. It is suggested that extreme event statistics for coastal sea-level should be incorporated into water management planning and forecasting.

Pathakamuri, Bhargavi

Authors: **Bhargavi Pathakamuri**, Florida International University
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Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Efficient Showerheads Role in Water Conservation – Status and Potential

Abstract: Miami Dade Water And Sewer Department (MDWASD) is implementing a 20-year water use efficiency plan for sustainable and healthy water resource management. As a part of this, showerhead rebate program initiated in October 2005. Water consumption trends for 248 residential customers (2.6 persons per customer) with one showerhead rebate issued in Miami municipality were analyzed. Average per capita water consumption for these customers was reduced from 99.23 to 92.42 and the total water savings accounts to 1.59 MGY from 2005 to 2008. Interestingly the percentage of water conserved by these customers after installing efficient showerheads is 6.86 from 2005 to 2008.

Paudel, Rajendra

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Joong-Hyuk Min, Soil and Water Science Department, University of Florida
James Jawitz, Soil and Water Science Department, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Phosphorus biogeochemical model complexity and prediction performance in a large stormwater treatment wetland of south Florida

Reconciling the trade-offs in the level of model process complexity is a continuing challenge for mechanistic model application. Although complex models tend to be more detailed, they are not able to explain the complexity of the real systems they seek to describe. In many cases, the lack of input data is a limiting factor for an appropriate application of complex models. In most effective models, the cost of added complexity has to be in balance with the benefits of increased accuracy. The hypothesis evaluated here is that biogeochemical model prediction accuracy in treatment wetlands is increased as the modeled process complexity increases, but the benefits of increased accuracy compared to the costs of added complexity is small. We first developed four different phosphorus (P) biogeochemical models, coupled with a two-dimensional hydrodynamic model, in a 147-ha cell of a 1544-ha stormwater treatment wetland designed to help protect the greater Everglades, FL, USA. The level of complexity in the models was increased sequentially by adding internal P cycling processes. Model prediction accuracy was assessed based on outlet total P concentration data. A complexity index was developed for each model, and the overall model effectiveness was determined based on both accuracy and complexity. Results revealed that the P biogeochemical model with more complexity did not guarantee significantly better simulation accuracy compared to the simpler one. Also, results showed that the most complex model was not necessarily the most “effective” in simulating transient total P behavior. Results from this study could provide valuable insights for effective model selection based on the available data and modeling goal, and powerful diagnostic information to support future model development.

Perez-Falcon, Gloria

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Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Modeling Landscape Processes to Explore Water as a Limiting Factor in Savanna Ecosystems

Plant and herbivore species in semiarid landscapes are subjected to many periods of water scarcity. This study was conducted to evaluate the effect of water as a limiting factor on savanna ecosystem components including functional groups of woody and herbaceous plants as well as herbivores. Numerical simulation of the savanna system in the Kruger National Park (South Africa) used the spatially explicit SAVANNA ecosystem model and 20 years of monitoring data collected by South African National Parks Board officials. Water availability in the SAVANNA model determines plant growth and death as well as herbivore distribution. Net Primary Production (NPP) of vegetation is determined as the product of water use through transpiration and water use efficiency. Herbivores will distribute according to available water. If water discharge does not support herbivore density dispersal will occur and mortality may follow if the demand continues to be unmet. Simulated herbaceous biomass and woody population levels were compared to field data to establish confidence in the model as a predictive tool. Additional analysis using Global Sensitivity Analysis methods highlighted the sensitivity of specific water balance components and their potential higher order interactions with other ecosystem components. Longer term management scenarios were simulated with 30 year climate files to explore ecosystem sensitivity to human interventions. In SAVANNA water stress is a significant contributor of plant and herbivore mortality. The frequencies of drought cycles play an important role and incite varying responses in the different herbivore and vegetation species. The cycles of drought have varying implications for the vegetative and herbivore species in the region; affecting carrying capacity of herbivores as well as potential degradation of land.

Perez-Ovilla, Oscar

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Rafael Muñoz-Carpena, UF Associate Professor
Congrong Yu, Graduate Student
Bin Gao, UF Assistant Professor

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Flexible simulation of surface runoff pollutants through dense vegetation

Vegetative Filter Strips (VFS) are one of the most widely recommended best management practices (BMP) by many state and federal agencies to control non point-source pollution from disturbed land areas. Our goal is to understand the dynamics of runoff pollutants through dense vegetation areas like VFS, that allow us to better predict the efficiency of pollutant removal in different scenarios (climatic, scale, length, slope, vegetation in VFS, soil, etc). VFSMOD (Carpena et. al. 1999) is one of the programs recommended by the Environmental Protection Agency and other federal and state agencies to design VFS. In order to provide the capability to simulated an unlimited number of pollutants in VFSMOD, a module to handle solute transport (FEMADR) was developed based on the solution of the 1-D Advective-Dispersive equation using a standard Bubnov-Galerkin cubic/quadratic finite elements method, and then coupled with a flexible biogeochemical multi-species reaction module (RSE) (James et. al., 2009). The advantage of the coupled component (FEMADR-RSE) is that pollutants of very different types can be simulated with the same program through conceptual models defined through the XML user interface. The coupled component (FEMADR-RSE) is first tested by comparing with analytical solutions of 1D reactive transport, and then used to predict experimental bench-scale surface transport of a tracer. Yu (unpublished, 2009) designed a laboratory experiment to trace a plug of bromide runoff at constant flow in a 1.5 x 0.5m sand bed under simulated rainfall. The experimental bromide runoff data was used to create and test a conceptual model to be used in the flexible FEMADR-RSE module for predicting bromide dynamics in surface runoff. The positive implications of this novel approach are that transport and fate dynamics of specific pollutants (either physical, chemical or microbiological) in VFS and natural areas of dense vegetation can be readily modeled. It is expected that the approach will serve as an exploratory tool for researchers and to develop simplified models to support environmental decision-making.

Pine, William

Authors: **William E. Pine**, University of Florida

Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 1

Implications of Modified Flow Regimes on Viability of Gulf Sturgeon Populations in the Apalachicola River

Rapid human population growth and an associated increase in consumptive water demands within the ecologically diverse Apalachicola-Chattahoochee-Flint (ACF) River basin of the southeastern United States have led to a series of highly publicized water-wars, exacerbated by recent drought conditions, between the basin states of Alabama, Georgia, and Florida. A key issue is how managing riverine flows to meet human water needs will affect the viability of federally listed species, including Gulf of Mexico sturgeon. These objectives are not mutually exclusive and create an ideal opportunity to experimentally assess Gulf sturgeon population responses to managed riverine flow conditions in the ACF. Our present understanding of Gulf sturgeon ecology within the Apalachicola River basin indicates that altered riverine flow regimes may affect spawning success and possibly recruitment patterns of the population. Through a combination of field and population modeling exercises we found that proposed extreme low-flow events from Jim Woodruff Lock and Dam may significantly reduce Gulf sturgeon spawning habitat at all known spawning sites. Gulf sturgeon populations are likely sensitive to changes in recruitment and if extreme low-flow events occur with increasing frequency due to flow policy choices or climatic events, population recovery could be impaired. Population recovery of Gulf sturgeon in the Apalachicola River represents an ideal objective function for resource managers in this basin creating opportunities to adaptively test experimental flow scenarios to enhance Gulf sturgeon population recovery and simultaneously screen and inform proposed water policy decisions in the entire basin.

Porzecanski, Ignacio

Authors: **Ignacio Porzecanski**, School of Natural Resources and Environment, University of Florida
Mark Brown, Environmental Engineering

Category: Managing water and energy in a transitioning environment
Session Title: Adaptive Water Management Strategies for a Transitioning Environment

Watershed management: reality or illusion?

Nathan Barassa Wangusi, Lorenzo Benini, Susanna Blair, Becky Blanchard, Megan Brown, Brian Camposano, L. Carlton, Anna Cathey, Bo Davidson, David Elliot, McKenzie Ezell, Lisa Gardner, Andrea Gaughan, Robin Globus, Hollie Hall, Jillian Jensen, Nathan Johnson, William Kanapaux, Ilan Kaufer, Sean King, Marie Kurz, Dina Liebowitz, Chris Long, Melissa Martin, Kathleen McKee, Sarah McKune, Nancy Montes, Michael Morgan, Michael Murray-Hudson, John November, Julie Padowski, Darina Palacio, Gregory Parent, Rachel Pawlitz, David Pfahler, Anthony Pinzino, Narcisa Pricope, Noorie Rajvanshi, Susan Risko, Estelle Robichaux, C. Schmidt, Robert Schulte, Claire Sunquist, O.T. Thakadu, Louise Venne, Deb Wojcik, Mark T. Brown, Matt J. Cohen, Richard Hamann, Ignacio Porzecanski.

In the context of the Wise Use of Water, Wetlands and Watersheds Integrative Graduate Education and Research Traineeship (IGERT) twelve watersheds from around the world were studied, mostly from the USA and the State of Florida (Apalachicola, Columbia, Crocodile, Fraser, Hudson, King's Bay, Ocklawaha, Peace, Sacramento, St. Mary's, Suwannee, and Zambezi). The purpose was to define the biophysical environment of each watershed, to analyze the social-ecological relationships within them, and to derive lessons about how these watersheds are being managed –especially whether adaptive management strategies could be discerned, recommended, or prescribed. Emphasis was placed on the linkages among the ecological, social and policy drivers of management agencies and actions, both at the government and community-levels, and from a science-based perspective. Watershed ecological complexity, measured by the number of different ecosystems in the watershed –and, therefore, watershed size- appear to be inversely related to the success of established adaptive management strategies (Crocodile, Sacramento, and Zambezi). Smaller, less transformed watersheds are more likely to have adopted an adaptive management structure with strong experimental and/or monitoring programs, especially in Florida due to the institutional signature of the Watershed Management Districts (Apalachicola, King's Bay, Ocklawaha, Peace, St. Mary's and Suwannee). Drastic land-use changes and river flow disturbances due to agricultural, mining, industrial and population growth throughout the history of the watersheds have resulted in almost generalized impairment of water quality and quantity through river flow disturbances in most watersheds, with severity increasing with institutional weakness and the ambiguities resulting from organizational and normative overlaps.

A notable shift in management approaches, from an emphasis upon building dams, and other infrastructures aimed at "taming" and utilizing the rivers for their hydropower, irrigation, filtration, and flood-control needs –to a "restoration paradigm" is evident in the last 40 years. The latter consists of a renewed focus upon conservation, wildlife survival, recreation potential and the remedial or mitigation plans to resolve legacy pollution problems (Hudson, Peace, Zambezi) or threats to urban infrastructures (Fraser, Sacramento). Within present institutional models, policy-making regarding water quality and quantity in most watersheds remains a slow, elusive and complex process of decision-making, frequently inadequate to resolve regional and trans-boundary conflicts. However, in some instances, large watersheds (Columbia, Fraser, and Hudson) have established deliberate adaptive management organizations during the last 30 years, and have therefore enabled science-based, experimental approaches to become part of the management strategies with a measure of success.

Prager, Rosanne

Authors: **Rosanne Prager**, CH2M HILL
Steven Eakin, CH2M HILL

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Managed Hydration Demonstrates Avoidance of Wetland Impacts by Groundwater Alteration

Groundwater withdrawal can potentially result in impacts to surface wetlands by lowering the water table of the surficial aquifer. Active hydration by metered application of groundwater, and passive hydration by construction of a control weir in an outfall ditch are two possible strategies to maintain viable wetland hydrologic characteristics and avoid adverse drawdown affects on wetland resources. A five-year demonstration project was conducted by the St. Johns River Water Management District in northeast Florida in coordination with land owners and four regional water supply utilities to investigate the effectiveness of these two augmentation strategies. Completed in September 2008, the study yielded conclusions useful to the adaptive management and avoidance of impacts by well field operations. Wetlands managed by active hydration showed improved hydrologic conditions within the first year. Passive hydration did not compensate for deficits in rainfall-driven water inputs and was a less reliable strategy. Surface water elevations were controlled by outlet weir elevation but overall success was dependent on rainfall. Implementing control weirs in conjunction with active hydration could provide greater management flexibility and a faster hydrologic response. Amphibian communities, a sensitive indicator of wetland hydroperiod in contrast to plant communities, responded quickly to increased surface water availability from rainfall, hydration, or both; without adverse affects. A minimal amount of ecological data was needed to develop the wetland target hydrograph and an optimal augmentation schedule (quantity and timing). The target hydrograph can provide a useful metric for maintaining an ecological condition that avoids unacceptable harm. A comparison of active hydration unit costs (i.e., water delivery system, monitoring equipment, and data reporting) to unit costs of purchasing mitigation bank credits indicated that active augmentation can be cost-effective.

Pyati, Radha

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Heather McCarthy, Jacksonville University

Category: Human dimensions of water sustainability
Session Title: Poster Session: Human Dimensions of Water Sustainability 1

The Second State of the River Report and Brochure on the Lower St. Johns River Basin: a Technical Report Designed for the Public

The Second State of the River Report and Brochure are a summary and analysis of the health of the Lower St. Johns River Basin (LSJRB) and is a collaboration between UNF and Jacksonville University supported by the Environmental Protection Board of the City of Jacksonville. Both documents are written for public reading and have been designed to make scientific and technical data from sources such as the Florida DEP STORET accessible and understandable to the public and to policymakers. The Report addresses four main areas of river health: water quality, fisheries, aquatic life, and contaminants. Section 1 provides an overview of the Report and the basin, and it describes the basin's landscape, human occupancy, and environmental management spanning the 1800s to 2009. Section 2 describes water quality in terms of dissolved oxygen, nutrients, turbidity, algal blooms, fecal coliform, and metals. Examination of individual tributaries reveals their overall health and identifies water quality characteristics in need of attention. Section 3 addresses the state of the river's finfish and invertebrate fisheries. Section 4 examines the condition of aquatic life, encompassing numerous species of plants and animals as well as wetlands. Section 5 discusses the importance of four classes of sediment contaminants to the health of organisms in four regions of the river. The classes include polycyclic aromatic hydrocarbons (PAHs), metals, polychlorinated biphenyls (PCBs), and pesticides that contain chlorine. The Brochure is an eleven-page, color document that encapsulates the conclusions of the full Report and provides readers with a graphic representation of ways they can help the St. Johns River. Since the release of the Brochure and Report in summer 2009, the public has viewed the Report and Brochure many times, as evidenced by the hit counts on the project website.

Rains, Mark

Authors: **Mark Rains**, Department of Geology, University of South Florida
Kathryn Murphy, Department of Geology, University of South Florida
Natalie Pechenik, Department of Geology, University of South Florida
Michael Exner-Kittridge, Department of Geology, University of South Florida
Mark Stewart, Department of Geology, University of South Florida

Category: Integrating science and policy for improved water management
Session Title: Monitoring and Modeling Hydrologic Processes

Hydrology of clay settling areas and surrounding landscapes in the phosphate mining district, peninsular Florida

The objective of this study was to use applied and naturally-occurring geochemical tracers to study the hydrology of clay settling areas (CSAs) and the hydrological connectivity between CSAs and surrounding hydrological landscapes. The study site is located on the Fort Meade North Mine in Polk County, Florida. The CSA has a well-developed, subangular-blocky, clay-rich surface layer with abundant desiccation cracks and other macropores, and a massive, clay-rich sublayer that is saturated below ~1.0-2.5 m. A bromide tracer was applied to study hydrological processes in the upper part of the CSA. Bromide infiltrated rapidly, perched on the massive, clay-rich sublayer, and flowed laterally across the landscape and through depressional wetlands. Infiltration and lateral flow were rapid suggesting that preferential flow through desiccation cracks and other macropores likely dominates flow in the upper part of the CSA. Naturally-occurring solute and stable isotope tracers were used to study the hydrological connectivity between the CSA and the surrounding hydrological landscape. Three-end mass-balance mixing model results indicate that groundwater from the CSA can be found in the surficial aquifer downgradient of the CSA. However, the precise flowpaths from the CSA to the surrounding hydrological landscape are unclear and the fluxes remain unquantified, so the precise effects of CSAs on the hydrology of the surrounding hydrological landscape also remain unquantified.

Rajvanshi, Noorie

Authors: **Noorie Rajvanshi**, University of Florida
Mark Brown, Environmental Engineering Sciences

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Comparing Energy Cost of Water in the Production of Biofuels from Corn, Pine and Sweet Sorghum

Liquid fuels derived from fossil fuels constitute one of the largest parts of energy consumption in the United States and worldwide. Biofuels like ethanol and biodiesel are seen as potential replacements for these liquid fuels derived from fossil fuels. The world ethanol production increased by more than 200% from 19 billion liters in 2001 to 66 billion liters in 2008 and is projected to increase further owing to political and trade decions. With the increasing scale of markets it has become important to understand and evaluate the environmental and energetic impacts of the production of ethanol. Water is one of the important resources affected by this increase in biofuel production. A unique way to quantify the water utilization in biofuel production is by calculating the water cost in terms of emergy. This can be achieved by calculating three different costs associated with water resources: Resource Costs (RC), Financial Costs (FC), and Environmental Costs (EC) and converting these costs in terms of emergy based monetary values. Financial Costs are the direct costs associated with supplying water, which include energy, materials, labor and infrastructure. Resource costs can be derived from two aspects of water, viz. chemical potential and geopotential. And finally the environmental cost also known as opportunity cost can be calculated using the GDP and total water consumption of the geographical area. This study is based on data from corn ethanol plant in South Dakota, a demonstration cellulosic conversion plant using woody biomass as feedstock in California and sweet sorghum ethanol plant in India. The study compares the emergy cost of water used for these three feedstocks. The financial value of the product, i.e. ethanol has also been compared with the financial and emergy cost of water for these three cases.

Rawls, Colin

Authors: **Colin Rawls**, Food and Resource Economics Department, University of Florida
Tatiana Borisova, University of Florida

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 1

Evaluating Residential Water Rate Design: An Empirical Analysis in Florida

When utilities design water rates, they must balance a number of potentially competing objectives: water conservation, revenue, revenue stability, affordability, and consumer equity. This research proposes a number of criteria based on these objectives that can be used to evaluate water rates. In the case of water conservation, these criteria include: average water prices, marginal water prices, percent savings on household water bill associated with water use reduction, and distribution of utility revenue between volumetric and fixed charges. In the case of revenue, the proposed criteria include: average monthly revenue, standard deviation of monthly revenue, standard deviation of household bill, and distribution of household bills. Finally, in the case of affordability and equity, the proposed criteria include: quantity of water that a hypothetical household on the Federal poverty line could consume without exceeding a defined hardship threshold, and Gini coefficient estimates of rate equity as defined by income groups. These criteria were used to conduct comprehensive rate evaluations of sixteen Florida utilities. Data were provided by the 2005 Florida Water Management District report, Florida Water Rates Evaluation of Single Family Homes, by Dr. John Whitcomb. The report collected water use and price data from more than 3,000 Florida Households from 1998-2003. The rate evaluations completed for this study suggest several broad conclusions. First, utilities' objectives of water conservation, water affordability, and customer equity do not appear to conflict with each other. Second, there is often a trade-off between water conservation incentives and stability of utility revenue. Third, inclining water rate structures with more than three price blocks tend to send stronger conservation price signals than other rate structures. Finally, water rates cannot be evaluated in isolation from utilities' sewer rates, taxes, and inflation.

Renner, Mikel

Authors: **Mikel Renner**, Southwest Florida Water Management District

Category: Managing water and energy in a transitioning environment
Session Title: Adaptive Water Management Strategies for a Transitioning Environment

Managing Water Resources in an Uncertain Future

Abstract: The Southwest Florida Water Management District is currently facing many water resource management challenges including shortages due to drought, salt water intrusion and deterioration in quality, and limits on the availability of groundwater sources. Continued pressures from population growth, development styles and potential new challenges resulting from climate change stress the system even further. Florida's water managers must now plan for potential increased variability in precipitation regimes, storm events, and rising sea levels. Significant changes in these phenomena from historical patterns are likely to result in changes to the amount of fresh water resources and land available to sustain life and maintain healthy water dependent natural systems. Primary water resource concerns revolve around changes to water dependent ecosystems, impacts to and from human activity and ground and surface water quality and quantity. The SWFWMD currently has in place numerous activities that will position water and land managers to efficiently adapt to potential changes and minimize negative impacts. Additionally it will become increasingly important to incorporate methods into our planning and programs to quantify and plan for uncertainties and risks related to changes in climate. This is particularly true as our population continues to grow along the coast, where public water, wastewater and facilities are located to serve those populations and where stormwater facilities may be inadequate. Planning and acting will be critical to maintain the quality of life, economic vitality and environmental sustainability for the region. This presentation will detail issues described above and water management district options and strategies for planning and action now.

Richter, Brian

Authors: **Brian Richter**, The Nature Conservancy

Category: Opening Plenary Session
Session Title: Plenary Session

Life Cycles: Sustaining the Flows of Water, Fish, and Human Culture

The notion of sustainability in water resource management is now being used to sell everything from hydropower dams to low-flow toilets. This presentation will explore the root meanings of the concept of sustainability and highlight strategies for attaining it in three different geographic and cultural settings. In Quito, Ecuador, water supply managers are investing in watershed protection as a means for reducing their water filtration costs, while at the same time providing a new source of income for mountain villagers. Along the Zambezi River in Africa, new ways of managing old dams are being proposed as a means for restoring river health and riverside communities that depend on the river's bounty for their well-being. In many of the states within the US, new water allocation rules are being adopted to try to better protect environmental flow conditions and associated benefits for people. Based on lessons learned from these and other projects around the world, The Nature Conservancy and a diverse array of partners are developing global certification programs for water use and hydropower development in an effort to accelerate global adoption of sustainable water management practices.

Risko, Susan

Authors: **Susan Risko**, University of Florida
Chris Martinez, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Long-range Streamflow Forecasts in the Tampa Bay Region Using ENSO

Increasing pressures on the availability of Florida's water supplies due to urban development and population growth require sophisticated management techniques to protect existing water resources. With the knowledge that climate represents a direct link to the availability of water supplies and by understanding the patterns associated with climatic influences, water resource managers can be better equipped for making more accurate water supply projections. This study has been conducted in support of Tampa Bay Water to efficiently perform groundwater/surface water source rotation to enhance system reliability using forecasted surface water supplies. Based on correlation and composite analysis of streamflow with gridded climate datasets at multiple lead times, the Niño 3 and Niño 3.4 indices were found to have significant correlations with streamflows in the region. Further analysis evaluates the Non-parametric Seasonal Forecast Model (NSFM) which integrates the use of historical streamflow data and climate information to determine various monthly and seasonal streamflow exceedance probabilities for multiple lead times. Exceedance probabilities are presented for three approaches of forecasting the first being the traditional use of historical streamflows, the second using only relevant climate information, and the last scenario being a combination of the previous two. Results from this study will provide Tampa Bay Water with the necessary tools and a thorough understanding of NSFM model processes and outputs for improved streamflow forecasts that will assist water resource managers in short-term source allocation decisions.

Roeder, Eberhard

Authors: **Eberhard Roeder**, Florida Department of Health
Elke Ursin, Florida Department of Health

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 2

Florida's onsite sewage research program: a source of information for environmental management

Serving about a third of Florida's population, onsite sewage treatment and disposal systems are a part of the wastewater infrastructure regulated by the Florida Department of Health. In addition to this regulatory role, the legislature also established a research program in the department. Implementation of this research program is funded through a $5 surcharge on all new septic system permits and through various grants and occasional special appropriations by the legislature. A Research Review and Advisory Committee (RRAC), composed of representatives of various interest groups, advises the department on priorities for research projects beyond those defined from year to year by the legislature, comments on research reports, and assists in selecting contractors for research projects. Over the course of the last twenty years the program has funded a variety of research that has resulted in information on the performance and impacts of onsite systems. This information can be useful in the development of environmental policy, such as load allocations. An ongoing focus of research is the nutrient impact by onsite systems. This topic has been of particular interest recently in the context of protection of springs, resulting in initial legislative funding of a multi-year project to evaluate nitrogen treatment in the onsite treatment system as well as in the soil and shallow groundwater, and to develop passive strategies for nitrogen reduction. In the past year, contractors for the department developed an inventory of onsite sewage systems based on improved parcels, onsite sewage permitting records, and connection information by sewer utilities. The contractor developed an estimation method to assign a probability of being served by onsite systems for those parcels where sewer and onsite permit records were not available. This geospatial information can be useful as a starting point for assessments of onsite sewage contributions in a TMDL or BMAP context.

Rooney, Robert

Authors: **Robert Roney**, Department of Agricultural & Biological Engineering, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Comparison of Statistical Methods for Downscaling 1-14 Day Weather Forecasts in the Tampa Bay Region using a Reforecast Data Set

Hydrologists and water management agencies require the accurate prediction of precipitation on a local spatial scale (10-20 km) that cannot be directly produced from Global Circulation Models (GCMs) due to their coarse grid resolution, typically on the order of several hundred kilometers. This study was conducted to improve short-term temperature and precipitation forecasts for use by Tampa Bay Water in their urban water demand model block of the decision making process. Two statistical downscaling and bias correction techniques were evaluated, logistic regression (LR) and an analog method (AM), using a retrospective forecast (re-forecast) data set. Reforecasting identifies a data set of retrospective numerical forecasts using the same model to generate real-time forecasts. Due to the large computational requirements reforecast data sets are not commonly produced. However, when available, the reforecast data set can be used to improve medium range weather forecast products, improve probabilistic forecasts of extreme events, and aid in diagnosing model errors. The reforecast data set used in this study was created using a fixed version of the National Center for Environmental Prediction's (NCEP) Global Forecast System (GFS) model. The resulting reforecast data set has a 2.5 degree resolution (approx. 250km grid spacing) and covers 30 years of historical record (1/1/1979 to Present). The forecast skill of the two methods were evaluated with regard to seasonal variation, potential improvements in predictor selection, spatial scale of the application, variability in the selection of user defined parameters and different lead days.

Roy, Moutusi

Authors: **Moutusi Roy**, University of Florida
Dr. Jonathon Martin, University of Florida
Dr. Christopher Smith, USGS
Dr. Jaye Cable, Louisiana State University

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Temporal variations in recharge to a coastal aquifer and linked changes in Fe concentrations of the subterranean estuary

Iron (Fe) cycling in subterranean estuaries can be influenced by the hydrology of the subterranean estuary. Iron concentrations are elevated at the freshwater-saltwater boundary of subterranean estuary, because slow flow there allows accumulation of dissolved Fe produced from Fe-oxide dissolution. A redox gradient and flow distribution in the subterranean estuary of Indian River Lagoon, Florida increases dissolved Fe concentrations by three orders of magnitude, from less than 1 µM at the shoreline to about 300 µM at the freshwater-saltwater boundary. To observe temporal variations in Fe cycling, pore water was sampled across this gradient eight times over a three-year period (November-2004, February-2005, May-2005, September-2005, May-2006, October-2006, April-2007, and September-2007). From November 2004 to October 2006, the freshwater-saltwater boundary (defined by the 300 mM chloride concentration contour) was more than 30 m offshore, but by April 2007 the boundary had shifted landward to about 22.5 m offshore. Simultaneous with this shift, Fe concentrations of between 200 and 300 µM moved from 30 m offshore in 2006 to about 22.5 m offshore. Reactive transport models show reaction rates of Fe-oxide dissolution were similar across the seepage face, at about 0.1 mg/cm2/year, and did not vary with time. Changes in reaction rate thus cannot cause the observed changes in Fe concentrations, which instead are likely caused by a decrease in recharge to the Surficial aquifer from tens of cm/year in 2004 to 2006 to about -10 cm/year in 2007. The decrease in recharge would narrow the width of the seepage face and move the freshwater-saltwater boundary landward. These results suggest that during drought conditions the width of the seepage face would decrease, and the freshwater-saltwater boundary would move landward. Because the width of the subterranean estuary changes temporally, the total amount of Fe-oxide dissolution and associated OC remineralization also changes temporally.

Saarinen, Justin

Authors: **Justin A. Saarinen**, GIS Associates, Inc.
Tonya Simmons, Simmons Environmental Consulting
Rich Doty, GIS Associates

Category: Optimal use of integrated water supplies
Session Title: Poster Session: Optimal Use of Integrated Water Supplies 2

Using GIS to Understand, Manage, and Project Water Demands

This poster presentation illustrates how GIS appraisal data can be used to benchmark water use for comparison to customer information systems data. An illustration of how GIS data can be used to manage demand via conservation targeting, planning, and implementation tracking will is provided. Top water users are identified (based on benchmark use rather than total use) and water conservation plans are developed. Cost effectiveness evaluations are performed so that the cost to save water can be compared to the cost to develop alternative sources. Case studies will be presented as proof of concept.

Schmitz, Joshua

Authors: **Josh Schmitz, P.E.**, Water Resource Associates
Carole Barice, Esquire, McGee and Mason
Michael Dema, M.A., Janicki Environmental

Category: Integrating science and policy for improved water management
Session Title: Integrating Science and Policy for Improved Water Management

Protecting Water Bodies Lacking Minimum Flows and Levels from Adverse Impact due to Water Withdrawals

Water practitioners are all aware of the potential for harm to Florida's waters with uncontrolled water withdrawals. Minimum flow and level (MFL) water regimes set by the water management districts are the cornerstone of the state's protection strategy. These regimes are widely recognized as adequate, but major water resource systems still lack MFLs as the districts deal with time and budget constraints. With much of the state designated as a water caution area, water bodies lacking MFLs are being targeted for development. Mandated water supply plans are gearing entire regions to conserve and develop alternative sources. These plans normally promise a future MFL thus relying on a supposition both for the protection of the resource and the region's future water supply. The public perception is that tapping water bodies lacking MFLs is a foregone conclusion. And there is little doubt that rapid growth can outpace the districts' ability to complete MFLs. In fact, draws from major water bodies lacking MFLs are authorized or denied based on the three prong test. Little data is usually available for these systems. Can a water body without a MFL still be protected and developed sustainably? Is the water supply development process adequate without MFLs? We will explore this question from both policy and technical perspectives, focusing on the resource and supply uncertainties that accompany water bodies lacking MFLs. The answers may lie in the large numbers of MFLs actually completed by the water management districts. Examples will be presented to show strategies for enhancing the protection and certainty of these resources while allowing the water management districts to fulfill their prescribed role managing water supply.

Scott, Tom

Authors: **Guy Means**, SDII Global
Sam Upchurch, SDII Global Corporation
Thomas Scott, SDII Global Corporation

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 1

Swallets: The Key to Springshed Protection in Florida

Swallets are openings through which sinking streams loose water to the subsurface. In Florida, these features are typically sinkholes within karst terrains that include spring systems. Swallets may perennially capture flow of a stream, capture portions of stream flow, or vary in function depending on stream and groundwater stage. Swallets and sinking streams are significant sources of groundwater within the karstic springsheds and of spring discharge. Variations in stream discharge affect groundwater potentials in the springsheds and spring discharge. Equally important, contaminants in the streams that drain into swallets are threats to springshed groundwater and spring water quality. In 2005 to 2007, the Florida Geological Survey undertook an extensive effort to inventory swallets in Florida. Over three hundred were identified. The streams they capture range from small, first-order streams to major rivers. Associated drainage basins range in size up to hundreds of square kilometers. It is clear from the swallet inventory that swallets are critical elements for spring and groundwater protection in Florida. Springshed and spring protection zones should include both vulnerable portions of the springshed and the surface-water basins of streams that enter the subsurface within the springshed.

Shannon, Scott

Authors: **Scott Shannon**, Malcolm Pirnie Inc.
Christopher Hill, Malcolm Pirnie Inc.
Edward Balchon, Malcolm Pirnie Inc.

Category: Optimal use of integrated water supplies
Session Title: Managing Integrated Water Supplies

An Ocean of Challenges: Developing the Coquina Coast Seawater Desalination Project

Centered in Flagler County, the Coquina Coast gets its name from the unique geological features of the northeastern coast of Florida. In an effort to meet increasing water demands and address limitations in future groundwater usage, the eleven municipalities centered in this region, together with the St. Johns River Water Management District, are developing the concept for a seawater desalination plant to help ensure a sustainable water supply for the region's future. Ultimately, the project could provide up to 80 million gallons per day of drinking water to an area encompassing parts of five counties. The project will offer many benefits, not the least of which is a sustainable, drought-proof alternative water supply. Implementing a project of this magnitude presents myriad technical and environmental challenges. For instance, determining the best type of seawater intake and treatment processes to optimize water quality performance and plant reliability, and designing and constructing intake and concentrate discharge structures to minimize impacts to sensitive coastal and marine environments are two examples. As daunting as these challenges can be, the technology required to overcome them is available and has been proven through operations around the world. Perhaps more important are the largely non-technical challenges. Financially, can a billion dollars worth of project infrastructure be funded without unreasonable rate hikes? Socially, can the project's partners build the public support needed to ensure it moves forward? Politically, can the various municipal partners cooperate, putting the interests of the group ahead of their individual desires? This presentation will review the considerations of the project's partners to help address these questions, the answers to which will determine the fate of the Coquina Coast Project, and will likely have implications for regional water supply projects in general.

Sheng, Y.

Authors: **Vladimir Paramygin**, Civil and Coastal Engineering Department, University of Florida
Y. Peter Sheng, Civil and Coastal Engineering Department, University of Florida

Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 1

Modeling the Effect of Freshwater on Salinity Dynamics in Apalachicola Bay

Apalachicola-Chatahoochee-Flint (ACF) system is an important watershed-riverine-estuarine ecosystem which encompasses the tri-state area of Georgia, Alabama, and Florida. Freshwater originates in Lake Lanier in Atlanta flows through Chatahoochee River, Flint River, and Apalachicola River before reaching the Apalachicola Bay in Florida. While the freshwater is used for drinking and agriculture, it is also vital to the shell fish in the Apalachicola Bay. Reduced freshwater flow in the ACF system will result in higher salinity in the Apalachicola Bay which adversely impacts the oysters in the Bay. Therefore, it is important to develop quantitative understanding on how freshwater flow in the ACF system impacts the salinity in the Apalachicola Bay, so that the minimum level of freshwater flow necessary to maintain the oyster industry can be established. As a first step towards the development of an integrated modeling system of the ACF system to enable assessment of the impact of freshwater withdrawal and climate change on the salinity and biological species inside the Apalachicola Bay, this paper presents a preliminary model simulation on the effect of freshwater on salinity inside the Apalachicola Bay. Specifically this paper will present the results of the simulated salinity dynamics in the Apalachicola Bay during the summer of 2004 when several hurricanes passed the region, using a 3D baroclinic circulation model CH3D with offshore boundary condition provided by Gulf wide models such as NCOM and HYCOM.

Shivers, Stephen

Authors: **Stephen Shivers**, Joseph W. Jones Ecological Research Center
Stephen Opsahl, Joseph W. Jones Ecological Research Center
Alan Covich, University of Georgia Odum School of Ecology

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

The Impact of Submerged Aquatic Vegetation on Carbon Dynamics and DOC Bioavailability in a Southeastern Reservoir

Although inland freshwater ecosystems comprise a small proportion of the Earth, they make significant contributions to the global carbon cycle. Inland waters contribute carbon to the atmosphere in the form of CO2 and methane, and can store carbon through burial in the sediment. With an estimated global surface area of 1.5 million km2, reservoirs could potentially play a crucial role in the biogeochemical cycling of carbon. The inputs of carbon to reservoirs are not only from riverine sources and atmospheric sources, but also from submerged aquatic vegetation (SAV) within the reservoir. SAV influences reservoir biogeochemical cycling by changing physical and chemical parameters of water quality, such as DO, pH, nutrients, and dissolved organic carbon (DOC). Additionally, bioavailability to consumers differs greatly between sources. We performed diurnal (24 hour) sampling within a dense stand of Hydrilla verticillata on Lake Seminole in order to study these changes. During the peak growing season, DO was supersaturated (>15 mg/L) near the surface and anoxic (

Shortelle, Ann

Authors: **Ann Shortelle**, MACTEC Engineering and Consulting, Inc.

Category: Integrating science and policy for improved water management
Session Title: Integrating Science and Policy for Improved Water Management

Comparison of States' Responses to the TMDL Planning Process with the Advent of Numeric Nutrient Criteria

Total Maximum Daily Load (TMDL) is a regulatory term from the U.S. Clean Water Act. The TMDL sets forth the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. USEPA and States implementing the Clean Water Act establish TMDLs for impaired waterbodies. In general, States develop inventories of waterbodies that do not fully support their designated beneficial uses (e.g. recreation, fisheries, etc.), and TMDLs are then developed for those impaired waterbodies. Load allocations are made for point and nonpoint source contributions, and plans are made for the implementation and enforcement of the TMDL. However, there is wide variation in State programs, and especially in the development and implementation of TMDLs associated with nutrient impairment. The push to adopt numeric nutrient criteria is resulting in a variety of methodologies and challenges associated with the scientific, economic, and societal aspects of this issue, further complicating an already complex issue. Can Florida benefit from the lessons being learned by others?

Shukla, Sanjay

Authors: **Sanjay Shukla**, University of Florida
Debashish Goswami, University of Florida
Wendy Graham, University of Florida
Alan Hodges, University of Florida
Vimala Nair, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 2

Water quality effectiveness of the water retention BMP at the two isolated wetlands in the Lake Okeechobee Basin

Wetland water retention (WWR) BMP was evaluated at two wetlands (wetlands 1 and 2) within a beef cattle ranch with respect to P and Nitrogen (N) loadings. To evaluate the WWR at wetland 1, two years of pre-BMP (June 2005-May 2006, pre-BMP1 and June 2006-May 2007, pre-BMP2) and two years of post-BMP (June 2007-May 2008, post-BMP1 and June 2008-May 2009, post-BMP2) surface and ground water quality data were used. For wetland 2, June 2005-May 2006 was considered as the pre-BMP period while June 2006-May 2007, June 2007-May 2008, and June 2008-May 2009 were the three post-BMP periods (post-BMP1, post-BMP2, and post-BMP3, respectively). At wetland 1, Total Phosphorus (TP) and Total Nitrogen (TN) loads for post-BMP1 period were less than those during the two pre-BMP periods. But for post-BMP2 period, TP and TN loads were almost twice than those during pre-BMP1. The average TP (93 kg) and TN (304 kg) loads for the two post-BMP periods were higher than the average TP (47 kg) and TN (161 kg) loads for the two pre-BMP periods. Large flow variability and presence of "P hotspots" masked the BMP effectiveness analyses at wetland 1. Drought conditions in 2007 resulted in mineralization of soil and plant P which may have been discharged during 2008. For wetland 2, TP and TN loads during the three post-BMP periods were less than those during the pre-BMP period. The pre-BMP and post-BMP3 periods had similar rainfall and flow volumes which resulted in better evaluation of the BMP. The P and N loads and flow-weighted concentrations were lower during post-BMP3 compared to pre-BMP. Water storage and hydroperiod estimates at both wetlands varied considerably depending on the accuracy of the topographic data (LIDAR and USGS). The hydrologic and water quality monitoring at the two sites is continuing to better quantify the effects of WWR BMP.

Sims, Roger

Authors: **Roger Sims**, Holland Knight LLP

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 2

Emerging Pollutants in Water Supplies

"This paper will investigate the legal implications of emerging pollutants in water supplies, such as pharmaceuticals, personal care products and other constituents of concern. The increasing pressure to re-use water will be evaluated in the context of ever-increasing technological capacity to detect nano-pollutants in ambient water sources. Current regulatory issues and pending government actions will be covered as well."

Smith, Andrew

Authors: **Andrew J. Smith**, Apalachicola Riverkeeper

Category: Human dimensions of water sustainability
Session Title: The Apalachicola-Chattahoochee-Flint River Basin: Complex Challenges, Integrated Solutions? 2

Human Dimensions of Water Sustainability in the Apalachicola Basin

The harvest from the eastern Gulf of Mexico, the Apalachicola River, Floodplain, and Bay support and maintain communities throughout the Apalachicola Basin. Individuals and families produce amazing amounts of oysters, crawfish, shrimp, tupelo honey, hardwood timber, crawlers, and other natural resources that have sustained them for generations. Their livelihoods are dependent on a healthy Apalachicola River and Bay ecosystem, which is directly impacted by consumptive water use and the US Army Corps of Engineers' management of the federal reservoirs in the Apalachicola-Chattahoochee-Flint (ACF) River system. . The states of Georgia, Florida, and Alabama and US Army Corps of Engineers have spent tremendous public resources litigating over their interpretations of how the Water Supply Act, Water Resources Development Act, Endangered Species Act, and Coastal Zone Management Act control the waters of the ACF. Water is an essential and finite natural resource and to be sustainable a society must limit its rate of consumption of such resources. The first affirmative step in sustaining the health of the ACF ecosystem is to quantify the freshwater needs of and the consumptive withdrawals from the system. With this information, we can determine and manage sustainable water use.

Srivastava, Vibhava

Authors: **Vibhava Srivastava**, University of Florida
Wendy Graham, Water Institute
Jonathan Martin, Department of Geology
Matthew Cohen, School of Forest Resources and Conservation

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

An integrated approach to investigate the hydrological behavior of the SantaFe River Basin, north central Florida

A simple two domain rainfall discharge convolution model (TDRDM; Long, 2009) was applied to the 3700 km2 Santa Fe River Basin (SFRB), in north central Florida, to predict the ground and surface water components of streamflow as a response to observed precipitation. In addition a two end member mixing analysis (EMMA; Schilling and Helmers, 2008; Soulsby and Dunn, 2003) technique, using measured concentrations of specific conductivity (SC) in streamflow as well as surface water and groundwater end members, was used independently to estimate the surface and groundwater contributions to streamflow within the basin. The results obtained from the two independent approaches showed reasonable agreement about the hydrologic behavior of the basin. Results obtained through the EMMA showed the dominance of surface or near surface flow processes in the confined region of the SFRB. The EMMA also showed that the unconfined region is dominated by groundwater throughout the period of study with a few exceptions during extreme storm events when surface or near surface water sources dominate groundwater contributions. Similar dominance of surficial processes in the confined region and ground water in the unconfined region was confirmed by TDRDM. The TDRDM indicated the presence of two relatively fast flow components in the confined region and one fast and very slow flow component in the unconfined region. Overall the complementary use of EMMA using SC data along with a simple rainfall-discharge convolution model helped to further refine our conceptual model of the surface and groundwater interactions in unconfined region of the SFRB. During the next phase of this research hypotheses based on this refined conceptual hydrologic model will be tested using the 3-D spatially distributed integrated surface-groundwater model PARFLOW (Maxwell and Miller, 2005; Kollet and Maxwell, 2008).

Swihart, Thomas

Authors: **Tom Swihart**, Florida Department of Environmental Protection

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Stakeholder Engagement Processes

A Few Lessons from the History of Florida Water Crises

Florida water history is marked by many serious water management problems and crises. In some cases, the identification of the problems led to major changes in state water law or in water management practices. For example, regional floods in southeast Florida in 1948 led to the creation of the Central and Southern Florida Flood Control District in 1949. Similarly, regional flooding in west-central Florida in 1960 resulted in the creation of the Southwest Florida Water Management District in 1961. Other times, however, the water problems or crises were neglected or allowed to fester. The Tampa Bay "Water Wars" occupied newspaper pages for two decades before a ceasefire occurred in 1998. What are a few lessons from the history of how water crises have been approached in the past in Florida? And, in particular, what relevance does the history of past water management crises have for how the state might address the pressing challenges of climate change?

Taylor, Nicholas

Authors: **Nicholas Taylor**, Program for Resource Efficient Communities, University of Florida
Jennifer McElroy, Gainesville Regional Utilities

Category: Optimal use of integrated water supplies
Session Title: Water Conservation and Demand-Side Management

Development of Demand Side Management Programs to Reduce Potable Water Use for Landscape Irrigation.

Throughout the Southeastern United States, there is growing concern over the scarcity of potable water supplies. In a program funded by the St. John's River Water Management District's Water Conservation and Demand Management Program, The University of Florida's Program for Resource Efficient Communities is working with Gainesville Regional Utilities on a demand-side-management program using soil moisture sensor technology to reduce quantities of potable water used for landscape irrigation. We will discuss program design, preliminary results and the potential for program expansion. Further details will be given about participant selection criteria, homeowner training, irrigation contractor training, and measurement and verification of results as key program elements. We will focus on lessons learned to improve the effectiveness of future demand side management programs.

Timilsena, Janak

Authors: **Janak Timilsena**, Department of Agricultural Biological Engineering, University of Florida
Greg Kiker, Assistant Professor, Agriculture and Biological Engineering Department, University of Florida
Chris Martinez, Assistant Professor, Agricultural and Biological Engineering Department, University of Florida

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 1

Water Management Scenario Analysis of Tampa Bay Water System

This study focuses on water resource allocation strategy and policy analysis of Tampa Bay Water, the largest wholesale water supplier in the region. The Water Evaluation and Planning (WEAP) system model is used as a tool to simulate different water supply allocation (Surface Water, Ground Water, and Desalinated Water) and demand scenarios. This research includes two phases of investigation: (i) Development of a baseline scenario based on historical water supply and demand data for the 2009 water year (ii) Development of several plausible future (2010-2025) scenarios based on future demand, future supply requirements, planned infrastructure alterations and conservation improvement. Historical water supply allocation data (Surface Water, Ground Water, and Desalinated Water) was obtained from Tampa Bay Water. Current and future scenarios were developed in close coordination with Tampa Bay Water management as well as their system operating policies. Forecasted climate information (e.g. El Niño and La Niña) and its effect in water allocation decision making was incorporated while developing the future scenarios. Sensitivity analysis is carried out by forcing different management strategies on source allocation and demand. This study provides better understanding of water resources planning, and evaluates different options for meeting future water demand in the Tampa Bay region.

Tomasko, David

Authors: **David Tomasko**, PBS&J
Ralph Montgomery, PBS&;J
Pam Latham, PBS&;J
Mike Coates, Peace River / Manasota Regional Water Supply Authority

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes 1

Linking Ecological Restoration with Water Supply Development using Off-Stream Reservoirs in Southwest Florida

The Peace River Manasota Regional Water Supply, in cooperation with the Southwest Florida Water Management District, recently examined various alternatives with regard to new off-stream reservoirs in the Upper Myakka, Cow Pen Slough and Shell Creek. The Upper Myakka River and Flatford Swamp were identified more than 10 years ago as having impaired ecosystem functions, due in large part to an excess of fresh water. These impacts are thought to be due to an increased amount of inflows associated with land use changes in the surrounding watershed. Dona Bay's impacts are associated with excessive freshwater inflows from the expanded size of the Cow Pen Slough watershed, a finding first made more than 30 years ago. In Shell Creek, a tributary to the lower Peace River, dry season flows have increased over historical levels, a phenomenon reported more than a decade ago. In Shell Creek, the augmentation of dry season flows by high conductivity water from upstream discharges has adversely affected the City of Punta Gorda's downstream water supply. Despite findings, now 10 to 30 years old, that these systems either have an "excess" amount of flow (i.e., Flatford Swamp and Dona Bay) or that there appears to be a significant concern about declines in water quality (i.e., Shell Creek) the stresses to these systems continue. Creating a nexus between the need for ecological restoration and new water supply development via the use of off-stream reservoirs was the focus of this recently completed study.

Traxler, Stephen

Authors: **Steve Traxler**, U.S. Fish and Wildlife Service
Dr. Herman Karl, MIT
Dr. Ronnie Best, USGS, Ft. Lauderdale, FL
Dr. Juan Carlos Vargas, MIT
Dr. Michael Flaxman, MIT

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Stakeholder Engagement Processes

Addressing the Challenge of Climate Change in the Greater Everglades Ecosystem: A Stakeholder-Based Approach

The Florida Everglades ecosystem is among the most important natural resources in North America and it is in the midst of perhaps the most complex and ambitious ecosystem restoration planning effort in U.S. history. (This effort will involve hundreds of semi-autonomous organizations and jurisdictions of thousands of people. To be successful, such a project must adopt a variety of planning, management, and communication strategies. In this regard, climate change is arguably the most significant and difficult issue to rise to prominence since the original formulation of the Comprehensive Everglades Restoration Plan (CERP) in 2000. Climate change will affect a wide variety of human and natural systems, and must be addressed within a context of considerable uncertainty in policy, human responses, and indirect effects. In order to plan and manage effectively in the face of such uncertainties, we are developing a stakeholder-based alternative futures process with two major objectives. First, in collaboration with the MIT-U.S. Geological Survey Science Impact Collaborative (MUSIC) and the U.S. Fish and Wildlife Service (FWS), we will develop a set of regional-scale "alternative futures" that spatially simulate likely climatic, hydrologic, and land use conditions in 2030 (based on IPCC scenarios). Secondly, in collaboration with MUSIC and FWS, is to examine the impacts of such changes on fish, wildlife, plants, and their habitats, such as National Wildlife Refuges in the Greater Everglades and Florida Keys Ecosystems. The work will be conducted using a spatially enabled stakeholder process, designed to combine the best available scientific information with local knowledge. The major outputs of our study will include information that characterizations of the potential impacts on the Everglades from climate change (this could take many forms such as research reports, GIS maps, and publications), and structured public and expert group processes. (Additional authors: Dr. Todd Hopkins, USFWS, Vero Beach, FL and Paul Souza, USFWS, Vero Beach, FL.)

Upchurch, Sam

Authors: **Sam B. Upchurch**, SDII Global Corporation

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Hydrologic, Biogeochemical and Ecological Processes in Springs Systems 1

The Importance of Springsheds and Spring Protection Zones

Springs are significant water and economic resources in Florida. Florida's governors and legislature have recognized their importance by establishing the Florida Springs Initiative and proposing a number of other initiatives to delineate springsheds and establish protection zones. Identification of springsheds (areas that contribute surface- and groundwater to the discharge of a spring) and protection zones (areas where land-use management can be used to effectively manage spring water supply and contamination) sounds simple, but is complex. This paper uses examples of springshed and protection zone delineation in Florida to illustrate the complexities and assumptions that must be made before the goals of spring protection can be achieved. For example, some of the uncertainties that must be addressed include: 1. How does one account for the unknown locations of karst conduits within the springshed? 2. Groundwater flow in spring systems is known to be rapid. How does one identify protection zones for systems where rapid travel times are probable and where dye tracing and modeling may be impossible or inaccurate? 3. Springsheds often appear to overlap and originate in unexpected locations. How does one delineate springsheds for such systems? 4. Should springsheds be delineated in areas where the host aquifer is highly confined? 5. How does one prioritize spring protection sub-areas? 6. How does one allocate total maximum daily loads (TMDLs) for springs with complex springsheds and multiple non-point sources?

Viveros, Paula

Authors: **Paula Viveros**, Program of Fisheries and Aquatic Sciences, University of Florida
Edward Phlips, UF, SFRC, Program of Fisheries and Aquatic Sciences

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Phytoplankton Composition and Abundance in Relation to Salinity, Nutrients and Light Gradients in Apalachicola Bay

The Apalachicola National Estuarine Research Reserve (ANERR) is located in the Florida panhandle on the northern coast of the Gulf of Mexico. This estuary is an example of an ecosystem that has been impacted by human development. The Apalachicola estuary is important both ecologically and commercially; it serves as a nursery and spawning ground for aquatic wildlife, and supports a large shellfish industry which depends on the fresh water dominated estuary. However, the flow of the river has been reduced in recent years, due to both drought conditions and increased upstream anthropogenic water withdrawal, endangering the integrity of the estuary, including the structure and function of the planktonic and benthic communities. The aim of the present study is to determine spatial and temporal patterns of phytoplankton composition and abundance in the estuary and correlate the results with observed gradients in salinity, nutrients concentration and light availability. The study is intended for two years; samples for chemical analyses and phytoplankton composition and abundance are collected on a monthly basis at a range of sampling sites within the bay. The overall goal of the study is to help define how future changes in flow and nutrient content of the Apalachicola River will impact the structure and function of the phytoplankton community which is the foundation of the food chain. The results of the project will provide critical information to the ANERR for the development of future management plans, and will contribute to a broader understanding of watershed-estuary relationships in river dominated ecosystems around world.

Walker, Krystal

Authors: **Krystal Walker**, Department of Environmental Engineering Sciences, University of Florida
Trevor Boyer, Assistant Professor, Environmental Engineering Sciences, University of Florida
Christine Overdevest, Assistant Professor, Sociology, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Evaluating the Chemistry of Halides and Dissolved Organic Matter in the St. Johns River

Although studies have been conducted on the St. Johns River to understand the effects of surface water withdrawals on environmental outcomes, there is a gap in knowledge pertaining to the chemistry of halides and dissolved organic matter (DOM). For example, it is not known how the concentration of bromide and iodide vary with respect to chloride. This is important because understanding the speciation of halides is expected to provide new insights into the geochemistry of the river. In addition, bromide and iodide are precursors to harmful disinfection byproducts that can be formed during water treatment. Although the concentration of DOM in the St. Johns River is known, there is little information on its chemistry. Understanding the chemistry of DOM is fundamental to understanding the numerous reactions that DOM takes part in, such as oxidation-reduction, photochemistry, contaminant binding, and impact on engineered treatment processes. The goal of this work is to understand the concentration and speciation of halides and DOM in the St. Johns River. The objectives of this work are: (1) to evaluate temporal trends in the ratios of bromide to chloride and iodide to chloride; (2) to couple bromide to chloride and iodide to chloride ratios with chloride flux from hydrologic modeling scenarios; (3) to evaluate temporal trends in the ultraviolet absorbance and fluorescence spectra of DOM; and (4) to discuss the implications of the chemistry of halides and DOM on natural and engineered processes. The proposed work will be accomplished by collecting weekly water samples, over the course of one year, from the St. Johns River near Deland. This location was chosen because it is downstream of proposed withdrawal locations, and has a stream gauge maintained by the U.S. Geological Survey. Water samples will be analyzed for a wide range of inorganic and organic water quality parameters.

Wang, Qingren

Authors: **Qingren Wang**, Tropical Research and Education Center, IFAS, University of Florida
Yuncong Li, TREC/UFL-- Homestead

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 1

Automatic Stations Setup and Surface Water Quality Monitoring in Everglades, Florida

The poster displays how to set up automatic stations and procedures for surface water quality monitoring and implementation in the middle of Everglades, Florida. It mainly consists of the following sections: development of standard operating procedures (SOPs) for sampling and chemical analysis; site selection and fundamental construction; power supply and essential equipment required for some water quality parameter in situ monitoring; flow measurement, data logger programming and storage, canal profile measurement, telecommunicating with AirLink, automatic sampler programming; procedures to collect grab samples and composite samples with flow proportional techniques; marsh area sampling skills, transportation, sample preservation and chemical analysis; quality control and assurance for low level of interested elements, especially phosphorus. It also provides some examples and general information in equipment selection and up-to-date knowledge and implementations for surface water quality monitoring continuously, flow proportional sampling challenges, chemical analyses, data processes, and preliminary results with general trends of phosphorus content for a long term (> 6 years) water quality monitoring project.

Waria, Manmeet

Authors: **MANMEET WARIA**, Department of Soil and Water Science, University of Florida
GEORGE O'CONNOR, PROFESSOR, DEPARTMENT OF SOIL AND WATER SCIENCE

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Environmental Behavior of Biosolids-Borne Triclosan (TCS)

Triclosan (TCS) is an antimicrobial compound frequently added in liquid soaps and is a common constituent of domestic wastewater. Wastewater is treated in treatment plants where solids (sludge) are separated and liquids (effluent) are discharged to surface waters. The presence of emerging contaminant (TCS) in surface waters has been well documented. In recent years, focus increased on the TCS concentration in biosolids as the TCS enters the agricultural soils and the environment through land applied biosolids. However, the fate and effects of TCS in land applied biosolids systems is largely unknown. Our research focuses on the environmental fate and ecological effects of biosolids-borne TCS under normal land application of biosolids scenarios, with the ultimate goal of performing an applicable environmental and human health risk assessment. We began by analyzing 15 biosolids from around the US for TCS content. The TCS concentrations ranged from 1 to 40 mg kg-1, and the mean TCS concentration (18 mg kg-1) in our study is consistent with the mean reported in the TNSSS (USEPA, 2009). We also performed a degradation study using 14C-TCS. The 18 week incubation suggested minimal (

Watts, Danielle

Authors: **Danielle Watts**, University of Florida
Matthew Cohen, University of Florida
Todd Osborne, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Hydrologic Controls on Ecosystem Respiration in the Everglades Ridge-Slough Mosaic

The Everglades in South Florida is a large subtropical peat wetland. Hydrologic modification over the last century has lead to the widespread loss of the historic ridge slough patterning that was characteristic of the pre-drainage Everglades. The loss of pattern is best understood as a change in peat accretion dynamics leading to loss of soil elevation bimodality; altered water levels have increased respiration (drained conditions) or decreased productivity (impounded conditions), which has profoundly altered the feedbacks that previously maintained patchiness. The objective of this study is to determine what factors in regional hydrology control annual ecosystem respiration, and to examine the possibility of thresholds in hydrologic conditions where increased water levels do not have a reciprocal influence on ecosystem carbon flux. We present the first year (December 2008 through December 2009) of bi-monthly ecosystem respiration measurements taken at 64 locations along a gradient of hydrologic conditions in Water Conservation Area (WCA) 3A. A multivariate model is presented, predicting respiration based on hydrologic attributes (inundation probability, median water depth) and other environmental covariates (water temperature, pH, community type). This model comprises one half of ongoing investigations into hypotheses of multiple equilbria for carbon accretion, represented on the landscape by ridges and sloughs.

Whittle, Amber

Authors: **Amber Whittle**, ENTRIX, Inc.
Michael Jones, Sarasota County, Water Resources

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Dona Bay Watershed Management Plan

Historically, the Dona Bay watershed (in Sarasota County, Florida) encompassed approximately 10,000 acres, whereas, currently, the watershed includes almost 48,000 acres. The fivefold expansion in area is the direct result of the channelization of the historical Cow Pen Slough by a series of deeply incised canals. This diversion of a significant portion of the Myakka River Watershed into the Dona Bay watershed has quadrupled the freshwater flows to Dona Bay and altered its estuarine ecology, including the decline of oyster populations during the wet season; however, water cannot presently be diverted back to the Myakka River due to flooding concerns. ENTRIX censused Sarasota County-owned lands located within the Dona Bay Watershed to evaluate the re-establishment of the historical floodplain wetland system of Cow Pen Slough and the Cow Pen Slough-Myakka River connection, the potential for storage of freshwater for public water supply, and the avenues to increase water quality in the estuary. The proposed Watershed Management Plan included the restoration of 310 acres of floodplain wetlands and the creation/restoration of 115 acres of freshwater marsh; the potential yield of 15 million gallons/day of public water supply; stormwater load reductions of 38-57% for N, 56-70% for P, and 82-88% for TSS; increased estuarine salinity of 10 ppt; and decreased freshwater runoff into the Dona Bay estuary by 41%. Sarasota County is currently undertaking Phase 1 of the Dona Bay Watershed Management Plan, which includes the restoration of 180 acres of floodplain wetland and the construction of a conveyance corridor between Cow Pen Slough Canal and a future public supply reservoir. Team members included Kimley-Horn and Associates (Master Plan and Phase 1), Post Buckley Schuh &; Jernigan, Mote Marine, and EarthBalance.

Will, Sandra

Authors: **Sandra Will**, Southwest Florida Water Management District
Michael Weatherby, MWH Americas, Inc.

Category: Optimal use of integrated water supplies
Session Title: Use of Reclaimed Water

Feasibility of Using Reclaimed Water for Aquifer Recharge in the Tampa Bay Area

In 2008, the Southwest Florida Water Management District (SWFWMD) initiated the Regional Reclaimed Water Partnership Initiative Project to work with utilities in the Tampa Bay Area to identify options for maximizing the beneficial use of available reclaimed water flows. One of the options identified was to use highly treated reclaimed water to recharge the Upper Floridan aquifer (UFA) to improve declining water levels and provide the opportunity for additional groundwater withdrawals. Because aquifer recharge using reclaimed water has been successfully implemented in other areas of the country, a feasibility study was conducted in 2009 that assessed the practicability of implementing this option in the southern Hillsborough and Polk County areas. The scope of work involved three main tasks: (1) assessing regulatory requirements; (2) quantifying water level improvements and potential groundwater withdrawals; and (3) performing cost analyses. Findings from the study indicate that it is possible to develop direct and indirect aquifer recharge projects to improve UFA water levels and provide opportunities for additional groundwater withdrawals in the area. Direct aquifer recharge (e.g., recharge wells) is most optimally located in coastal areas where the native aquifer water quality is poor and regulatory requirements are less stringent than more inland areas. Indirect aquifer recharge (e.g., rapid infiltration basins) would be most beneficially located in areas where the surficial sands are thick and a good connection to the underlying UFA exists. Depending on location, potentially up to 90 percent of recharged water quantities could be used as a mitigation offset for future additional groundwater withdrawals. Estimated costs are comparable to costs of other planned alternative water supply projects. Results from this study can be used by water suppliers to determine if these concepts can be incorporated into their water supply plans. More site specific assessments including aquifer metals mobilization studies are needed, however.

Wolf, Aaron

Authors: **Aaron T. Wolf**, Oregon State University

Category: Opening Plenary Session
Session Title: Plenary Session

Shared Waters: Conflict and Cooperation

Water is an eloquent advocate for reason. Admiral Lewis Strauss.

Water management is, by definition, conflict management: Water, unlike other scarce, consumable resources, is used to fuel all facets of society, from biologies to economies to aesthetics and spiritual practice. Moreover, it fluctuates wildly in space and time, its management is usually fragmented, and it is often subject to vague, arcane, and/or contradictory legal principles. As such, there is no such thing as managing water for a single purpose – all water management is multi-objective and based on navigating competing interests. Within a nation these interests include domestic users, agriculturalists, hydropower generators, recreators, and environmentalists – any two of which are regularly at odds, and the complexity of finding mutually acceptable solutions increases exponentially as more stakeholders are involved. Add international boundaries, and the difficulty grows substantially yet again.

While press reports of international waters often focus on conflict, what has been more encouraging is that, throughout the world, water also induces cooperation, even in particularly hostile basins, and even as disputes rage over other issues. This has been true from the Jordan (Arabs and Israelis) to the Indus (Indians and Pakistanis) to the Kura-Araks (Georgians, Armenians, and Azeris). Despite research that finds repeatedly and empirically that water-related cooperation overwhelms conflict over the last fifty years (see, most recently, Wolf et al. 2003), prevailing theories fail to explain this phenomenon. Certainly, there is a long history of conflicts over, or related to, shared freshwater resources. But there is also a long, and in many ways deeper, history of water-related cooperation. Why do countries that share a basin cooperate on water, even when they will not cooperate over other issues? Here is a resource on which we all depend, which fluctuates wildly in space and time, and for which there is little guidance in international law. By any quantitative measure, water should be the most conflictive of resources, not an elixir that drives enemies to craft functioning and resilient institutional arrangements.

This presentation will discuss conflict and cooperation over shared water resources internationally, in the US West, and end with lessons learned for the ACT and ACF basins.

Woli, Prem

Authors: **Prem Woli**, University of Florida
James Jones, UF/ABE
Keith Ingram, UF/ABE

Category: Managing water and energy in a transitioning environment
Session Title: Poster Session: Managing Water and Energy in a Transitioning Environment 2

Forecasting Agricultural Drought with Agricultural Reference Index for Drought (ARID)

Drought forecasting can help set out mitigation strategies and minimize losses. Because a drought index is an indicator of drought, the latter may be forecast by forecasting the former. We investigated the potential of using Agricultural Reference Index for Drought (ARID) and various climate indices (CIs) for drought forecasting; the applicability of linear regression (LR), artificial neural network (ANN), adaptive neuron-fuzzy inference system (ANFIS), and autoregression moving average (ARMA) models to forecasting ARID; and the performance of these methods relative to the El Niño-Southern Oscillation (ENSO) approach. Using historical weather data of 56 years of five locations in the southeast USA, monthly values of ARID were computed. Also, monthly values of six CIs that have significant connections with the weather phenomena in this region – AMO, JMA, NAO, NIÑO 3.4, PDO, and PNA – were collected. For ENSO, values of ARID were separated into three ENSO categories and averaged by phases. For ARMA, monthly time series of ARID were fitted to ARMA models. For the other methods, CIs were used as predictors. To avoid possible correlations among CIs, their first principal component (PC1) was used as an input variable. Using LR, ANN, and ANFIS, values of ARID were predicted from the past values of PC1. The performance of these methods was assessed using cross-validation, RMSE, d-index, and modeling efficiency. The ANN models showed the highest performance followed by the ANFIS models. The performance of ENSO, LR, and ARMA models varied depending on months and locations. While ENSO performed better during the winter, LR and ARMA did better during the summer. Although no method could make perfect forecasts, forecasts of ANN and ANFIS models were significantly better than those of ENSO. Results indicated that using CIs and/or artificial intelligence techniques might improve forecasting and that ARID can be used to forecast agricultural drought.

Yocom, Ken

Authors: **Ken Yocom**, University of Washington

Category: Human dimensions of water sustainability
Session Title: Human Dimensions of Water Sustainability: Stakeholder Engagement Processes

Building Watershed Narratives: An Holistic Approach for Guiding Urban Stream Rehabilitation Practices

This research proposes a methodological model for identifying and addressing the problems inherent with urban streams by utilizing a narrative-based approach for understanding the historical conditions of a watershed and for examining the values and perceptions that participants bring to the restoration process. Incorporating contemporary methods in spatial analysis, historical research, and participant interviews I have developed a model for restoration research that creates a chronotope for disentangling the multiple histories entwined in the physical, social, political and economic landscape of the contemporary urban environment. I use this model to develop case history narrative of an urban watershed in Seattle that has recently been the focus of rehabilitation practices. This research highlights the need for urban stream restoration to be understood as a process more than from a project-based perspective, and shows that this process can be more effective if it is scoped from a watershed perspective, temporally and spatially grounded, clearly defined yet adaptive to changing conditions, inclusive of educational and participatory goals, and engrained in models of community stewardship.

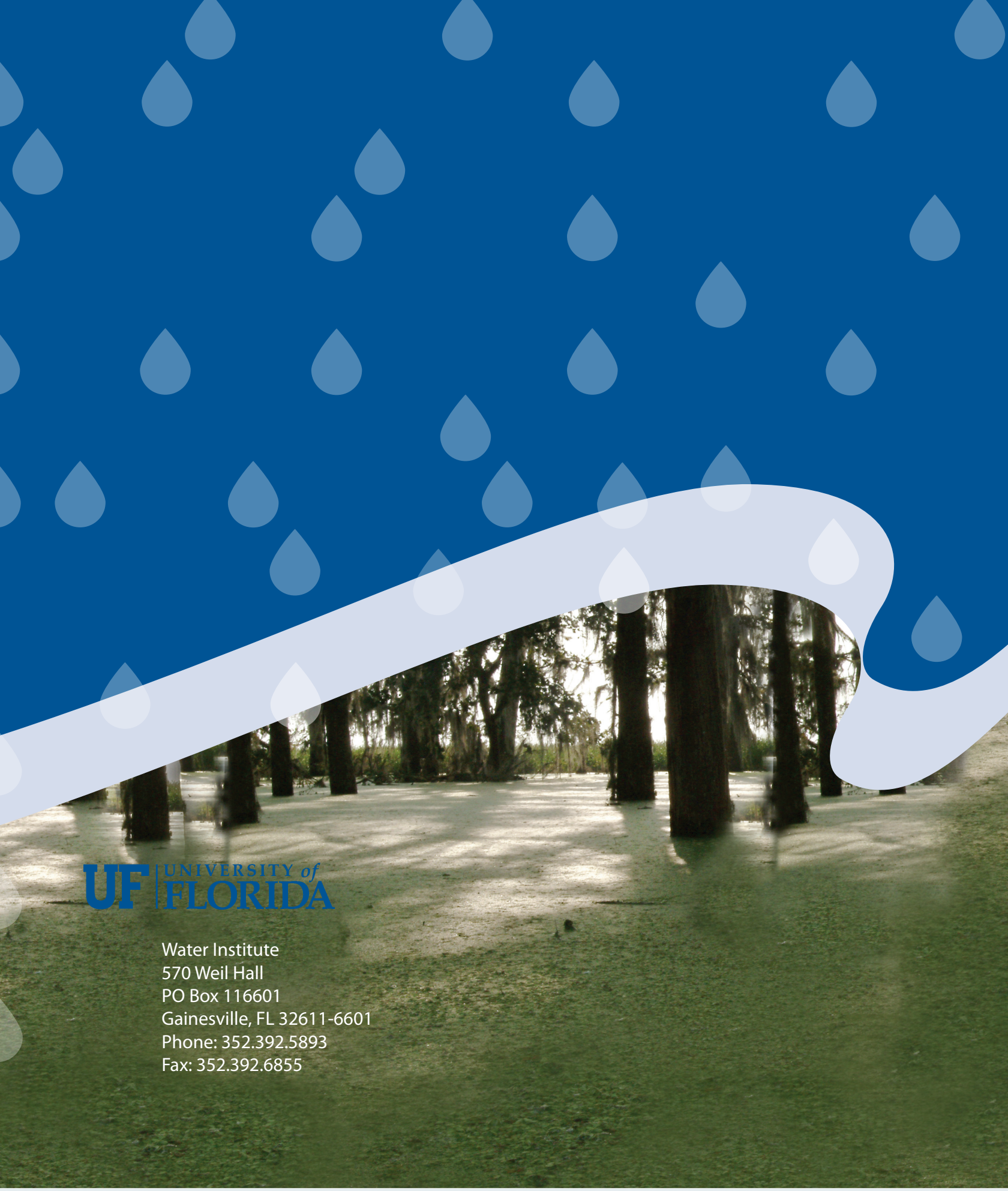
Zajac, Zuzanna

Authors: **Zuzanna Zajac**, University of Florida
Rafael Munoz-Carpena, University of Florida

Category: Hydrologic, biogeochemical and ecological processes
Session Title: Poster Session: Hydrologic, Biogeochemical and Ecological Processes 2

Global Uncertainty and Sensitivity Analysis of Spatially Distributed Hydrological Model, Regional Simulation Model (RSM), to spatially distributed factors.

This research addresses two aspects of uncertainty assessment in spatially distributed modeling: uncertainty analysis (UA), described as propagation of uncertainty from spatially distributed input factors on model outputs; and sensitivity analysis (SA) defined as assessment of relative importance of spatially distributed factors on the model output variance. An evaluation framework for spatially distributed models is proposed based on a combination of sequential Gaussian simulation (sGs) and the global, variance-based, SA method of Sobol to quantify model output uncertainty together with the corresponding sensitivity measures. The framework is independent of model assumptions; it explores the whole space of input factors and provides measures of factor's importance (first-order effects) and their interactions (higher-order effects). A spatially distributed hydrological model (Regional Simulation Model, RSM), applied to a site in South Florida (Water Conservation Area-2A, WCA-2A), is used as a benchmark for the study. The model domain is spatially represented by triangular elements (average size of 1.1 km2). High resolution land elevation measurements obtained by the USGS' Airborne Height Finder survey are used in the study. The original survey data, together with smaller density subsets drawn from this data are used for generating equiprobable maps of effective land elevation factor values via sGs. These alternative realizations are sampled pseudo-randomly and used as inputs for model runs. In this way, uncertainty regarding a spatial representation of the elevation surface is transferred into uncertainty of model outputs. The results show that below a threshold of data density, uncertainty of model outputs increases with a decrease of density of elevation data. Similar pattern is observed for the relative importance of sensitivity indexes of the land elevation factor. Therefore, reduced data density of land elevation could be used without significantly compromising the certainty of RSM predictions and the subsequent decision making process for the specific WCA-2A conditions.



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