Hydrologic Fluxes, Restoration, and the Marsh-Mangrove Ecotone of Ten Thousand Islands NWR

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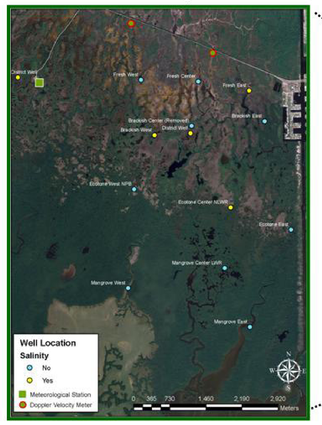
INTRODUCTION

Restoration projects have proposed to restore a significant amount of freshwater flow to certain receiving basins across the Tamiami Trail (US Highway 41) in southwestern Florida. This highway, along with reduced total volumes of freshwater delivery over the past century, has served as a barrier to normal, seasonal sheet flow to the extreme Everglades coastal margin. The goal of hydrological restoration to the region is to mimic as close as possible seasonal pulsing of fresh water, and to re-establish a condition more conducive for fostering historic vegetative communities. Since the Ten Thousand Islands National Wildlife Refuge (NWR) is entrusted with protecting marsh area from converting to mangrove for specific wildlife usage – a transition that is related to water management and sea-level rise – it is important to develop tools for determining how alterations in water flow might impact habitat transitions.

Monitoring Grid



Ten Thousand Islands NWR

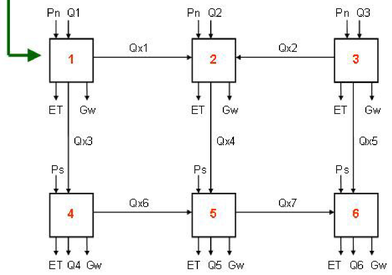
Hydrologic monitoring

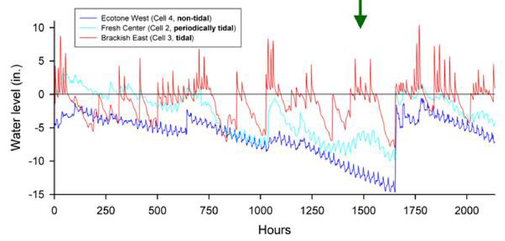
- Water level on a 3 x 4 grid
- Flow across Tamiami
- Salinity wells
- Meteorological station (ET)
- Multiple rain gages

MODELING

- First, we are initializing and calibrating a simple mass-balance model to describe stage characteristics within 6 separate hydrologic units at Ten Thousand Islands NWR. We will develop individual water budgets for each unit describing delivery to and exchange among all hydrologic units.

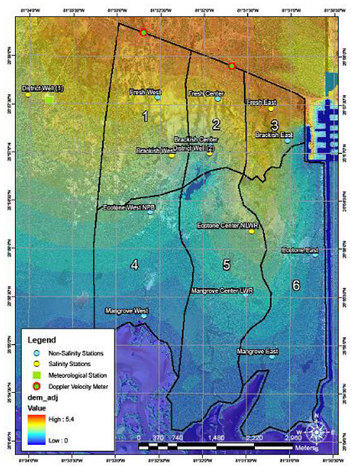
- Within each unit, surface hydrological fluctuations are tightly linked; signatures are non-tidal, periodically tidal, or tidal.



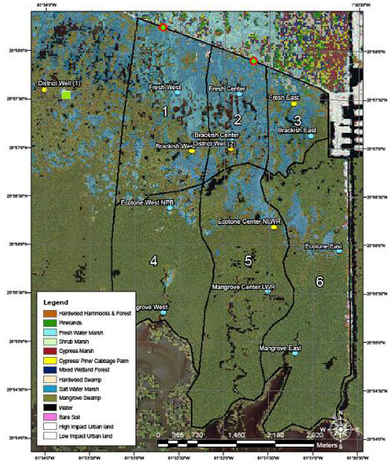


- Then, a fully hydrodynamic model, compartmentalized for each hydrologic unit, will be developed by dividing each unit further into 400 × 400 m cells, each with different base surface elevations (based upon a DEM) and Manning's coefficients (n) depending on predominant vegetation

Digital Elevation Model (DEM)



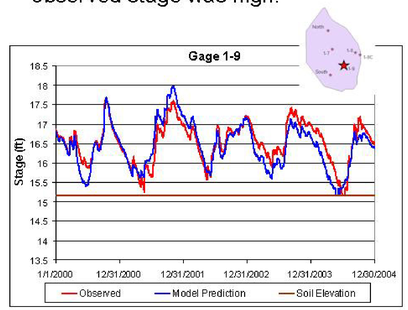
Predominant Vegetation

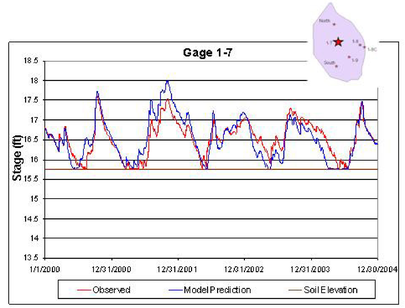


RELATED MODEL

- A fully hydrodynamic model developed for Ten Thousand Islands NWR will mimic, in many ways, a model developed for A.R.M. Loxahatchee NWR (Ehab Meselhe, unpubl.).

- In the case of the Loxahatchee model, linkages between model predicted and observed stage was high:





DISCUSSION

To date, results from this on-going modeling effort are few, as years 1 and 2 were devoted principally to collecting hydrology data and developing modeling protocols. However, there are at least two important points that can be offered:

(1) Within-wetland hydrologic characteristics from a number of monitoring stations (and units) within Ten Thousand Islands NWR are tightly linked, and generally segregate by those units registering tide (e.g., mangrove, *Juncus* marsh) and those units that do not register tide (e.g., *Spartina* marsh, *Eleocharis* marsh, Ecotone *Distichlis*/*Batis* marsh).

(2) Water levels crest at a particular stage after a freshwater loading event (i.e., up-stream flow, rainfall), above which drainage is extremely rapid until "bank full" water levels are met.

With this model and information from an on-going study that will link specific marsh vegetation response to observed water levels (R.J. Howard, unpubl.), we will develop a predictive tool for refuge management to understand the specific impact that restoration activity is likely to have on the marsh-mangrove habitat transition on Ten Thousand Islands NWR.

ACKNOWELDGMENTS

Funding for this project is being provided by the USGS Priority Ecosystems Program (PES) and NPS Critical Ecosystems Initiative (CESI). We would like to thank Drs. G. Ronnie Best and Laura Brandt for facilitating and continuing to support this interagency and cross-discipline partnership.

GEERS 2008 – Naples, Florida