H. Carl Fitz[1], S. Newman[2], S. Hagerthey[2], K. Rutchey[2], M. Cook[2], P. Linton[3], and F.H. Sklar[2]
[1] Soil and Water Science Dept.
FLREC, IFAS, Univ. of Florida
cfitz@ufl.edu 954-577-6363
[2] Everglades Division
[3] Water Controls Operations Division
South Florida Water Management District

Research for Extension application: Modeling tradeoffs between hydrology and water quality in Everglades restoration planning

In the northern Everglades, Water Conservation Area 1 (WCA-1) is a large impounded wetland. Comprising most of the Arthur R. Marshall Loxahatchee National Wildlife Refuge, the 567 km^2 WCA-1 is entirely surrounded by levees, with a continuous canal that exchanges water with the adjacent marsh along the entire interior perimeter of the basin. Rainfall supplies most of the basin's water, with managed inflows and outflows into and out of the canal. Largely due to a north-south land elevation gradient, the southern region of the marsh is relatively deep and the northern region is relatively dry. A water quality problem exists in the marshes adjacent to the perimeter canal, with nutrient and conductivity ("hard" water) intrusions from the canal. To aid in conceptual planning towards ecological restoration of this unique wetland, an ecological landscape simulation model (http://ecolandmod.ifas.ufl.edu) was used to evaluate restoration alternatives.

A new application of the Everglades Landscape Model (ELM) employed a fine-scale, 200 m resolution grid and some simple rule-based water management algorithms. This modified ELM simulated a suite of hydro-ecological interactions involving soil, macrophyte, periphyton, water, and water quality dynamics of a simplified ecosystem, within a landscape mosaic of different habitats distributed across model grid cells. However, for the purposes of this project evaluation, it focused on output variables involving hydrology and water quality.

The goals of the model application, conducted in two phases, were to:

- Explore conceptual restoration scenarios for WCA-1 that achieve more natural flow while maintaining “softwater” characteristics
- Integrate hydrologic and water quality Performance Measures for better decision making
- Evaluate water and nutrient management scenarios, to:
    - Achieve Natural System Model (NSM) -like depths
    - Minimize gradient of dry in north, deep water in south, establish flowing system
    - Minimize (towards background levels) chloride and phosphorus in system

During the first round of 12 alternative scenarios, results indicated: a) rainfall-only inputs of water were insufficient for hydrologic restoration, b) the perimeter canal accelerated northern over-drainage (indicating the need for some form of canal-plugs, adjacent berm, or backfill), and c) recirculating water from the downstream, southern region to the north was effective at redistributing water and maintaining a (relatively low velocity) flowing system while minimizing the water quality constraints of water introduced from external sources. The "selected" alternative for this round of evaluations met hydrologic restoration targets and improved water quality, but did not meet all of the water quality targets. Thus, a second round of 7 alternative scenarios "tweaked" stage regulation rules and assumed a method could be developed for somewhat reducing groundwater losses from the system. The "selected" alternative for this round met both the hydrologic and water quality restoration targets and, ultimately, significantly improved the hydrologic gradient, increased water flows, and had very minimal water quality concerns.