Analysis and Modelling of the Arthur R. Marshall Loxahatchee National Wildlife Refuge

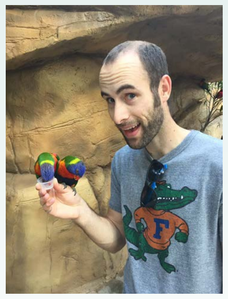
Ian Hahus (hahus@ufl.edu); K. Migliaccio, PhD, PE; R. Muñoz-Carpena, PhD; G. Kiker, PhD; M. Cohen, PhD; D. Kaplan, PhD

A Little About the Lox and Our Project

The A.R.M. Loxahatchee National Wildlife Refuge is located in Palm Beach County, Florida, and contains the northernmost remnants of the Florida Everglades. The Refuge Interior, also known as Water Conservation Area 1 (WCA 1), is a 570km^2 managed wetland that is surrounded by perimeter canals and levees. The Refuge is managed for water supply, flood protection, and ecosystem benefits. The Everglades Program Team requested that we develop a hydrologic model to help them evaluate potential water management decisions. Our specific objectives were to:

- Use cluster analysis to compartmentalize the Refuge based on spatially varying characteristics
- Format and discretize a hydrologic model of the Refuge to inform management decisions based on competing objectives
- Quantify model prediction uncertainty due to model formulation and discretization
- Discriminate among water management scenarios based on predicted ecological indices

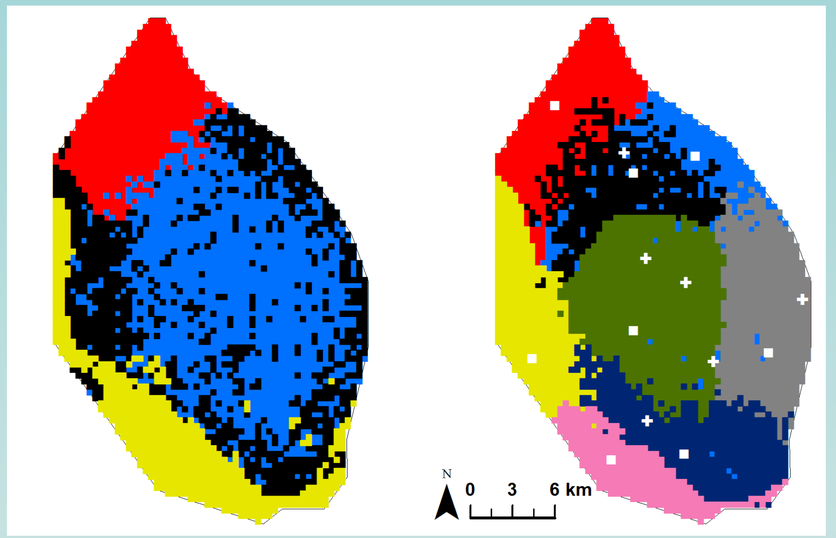
A Little About Me



- I received a CALS Graduate Assistantship and am now a PhD student in Land and Water Resources Engineering
- I'm from Branchville, IN
- I went to Purdue University for my undergrad degree in Agricultural Engineering
- My favorite trees are the White Oak (*Quercus alba*) and White Pine (*Pinus strobus*)
- In my spare time I enjoy reading, playing a variety of sports, quoting episodes of *Seinfeld*, and herping (look it up, it's not what it sounds like)

Cluster Analysis

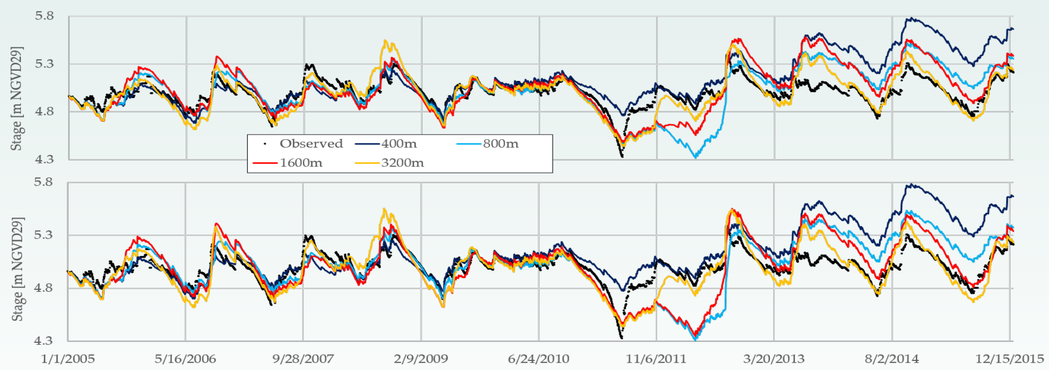
- Used statistical methods known as cluster analysis to analyze the Refuge based on natural and anthropogenic data
- Clusters were made of 400m grids containing information about elevation, water level, rainfall, vegetation, and distances to manmade structures such as levees and pump stations
- Partitional clustering provided more well-defined clusters than hierarchical clustering in most cases
- Inclusion or omission of anthropogenic attributes had a pronounced effect on the analyses, but more work needs to be done to accurately define these attributes
- Cluster maps can aid future monitoring and management of the Refuge



Left: Partitional clustering without using coordinates or distance fields yielded results similar to analyses of water quality data. Right: Cluster analysis can be used to compare existing monitoring sites (plus signs) with statistically representative locations (squares). Each color represents a different cluster.

Hydrologic Modelling

- Used a flexible gridded model to simulate the high-volume pumped flow entering the Refuge as well as the diffuse overland flow occurring throughout
- Tested two simplified flow equations: a depth-dependent Manning's formulation [$Q = \frac{L}{\alpha} d^{\frac{5}{3}-\beta} S^{\frac{1}{2}}$] and a basic power law [$Q = ad^b$]
- Manning's performed better than the power law, and larger grid sizes performed better than small ones
- Future work will be to refine the model and use it to predict ecological impacts



Manning's [top] and power law [bottom] models were tested using 400, 800, 1600, and 3200m grids and calibrated to a stage gauge near the center of the Refuge.