



## Robust decision making for South Florida water resources by ecosystem service valuation, hydro-economic optimization, and conflict resolution

The goal of the National Science Foundation and United States Department of Agriculture Water, Sustainability, and Climate (WSC) Program is to “... understand and predict the interactions between the water system and climate change, land use, the built environment, and ecosystem function and services...”

### Motivation

With multiple competing water allocation targets, exposure to extreme climate variability, and vulnerability to sea level rise (SLR), South Florida faces a unique severity and diversity of challenges that lie at the heart of the WSC program.

Every day in South Florida about 7.7 million people, companies, and farms use more than 3 billion gallons of water. With expected population growth and potential climate change impacts, different water use optimization strategies are needed. In order to investigate various strategies, a 5-year \$5M WSC project focused on South Florida (the SFWSC) was initiated in 2013. Project researchers seek to develop hydrological and economic criteria for evaluating current and future water use and provide new insights into the value of water resources in the region. With this knowledge, the trade-offs decision-makers face under various climate change, economic, population, and SLR scenarios can be evaluated.

### Approach

A hydro-economic optimization model utilizing a network design, such as the one pictured here (Figure 1) will be developed. The model will be used to examine the hydrologic, economic, and ecological trade-offs inherent to competing management objectives.



Figure 1. Schematic of SFWSC hydro-economic model

Novel investigations on the behavioral dimensions (e.g., risk perceptions) of decision-making in water resource management and land use planning under different economic and climate scenarios are also being explored.

### Objectives

The project’s objectives are to: 1) Develop a hydro-economic model for South Florida that optimizes water allocations based on the economic value of water; 2) Develop new information on the economic value of ecosystem services to be incorporated into model formulations; 3) Test management schemes designed to increase the resilience of water resources to climate variability, climate change, and SLR; 4) Engage stakeholders to improve understanding of the cognitive and perceptual biases in risk management and decision-making; and 5) Develop recommendations for adaptive water management that optimize economic and ecological productivity and foster sustained public support.

### Project Support



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### Participants

The SFWSC project team is an interdisciplinary group of hydrologists, ecologists, economists, and

social scientists from six Florida universities (Florida International and Florida State Universities, the Universities of Miami, Florida, South Florida and Central Florida), Penn State University, the Universities of Pennsylvania and Hawaii, Michigan Technological University, Geodesign Technologies, the South Florida Water Management District, and the United States Geological Survey.



**Figure 2.** Project team members at kick-off meeting, March 2-4, 2013



## Background

The SFWSC project began as a smaller study focused on ecosystem services, specifically fisheries and carbon dynamics, in the lower Shark River in Everglades National Park. Stakeholder participants recommended expanding the study's scope to include more comprehensive and regional scale assessments, resulting in the current project.

The SFWSC project employs new optimization modeling approaches to develop management strategies that seek to build resilience of water supplies for built and natural systems, while accounting for the broad value of water. Optimization criteria will incorporate the results of new research linking water management, ecological

function, and the socio-economic value of ecosystem services provided by South Florida's estuaries. These results will be combined with economic benefit-cost analyses of water use in traditional sectors such as agriculture, utilities, and manufacturing within a regional hydro-economic model that represents the built and natural systems of South Florida. With stakeholder input, the model will be used to explore economic and ecological implications of applying different criteria, such as minimizing costs, in regional water optimization decisions under a range of population, economic, and climate scenarios over the next 50 to 100 years.

This modeling effort is envisioned as a first step towards the development of comprehensive strategies to enhance the sustainability of regional water supplies. A second fundamental step recognizes the importance of the human element in decision-making. SFWSC social and behavioral scientists will investigate how individuals' perceptions of risks to the water supply differ, and how these differences influence decisions made under uncertain conditions, such as those faced by South Floridians due to sea level rise. New experimental approaches will improve our understanding of how information type and uncertainty levels impact decisions made by individuals and groups of regional stakeholders. Experimental results will be used to devise more effective decision-making forums that foster more widespread long-term support of regional water management plans. Finally, with agency and stakeholder involvement, the project will develop recommendations for adaptive water management policies.

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