

Hydrodynamic and Salinity Modeling in Florida Bay

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Florida Bay is a large and shallow lagoon, characterized by its high productivity as an estuary and its abundance of seagrass communities which play an important role in supporting economically critical recreational fisheries. This area of approximately 2,200 square kilometers is bounded by the Everglades National Park (ENP) to the north, the Florida Keys to the south and east, and the Gulf of Mexico to the west. Salinities in Florida Bay are highly dependent upon evaporation, direct precipitation and freshwater inputs and flows. This study focuses on developing a hydrodynamic and salinity model for Florida Bay. The model will be used for a comprehensive understanding of the salinity patterns in Florida Bay. This understanding is critical to water management and hydrologic restoration actions necessary to protect and support this critical ecosystem in terms of quantity, quality, and timing and distribution of freshwater deliveries. There is a significant gap in knowledge when it comes to the connectivity between groundwater and the bay, and the relationship between groundwater and salinity level in Florida Bay. In response to this knowledge gap, the Groundwater Exchange Modeling and Monitoring (GEMM) Plan was created to provide a proposed framework to address the uncertainties associated with landscape-scale flow patterns, surface-groundwater interactions, impacts of seepage eastward on groundwater movements south to Florida Bay, and the influence of water management on the development of hypersalinity (>40 psu) in Central Florida Bay. Phase I of this study is Model Potential and Capabilities Demonstration. It aims to investigate the functionalities of the Delft3D model, with a primary focus on its hydrodynamic module and the D-Water Quality process library. A preliminary and uncalibrated Delft3D-based modeling framework has been developed to simulate hydrodynamics, waves, salinity, temperature, sediment transport and other water quality processes in Florida Bay. The D-Water Quality processes are integrated in D-Flow FM. Phase II of this study is ongoing. The model system will be calibrated and used to forecast hydrodynamic, ecological, and hydrological responses to different climatic (e.g., storm surge events), operational, and environmental conditions in Florida Bay and its upstream watershed. These responses will be integrated with water management operations to minimize the occurrence of hypersalinity events in Florida Bay. In support of the GEMM program, the model system will serve as a quantitative platform for evaluating various factors in Florida Bay, including the vertical barrier to lateral flow, interactions between vertical and horizontal flows, ecological parameters, current and future water management practices, as well as the impact of sea-level rise on the integrated surface water and groundwater hydrologic systems.