

Calibration of a Variable-Density Groundwater Flow Model Using Detailed Airborne Geophysical Data

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ABSTRACT

In south Florida numerical models are routinely used to develop a quantitative understanding of complex hydrologic processes and to evaluate potential restoration strategies. As with most modeling situations, the data used to calibrate the model are often sparse and limited in spatial extent. As part of the TIME (Tides and Inflows in the Mangroves of the Everglades) project, the U.S. Geological Survey is developing an integrated surface-water and variable-density groundwater flow model. In an attempt to obtain more detailed subsurface information for model calibration, electrical resistivity data were obtained using helicopter electromagnetic (HEM) surveys. The HEM data provide a three-dimensional picture of subsurface resistivity variations which can be related to geology and subsurface water quality. The data provide a sample every 5-10 meters along flight lines, which are spaced 400 meters apart. Maps of depths to selected resistivities clearly indicate the position of the interface between the fresh and saline groundwater. The interface is located approximately 8 to 20 kilometers inland from the Gulf of Mexico. The position of the interface appears to be controlled primarily by ground and water-level elevations. Roads and canals influence the near-surface resistivity patterns.

The groundwater portion of the integrated hydrologic model is simulated using the SEAWAT code, a variable-density groundwater flow model that combines MODFLOW with MT3DMS. Calibration of this model would normally consist of comparing model-simulated salinities with salinities measured in groundwater monitoring wells. Because of difficult ground access in the area, the number and placement of observations wells is severely limited. Improvements in model calibration are possible using the high sampling density of the HEM resistivity data and correlating these results with monitoring well information to provide virtual observation wells. The location of the fresh/saline interface determined by preliminary groundwater modeling lies within five kilometers of the position determined using the geophysical data. Further work is required to incorporate the details from the airborne data into the variable-density groundwater flow model.

Keywords: variable-density numerical modeling, helicopter electromagnetic surveys, saltwater interface

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