Spatially-explicit Hydrodynamic and Water Quality Modeling of the A.R.M. Loxahatchee National Wildlife Refuge: Part II - Model Application

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The Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) is a 58,275 ha remnant of the Northern Everglades. Changes in water quantity, timing and quality have resulted in different levels of impacts to the Refuge. Therefore, a priority for the Refuge is the development of water quantity and quality models to identify appropriate water management strategies that will maximize benefits for protection of fish and wildlife, while meeting flood control, water supply uses. Modeling provides a better understanding of the impacts of contaminants and nutrient loading, and quantifies benefits of management alternatives.

This presentation focuses on the validation and application of new hydrodynamic and water quality models of the Refuge. Based on MIKE FLOOD and ECO Lab modeling frameworks (DHI), these spatially-explicit models of the Refuge simulate hydrodynamics and water constituent concentrations, including chloride (CL), total phosphorus (TP) and sulfate (SO_4). The model was calibrated for a 5-year period (2000-2004), and validated for two other periods (1995-1999, and 2005-2006). The model results generally are in good agreement with observed stages and concentrations. Statistical analyses demonstrate the applicability of these models for temporal and spatial prediction of water levels and water quality concentrations. Visualization of model results using time series graphs and animations further improve our conceptualization of model mechanisms and predictions. In subsequent evaluations, hydrodynamic model results were compared with the U.S. Geological Survey's Everglades Depth Estimation Network (EDEN). EDEN produces spatial patterns of daily median water surface elevation (at a 400m resolution) across the greater Everglades including the Refuge.

Key messages relevant to restoration include:

- New hydrodynamic and water quality model exists for the Refuge, with potential planning applications related to temporal and spatial prediction of water levels and water quality;
- Constituent calibration for a conservative material (CL), as well as reactive constituents, constrained and improved credibility of the hydrological model as well as the constituent transport and transformation models;
- Consistency of predicted spatial and temporal patterns of constituent concentration with historical observations in both the canal and marsh demonstrate the utility of this model;
- Comparison of models with different underlying assumptions and structures improves our ability to clarify expectations of a model, and focus attention on where additional efforts are needed.

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