

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

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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 setup and application of hydrodynamic and water quality models for the Refuge. The spatially-explicit MIKE FLOOD and ECO Lab modeling frameworks (DHI) was used to simulate the hydrodynamics and constituents transport and transformation within the Refuge. This MIKE FLOOD implementation dynamically links a one-dimensional model of the 100km perimeter canal with a 400m uniform grid of over 3600 two-dimensional marsh model cells. Constituent transport is driven by modeled water flows and dispersion, as constituent concentrations are transformed through reactive and settling processes modeled within the ECO Lab framework.

Currently, the model simulates concentrations of chloride (CL), total phosphorus (TP) and sulfate (SO₄) concentrations in the canal and marsh. CL is modeled as a conservative (i.e. non-reactive) constituent, and has proven to be of value in identification of flow patterns within the canal and marsh. TP is modeled using a two state variable model structure analogous to that applied in the widely-used DMSTA model. SO₄ is currently modeled using a simplified net disappearance rate that is modified at low concentrations by a Monod relationship. SO₄ provides a constituent for calibration that compliments CL calibration.

Key message relevant to restoration:

- The MIKE FLOOD and ECO Lab modeling software can be used to simulate hydrology and water quality constituent concentrations in the Everglades;
- New 400m resolution hydrodynamic and water quality models for the Refuge are available for restoration planning applications;
- When compared with single constituent modeling, modeling multiple water quality constituents further constrains and tests model calibration, increases model credibility, and better identifies needed improvements in models;
- This spatially-explicit model runs on a typical PC with run times of roughly four hours per year of simulation.

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