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quick facts on…

Natural System Regional Simulation Model (NSRSM)

Simulating South Florida's Pre-Development Hydrology

JANUARY 2013

The South Florida Water Management District *is a regional, governmental agency that oversees the water resources in the southern half of the state. It is the oldest and largest of the state's five water management districts.*

Our Mission *is to manage and protect water resources of the region by balancing and improving water quality, flood control, natural systems, and water supply.*


Florida (ca.1850)

Model Features:

- Pre-drainage Everglades landscapes and hydrology (ca. 1850) are directly represented in the model.

- Initial simulation uses recent climatic input (1965-2005).

- A variable mesh covering 12,000 square miles with approximately 7,500 cells. Triangular cells range from a minimum of 0.8 miles per side to a maximum of 6.4 miles per side.

- All significant pre-development rivers and streams are represented in the model.

- Lake Okeechobee simulated using lake module.

- Topography is adjusted for subsidence.

The South Florida ecosystem has been significantly affected by drainage activities that were initiated in the late 1800s and which have continued unabated for over 100 years. In the 1990s, two decisive acts of Congress set the stage for hydrologic restoration initiatives. First, the authorization of the Kissimmee River Restoration Project was designed to restore 43 miles of meandering river channel and 27,000 acres of wetlands north of Lake Okeechobee. Second, the reauthorization of the "Central and South Florida Project for Flood Control and Other Purposes" resulted in the implementation of the Comprehensive Everglades Restoration Plan (CERP). CERP was designed to restore the Everglades ecosystem while maintaining adequate flood protection and water supply for south Florida.

Strategies for restoration require an understanding of the south Florida regional system hydrology prior to drainage and development. Natural system modeling has been used in south Florida, in combination with other adaptive management tools, to formulate restoration plans and set targets.

Recent technological advances and improved knowledge of natural system features has resulted in the implementation of the "next generation" Natural System Model (NSM). Using Regional Simulation Model (RSM) governing equations, numerical methods, and object-oriented software design developed at the SFWMD, the Natural System Regional Simulation Model (NSRSM) has been implemented concurrently with its counterpart, the managed system RSM. RSM is a finite-volume based computer model that simulates multi-dimensional
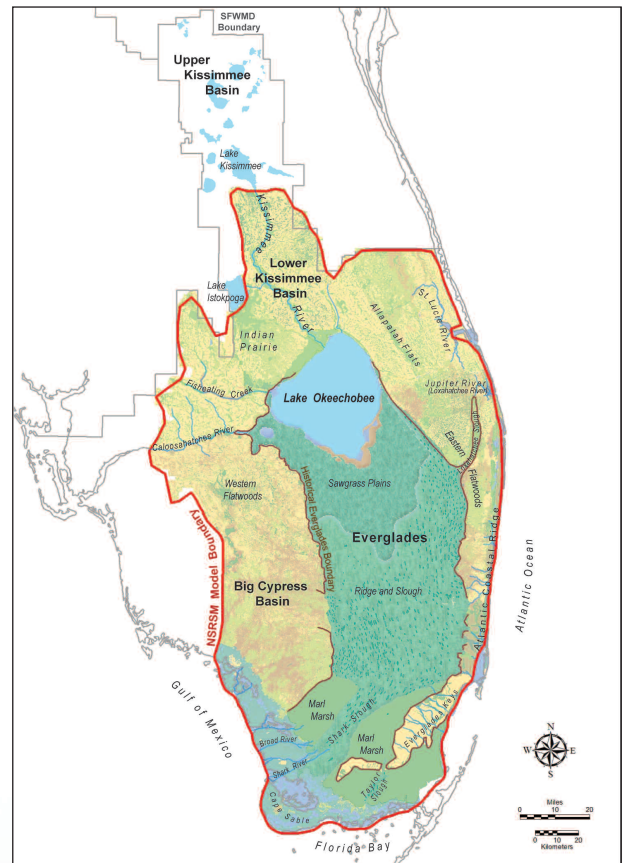
and fully integrated groundwater and surface water flow. The RSM hydrologic simulation engine (HSE) is extremely applicable to the unique hydrologic processes and geologic features in pre-drainage south Florida, such as storage and flows through a flat but micro-topographically varied ridge and slough landscape.

The NSRSM, like its predecessor the NSM, simulates the natural system hydrology of south Florida. The recent availability of long-term climatic data and refined data sources (e.g. topography, landcover, pre-channelized rivers), in combination with the model's improved hydrologic simulation engine (HSE), have resulted in simulations that reasonably represent pre-drainage hydrology in south Florida.

Hydrologic Simulation Engine

The model is powered by the RSM HSE, which simulates the coupled movement and distribution of groundwater and surface water. In addition to overland flow, the dominant water-transport mechanism in the natural system, HSE processes include rainfall, evapotranspiration, tidal fluctuation, surface water infi ltration, groundwater flow, and stream flow. NSRSM flows are simulated in an integrated system using water movers that control fluxes between water bodies-an RSM concept particularly suited to natural system application.

Model Domain

The historical Kissimmee-Okeechobee-Greater Everglades system is simulated in the NSRSM's 7,438 cell mesh with the exception of the upper Kissimmee basin, which is represented by boundary conditions. The model domain also includes eastern portions of the Big Cypress and Caloosahatchee River Basins, the St. Lucie River watershed, and the Atlantic Coastal Landscapes. Triangular cell sizes range from a minimum of 0.77 miles per side along the eastern coastal ridge to a maximum of 6.4 miles per side in the prairies northwest of Lake Okeechobee. Model elevations are based on the 1929 National Geodetic Vertical Datum (NGVD29) and the horizontal spatial data are referenced to the 1983 North American Datum (NAD83).

Model Testing, Evaluation and Results

Testing and evaluation of the current model, NSRSM v3.5.2, was completed in September, 2012. Preliminary results indicate system-wide performance is within reference ranges for pre-development conditions documented in published and peer reviewed literature. NSRSM has been internally and externally peer reviewed.
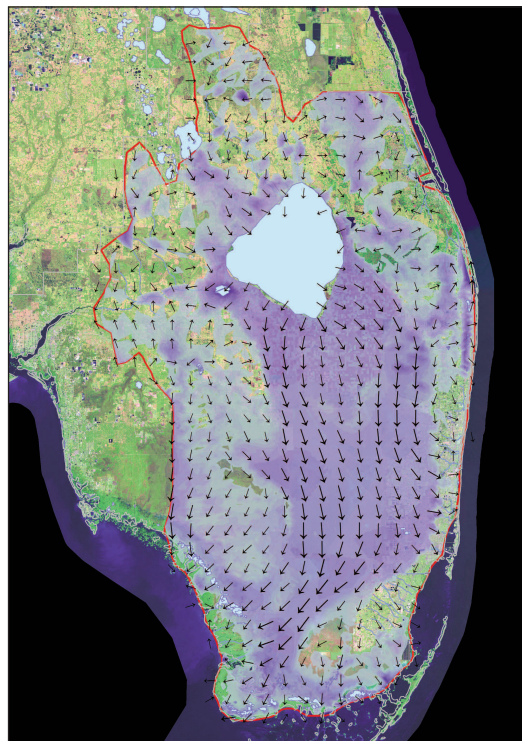
NSRSM results can be animated for ponding depths and flow vectors
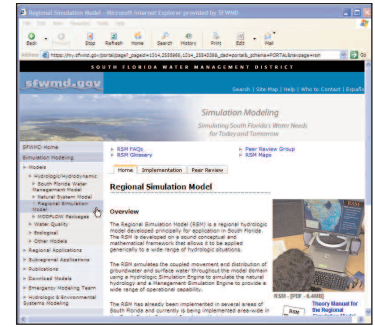
Software Platform

- NSRSM executed using Linux OS

- Developed in C++

- Compiled using GCC

- XML input, plus optional I/O formats include HEC/DSS, NetCDF

Visit the RSM website at:
http://my.sfwmd.gov/hesm and navigate to Regional Simulation Model to find the latest information on new model developments and for access to model code and documentation. Support is available for internal SFWMD customers through the Hydrologic and Environmental Systems Modeling Section, Jose Otero, Regional Modeling Unit Section Leader (jotero@sfwmd.gov).
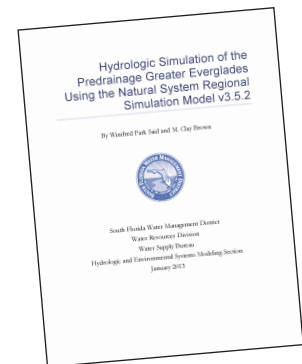
The NSRSM v3.5.2 Implementation Report is available for download on the web site.