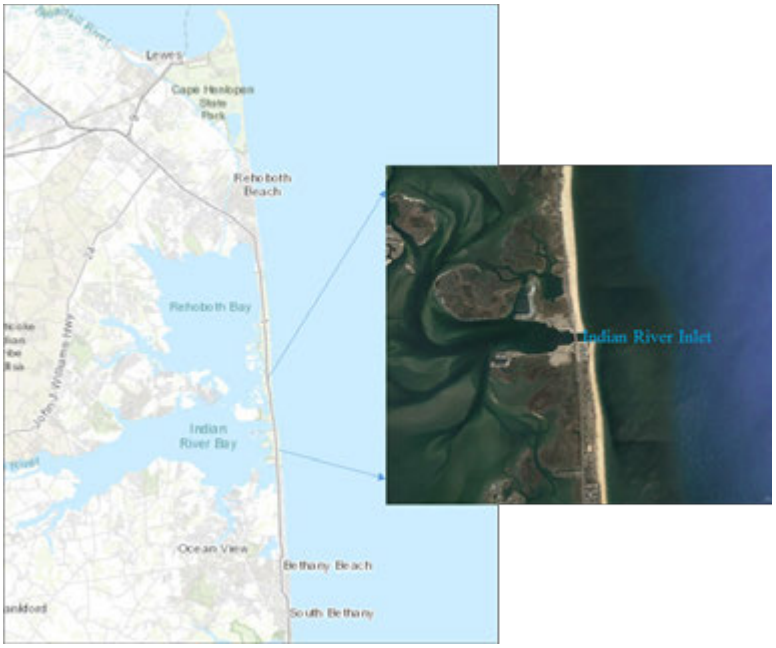
US Army Corps of Engineers
Engineer Research and Development Center

National Regional Sediment Management Program Philadelphia District (NAP):

Simulation of Shoreline Changes in the Delaware Coast

Description

This study is to apply the USACE shoreline evolution model, GenCade to simulate shoreline change in the Delaware Coast driven by environmental factors such as inlet sediment transport, offshore waves, longshore sediment transport, beach nourishment, sand bypassing, and sea level change. It focuses on modeling shoreline change in the Delaware coast around the Indian River Inlet, driven by sediment transport through the inlet and along the adjacent coast.



Delaware Coast around Indian River Inlet

Issue/Challenge To Address

Along the relatively short and straight Delaware Atlantic Coast, shoreline configurations are largely determined by antecedent geology and inlet morphology. Variations in shoreline position are influenced by episodic events (e.g. coastal storms) and anthropogenic factors (e.g. beach nourishment). These conditions play an important role in shoreline stability as well as evolution of shoreline/beach positions and shapes. Studies of Delaware's shoreline evolution in the past have revealed that even though the long-term trend is erosional; the shoreline has experienced fluctuating erosional/accretional stages with changes in environmental parameters.

There are four major shore protection projects along the DE coastline: Rehoboth Beach, Dewey Beach, Bethany/South Bethany, and Fenwick Island. The projects of the Indian Ricer Inlet navigation and sand bypass have been a focus of many previous studies for sand transport and dredging. Delaware has maintained records of the history of state-sponsored beach fills since the 1950s and federal beach fill projects since 2004. In addition regular transects of the Delaware shoreline have been collected since 2004 with nearshore wave observation data at Bethany, Dewey, and Ocean City. Beach profiles and nearshore waves are two critical variables for predicting shoreline evolutions with the GenCade model. But determining sand volume changes and assessing impacts due to beach fill/sand bypassing projects, inlet sediment transport, sea level rise, and cross-shore sediment transport are also important for predicting shoreline changes. To understand the long-term and complex shoreline changes along the coast around the Indian River Inlet, collecting and analyzing observation data are imperative, which include oceanographic

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data (waves, storms, etc.), beachfill volumes and locations, inlet sediment bypassing information, and sea level change estimates.

Successes Lessons Learned

Lessons learned will be compiled during the duration of this study.

Estimated Benefits & Cost Savings

- Predictions of shoreline change along the Delaware coastline will enable RSM to quantify sediment transport fluxes driven by coastal processes and to predict shoreline erosion rate in response to waves and climate. Therefore accurate simulation results of beachfill volumes optimize sand volume requirements and therefore save beach nourishment costs.
- Through learning beach protection practices from the Philadelphia District and analyzing historical shoreline survey data, the research team will develop a validated site-specific shoreline evolution model, i.e., a GenCade DE Coastline Prediction model. The model and simulation results will facilitate engineering planning and management practices for shoreline erosion protection.

Expected Products

- Validated shoreline change simulation model, GenCade for Delaware coastline
- Final Report and Presentation
- A GenCade Training workshop

Stakeholders/Users

Sharing existing data and exchanging expert opinions will be accomplished with the partners in the Philadelphia District (NAP) and the Department of Natural and Environmental Control of the State of Delaware (DNREC). Engineers and researchers in NAP and DNREC will be potential users to apply the GenCade model.

Projected Benefits Value Added

GenCade includes key features for modeling sediment budgets for inlets, sand bypassing, and beachfill. New sediment transport processes have been proposed and developed to represent cross-shore sediment transport and impacts of sea level rise. Simulation results of long-term shoreline change in response to coastal processes (i.e. waves, sediment exchange through inlet, etc.) and beach-fill for the Delaware Coast will facilitate coastal planning, and flood risk prevention in the region.

Leveraging Opportunities

The GenCade model development is funded by the CIRP "Inlet Engineering Toolbox" work unit. The model's existing capabilities such as longshore sediment transport, beach-fill, and sand bypassing will be examined through hindcast simulations of shoreline change along the Delaware Coast. Particularly, the inlet reservoir model for tidal inlet shoal and bar volume evolution will be validated through historical data analysis of sediment transport and shoal volume changes at Indian River Inlet. New features pertinent to the Delaware coast include cross-shore transport and sea level rise, which will be tested and added to GenCade. The long coastline may also require new GenCade algorithms that include alongshore-variations in offshore wave inputs from a nearshore wave model.

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Points of Contact

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