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The National Park Service

ATLSS High Resolution Topography and Hydrology Model

Creating a High-Resolution Topography and Hydrology Model

The Across Trophic Level System Simulation (ATLSS) Program of the U.S. Geological Survey has produced High-Resolution Hydrology and High-Resolution Topography models to provide high-resolution hydrologic data for the Greater Everglades landscape. Such hydrologic data is essential for describing the effect of hydrology on the important wildlife populations that are being modeled by the ATLSS Program. These ATLSS models are used to evaluate the effects of different water regulation plans as part of the Comprehensive Everglades Restoration Plan (CERP).

The need for such high-resolution hydrologic data is great. Although many hydrology data sets exist for South Florida, they either provide data at a spatial scale that is too coarse to apply to models of animal populations, or do not cover a large enough spatial area. For example, the hydrology data generated by the South Florida Water Management Model (SFWMM) provides hydrology data at a 2- × 2-mile resolution. Landscape features important to wildlife habitat, however, almost always require a finer scale of spatial resolution to be represented. With data from the SFWMM, individual model organisms only have information about the differences between 2- × 2-mile cells, a scale that is beyond the perceptual range of most organisms.

How the High-Resolution Topography Model Was Developed

The ATLSS High-Resolution Topography model generates high-resolution topography for most of South Florida. We use the term high resolution to refer to this model because it is capable of providing an estimate of topography at resolutions as fine as 30 × 30 meters, although typically the model is used to predict elevations at a 100- × 100-meter or 500- × 500-meter resolution. The model calculates high-resolution topography by combining three existing data sets. The first data set is a high-resolution vegetation type map such as the Florida GAP map. The resolution of the vegetation map dictates the finest resolution for the High-Resolution Topography map (i.e., 30 × 30 meters). The second data set is a set of hydroperiod estimates for each vegetation type specified in the vegetation map. By hydroperiod, we mean the number of days on which surface water is present, so it is related to elevation. Last, we use a hydrology data set such as the output from the SFWMM. These three data sets are combined to estimate the elevations across the South Florida landscape. These data sets are supplemented with the assumption that the plant species that make up each vegetation type in a particular location are closely associated with the hydroperiod in that location. Elevation and hydrology in a particular location interact to create the local hydroperiod. Although many parameters affect vegetation types, we believe that average hydroperiod is the most important to plants.

To create the High-Resolution Topography model, the vegetation type map and data relating hydroperiod to each of the various vegetation types were combined to make a new map of high-resolution hydroperiod estimates for each location, on a 30- × 30-meter scale, within each 2- × 2-mile cell of the SFWMM. These hydroperiod estimates allowed us to estimate the varying elevation of 30- × 30-meter pixels within the 2- × 2-mile cells. These constructed elevation

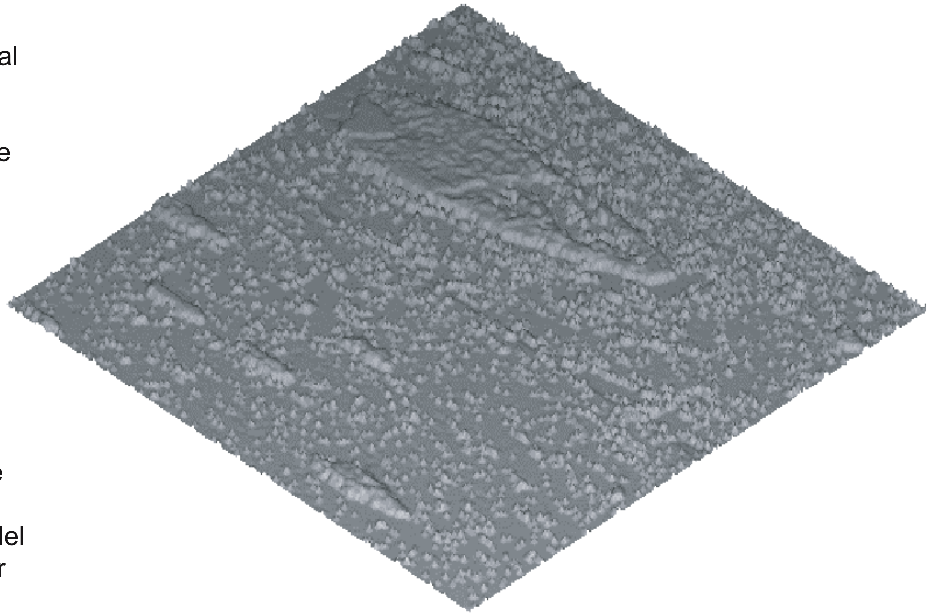

Figure 1. A typical 4- × 4-mile section from the High-Resolution Topography map surrounding a tree island

values were only starting points, however. We had to make sure that our calculated map of high-resolution hydroperiods was consistent with the coarser resolution 2- × 2-mile output data from the SFWMM. We therefore adjusted the elevation at each point on our map until the hydroperiod predicted by the interaction of the hydrology data and the adjusted elevation was consistent with the hydroperiod estimates for each location. Such adjustment was possible because the relations between vegetation type and hydroperiod have enough uncertainty to allow some flexibility of these values, within certain bounds. The final High-Resolution Topography map was able to meet all of the constraints on water mass conservation imposed by the dynamics of the hydrology model.

How the High-Resolution Topography Model Is Being Used

The output from the High-Resolution Topography model is a topography map with substantially more spatial heterogeneity in elevations than the existing topography data set. The High-Resolution Topography model also generates topography for important features such as tree islands, which is missing from the previously available topography data. Figure 1 shows a 4- × 4-mile section from the High-Resolution Topography map surrounding a tree island.

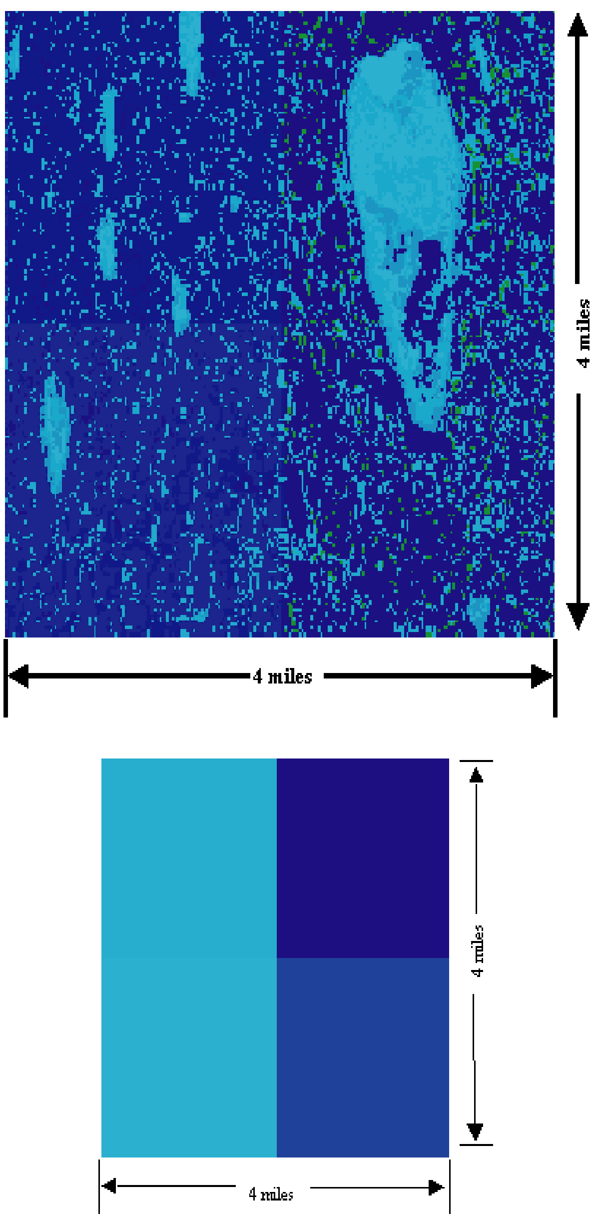

Figure 2. Comparison of the variation in water depths on a 4- × 4-mile section provided by the SFWMM (bottom) with that of the ATLSS High-Resolution Hydrology model (top).

The primary use of the High-Resolution Topography model is to generate High-Resolution Hydrology by distributing hydrology data from the coarser-scale SFWMM model over the High-Resolution Topography map. As Figure 2 shows, the High-Resolution Hydrology data provide more variation in water depths than the other hydrology data sets, such as those derived from the SFWMM. High-Resolution Hydrology is important for ATLSS ecological models of Everglades biota-both the Spatially Explicit Species Index models and individual-based models of key Everglades species and functional groups (e.g., Cape Sable seaside sparrow, Florida panther, and snail kite). An important feature of many of the ecological models is the response of the animals to differences in vegetation and water depth, which can occur on an extremely fine spatial resolution. For example, an individual Cape Sable seaside sparrow or Florida panther responds to features of the landscape at a much finer scale than 2- × 2-mile cells. Instead, they respond to differences in vegetation and water depth at such scales of resolution as 100 × 100 meters. The differences between locations at this scale can have a strong influence on the dynamics of populations, communities and, ultimately, the entire Greater Everglades ecosystem.

The development and refinement of the High-Resolution Topography model is continuing. Recently, we updated the model to use the latest Florida GAP map (Version 6.6). This has entailed generating new hydroperiod estimates for each of the vegetation types present in the new map. A new version of the High Resolution Topography map has been created on the basis of the 6.6 Florida GAP map. We are presently in the process of analyzing the differences between this map and the previous High-Resolution Topography map based on the 2.1 version of the Florida GAP map.

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The Critical Ecosystem Studies Initiative supports studies conducted to provide physical and biological information, simulation modeling, and planning that are critical for achieving South Florida ecosystem restoration