American Water Resources Association
2009 SPRING SPECIALTY CONFERENCE
Managing Water Resources Development in a Changing Climate
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Anchorage, AK

Tuesday, May 5
1:30 PM – 3:00 PM
Session 21: Changing Everglades Management?

1. Climate Change Considerations for Everglades Restoration - Stuart Appelbaum, U.S. Army Corps of Engineers, Jacksonville, FL

Restoration of the Florida Everglades is one of the largest ecosystem restoration efforts currently being undertaken in the world. The Everglades, which are a part of the south Florida ecosystem, are a nationally and internationally unique and important natural resource. The south Florida ecosystem encompasses an area of 18,000 square miles and stretches from Orlando to Florida Bay. In 2000, the U.S. Congress approved a plan, called the Comprehensive Everglades Restoration Plan, to restore and preserve south Florida's natural system, while providing for other water-related needs of the region, including water supply and flood control. The comprehensive plan involves structural and operational modifications to the existing water management system in south Florida. The comprehensive plan includes 68 components with a current estimated cost of $10.9 billion and will be implemented over a 30-year period. Global climate change will be one of the most important issues to be addressed in this century from a scientific, technical, and societal standpoint. The impacts of sea level rise will significantly impact natural areas as well as human activities. Climate change has the potential to greatly affect the restoration plan for the Everglades. Much of the Everglades lies at elevations that are not far above sea level. Additionally, abundant wet season rainfall is an essential characteristic of the Everglades. Climate change could affect the total amount and temporal distribution of rainfall in the Everglades. Much more work is needed to fully incorporate climate change considerations into the restoration plan. Sensitivity modeling of potential climate change scenarios is needed to better understand the effects of climate change on the restoration plan. Additional monitoring of key indicators and parameters affected by climate change is needed. The re-establishment of a reliable flow and increased level of southward flowing fresh water is now more important that ever. Increasingly, the Everglades restoration effort needs to integrate climate change into the planning and implementation of the restoration plan. This presentation will provide an overview of the Everglades and the restoration plan, and will describe the potential effects of climate change on the Everglades and on the restoration program.

2. Climate Change Concerns for Everglades Restoration Planning - Glenn Landers, U.S. Army Corps of Engineers, Jacksonville, FL

Climate Change Concerns for Everglades Restoration Planning Glenn B. Landers Everglades Division, U.S. Army Corps of Engineers, Jacksonville, FL, USA The Comprehensive Everglades Restoration Plan (CERP) was completed in April 1999 and approved by Congress in WRDA 2000 as the basis for additional detailed design studies and subsequent requests for construction authorizations. CERP goals include restoration of natural hydrologic conditions in the remaining 50% of the historic Everglades while maintaining existing levels of flood protection, water supply and other project services in developed areas. Studies during development of the CERP indicated that a potential 0.5 foot sea level rise by 2050 (the project planning horizon) would not significantly impact project performance. The rate and magnitude of future climate changes and impacts is uncertain, but recent climate change data indicate global warming trends are accelerating significantly and will continue well beyond 2100. This paper will give an overview of forecast climate change concerns related to Everglades Restoration Planning and identify problems to be addressed by current or future studies. These concerns and potential impacts are relevant to water resources planners and others dealing with natural and developed areas in coastal and inland environments. They include sea level rise, salt water intrusion impacts on public water supply wells, changes in precipitation and evaporation patterns, increases in tropical storm activity, and other items. Significant climate changes may be coming more rapidly than many people anticipate. Proactive interagency cooperation and planning are required now to help reduce future risks and losses. Key findings: • In South Florida, relative sea level rose about 1 foot over the past 100 years. • Estimates of future sea level rise are uncertain, but the rate of rise is accelerating. • Natural areas need quick restoration of freshwater flows and proactive regional adaptation. • Developed areas need to reduce risks of future flooding and water supply well damages. • FY09 start of CERP sea level rise sensitivity analyses for various climate change scenarios.

3. Everglades Water-Quality in an Uncertain Future - Stuart Muller, University of Florida, Gainesville, FL

The Everglades of south Florida are a globally unique ecosystem,stretching 100 miles from the freshwater marshes of the famed "Sea of Grass" to Florida Bay, with the largest contiguous mangrove swamp in North America linking them. Management of this ecosystem's hydrology is complex, requiring a balance between flood protection to surrounding agriculture and development, and restoring historic flows to the system as part of the $10 billion Comprehensive Everglades Restoration Plan. Furthermore, water quality must be assured in both the freshwater Everglades and the Bay into which it flows. Climate change is expected to affect the management of the system through sea-level rise and changing rainfall patterns, and it is necessary to evaluate possible management responses to determine their consequences for water quality. A new water quality model has recently been developed to simulate phosphorus biogeochemistry and transport in the Everglades, and is being adapted for application to the southern Everglades. Since water quality depends principally on the underlying hydrology, this model is being integrated with a hydrologic model capable of reproducing the complex variable density hdyrodynamics of the southern Everglades where salinity and tides have effect. This tool is to then be applied to evaluate the effects on water quality of management scenarios in response to climate change and sea-level rise.

4. Dynamic Factor Modeling of Floodplain Hydrology in a South Florida Bald Cypress (Taxodium distichum) Swamp - David Kaplan, University of Florida, Gainesville, FL (co-authors: Rafael Muñoz-Carpena, Axel Ritter)

The Loxahatchee River is located on the lower eastern coast of Florida, USA. Changing hydroperiod and salinity regime in the river and its floodplain over the last century has been linked to undesired vegetative changes in the floodplain forest, with loss of old-growth bald cypress and transition to mangrove-dominated communities as saltwater moves further upriver and into the floodplain forest. Climate change-induced sea-level rise has and will continue to exacerbate these changes. Description and modeling of hydroperiod, groundwater elevation and salinity, soil moisture, and soil porewater salinity are essential to understanding the hydrological and ecological functioning of the floodplain forest. However, finding direct relationships between basic hydrological inputs (rainfall, river stage, river salinity, etc.) is not always straightforward because of the complex interactions between surface water, groundwater, and porewater in a variably saturated matrix with heterogeneous soils, vegetation, and topography. Analysis of long-term monitoring of soil moisture and porewater salinity; groundwater elevation and salinity; upstream river flow and salinity; downstream surface water elevation and salinity; and meteorological data in order to characterize the temporal variation of hydrological and water quality variables has improved understanding of system dynamics slightly. However, investigating relationships between multivariate time series using visual inspection and comparative statistics is difficult, subjective, and may not appropriately characterize the system. Thus, an alternate method for identifying common trends and causal factors is required. Dynamic Factor Analysis (DFA) is a dimension reduction technique and can be a powerful tool for the modeling of short, incomplete, non-stationary time series in terms of common trends and explanatory variables. With DFA, underlying temporal variation in observed data (input time series) is modeled as linear combinations of common trends, a constant level parameter, zero or more explanatory variables (additional observed time series), and noise. The objectives of this study are (i) to apply DFA to study the interactions between hydrological conditions in the floodplain (soil moisture, porewater salinity) and other hydrological variables obtained throughout the Loxahatchee River watershed; and (ii) to identify common trends and explanatory variables that are most important in affecting floodplain hydrology to improve understanding and management of the system.