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Simulation of Seasonal Inundation Patterns in the South Florida Everglades

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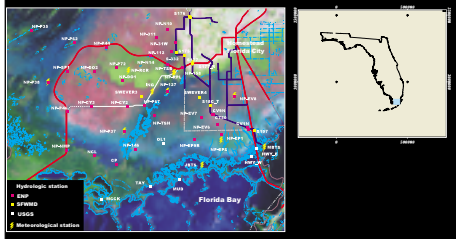
Purpose

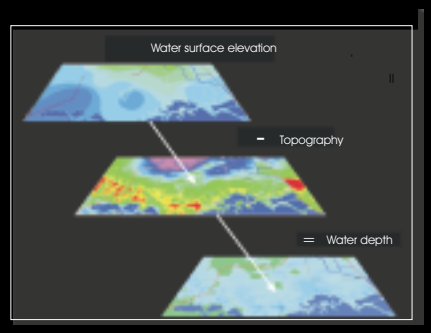
The ability to identify changes in water-surface elevation and hence water depth, in space and time, is fundamental to evaluating both the historical hydrology and the success of restoration efforts in the southern Everglades. The objective of this project is to develop a model based solely on available hydrologic and topographic data, that can then be used to study and evaluate regional innundation patterns.

Model Domain



Methodology

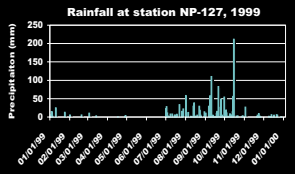
Topographic and hydrologic data (see data sources) are used to produce a topographic grid and daily water-surface elevation grids at a 50-meter resolution. The topographic grid is subtracted from the water surface elevation grids to produce daily water depths for the analysis of inundation patterns and hydroperiods.



Data Sources

Topographic data were obtained from the U.S. Geological Survey (USGS) - National Mapping Division. The data were collected at a 400-meter spacing via helicopter using differential global positioning system technology. Daily water-surface elevation data were supplied by a variety of sources. Water-surface elevation and topographic data were converted to the Universal Transverse Mercator coordinate system, North American Datum 1983, and North American Geodetic Vertical Datum 1988, in meters.

Discharges from control structures S-332 and S-175 (obtained from the SFWMD) are included in the model to help characterize regional responses to boundary inflows. Also, measured depths from USGS field efforts in 1997 and 1999 are used to estimate model accuracy.

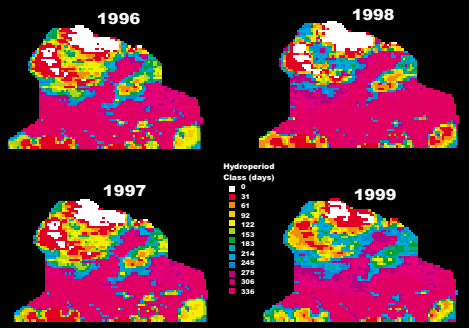


Precipitation data are included in the model to help determine the relationship between local rainfall events and regional inundation depths and patterns. Data from 10 meteorological stations were obtained from the ENP and the USGS. The general wet and dry seasons are from June through November and December through April, respectively.

Acknowledgments

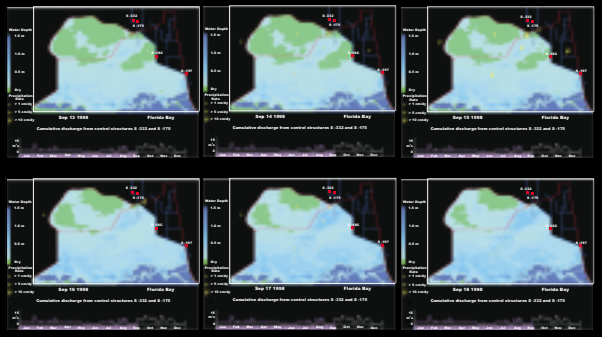
Data were provided by the South Florida Water Management District (SFWMD), the National Park Service - Everglades National Park (ENP), and the USGS - Water Resources Division.

Hydroperiods



Hydroperiod maps for each year are generated by computing the number of days each 500-meter grid cell is wet. A hydroperiod map for each year, shown above, illustrates the relative wetness in the region from within and between years.

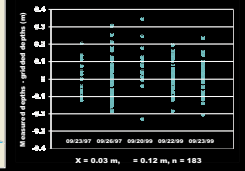
Visual Analysis



This sample time series illustrates the response of inundation depths to precipitation and control structures releases. Preliminary visual analysis of the water-depth time series reveals the timely response of regional water depths to local rainfall events and to control structure releases as well as temporal changes in the spatial extent of inundation.

Simulation Accuracy

Locations of water depths measured in the model area, September 1997 and 1999.



Cumulative error estimated by the difference between measured and modeled water depths.

Accuracy is of concern due to the sparseness of data, small grid values (water-surface elevations and water depths), and multiple sources of data. To estimate cumulative error from all data sources that contribute to the simulated water depth, measured depths were compared to gridded water depths. The mean difference between measured and gridded depths is 0.03 m, with a standard deviation of 0.12 m.

Conclusions

Seasonal variation in inundation patterns and the timely response to rainfall events and control structure releases are well illustrated by the water-depth maps. The hydroperiod maps allow a quantitative analysis of annual inundation. Visual and quantitative analysis will be useful to discern temporal changes in inundation patterns, particularly as these may have been affected by anthropogenic influences such as the management of control structure releases and the re-engineering of canals.

TIME
http://time.er.usgs.gov

Sample water-depth maps and graphic sequences are available at the Tides and Inflows in the Mangroves of the Everglades (TIME) website.