High spatial resolution 2D wetland surface water flow modeling in the Everglades, Florida, constrained by Interferometric SAR observations

Heming Liao[1], Reinaldo Garcia[1,2], Shimon Wdowinski[1]

1. Earth and Environment Department, Florida International University
2. Hydronia, LLC.

High spatio-temporal surface water dynamics are important information for understanding hydrological processes and scenario analysis. This information is vital for water management organizations and policy makers to evaluate, plan and simulate water control operations under different climatic and hydrologic conditions. Current hydrological data, including water level, evapotranspiration and rainfall, are mainly collected at discrete locations with high temporal resolution, but often poor spatial resolution, which could be vital for high resolution hydrological modeling. Insofar, two-dimensional (2D) models were used to simulate these environments, often, by simplifying the spatial resolution with coarse grids limiting the accuracy of the predicted hydrologic parameters.

We present a new integrated approach for conducting high spatial resolution models of wetland surface flow using an advanced modeling software package, high temporal resolution hydrological data at limited locations, and high spatial resolution remote sensing observations of water level changes between time intervals. The model is based on the RiverFlow2D finite-volume model developed by Hydronia, LLC. The hydrological data, including water level, flow velocity, rainfall, evapotranspiration, were provided by South Florida Water Management District. The space-based observations were derived from Interferometric Synthetic Aperture Radar (InSAR) processing of data acquired every 12 days by the European satellite Sentinel-1. They provide high spatial resolution (30 m pixel resolution) of water level changes between two acquisitions with an accuracy of 2-3 cm. The model was applied to Water Conservation Area 1 (WCA1) in the Everglades, Florida, because it is a closed managed wetland area rich with hydrologic and environmental data. The model simulates the flow in WCA1 by imposing flow values measured at 15 gates along the boundary and also accounts for rainfall and evapotranspiration. Initial models are run with homogenic vegetation cover, which is translated to a uniform Manning's Coefficient throughout the area. The high spatial resolution InSAR observations will be used to constrain the model in an iterative approach to modify the Manning's Coefficient throughout the area that will best fit the InSAR observations.