CMS Modeling of the North Coast of Puerto Rico

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1. Introduction

The goals of the San Juan, Puerto Rico Regional Sediment Management (RSM) study are to isolate where erosion problems exist, what their causes are and coordinate with stakeholders to formulate and implement strategies to mitigate shoreline erosion and maximize beneficial use of sediment where appropriate. Because the north coast of Puerto Rico is a series of pocket beaches with a diverse shoreline features, it is necessary to study the shoreline at an appropriate spatial resolution to resolve the mean nearshore current structure. The Coastal Modeling System (CMS), which is an integrated 2D numerical modeling system for simulating waves, current, water level, sediment transport, and morphology change at coastal inlets and beaches was used to examine salient horizontal current structure for the north shoreline of Puerto Rico. The study area extended approximately 50 miles from west of San Juan (Vega Baja) to east to Luquillo. Mean nearshore currents were examined for convergences, divergences and dominant transport direction to indicate regions that would be favorable placement areas for beneficial use of sediment.

2. Study Procedure

The USACE Regional Sediment Management (RSM) program funded a coupled wave and hydrodynamic modeling study of the north coast of Puerto Rico to determine coastal regions that may prove to be suitable placement areas. The Coastal Modeling System (CMS) was used to calculate nearshore currents that are forced by waves and tidal currents. The CMS Flow and CMS Wave grid spanned approximately 50 miles alongshore and was forced with astronomical tides and Caricoos Buoy at San Juan. The model was calibrated and verified with AWAC data collected in the nearshore.

3. Selected Results

It was found that the strength of the coastal currents are, as expected, strongly correlated with incoming wave energy as well as surface gradients in the nearshore. Onshore flows are indicated by the mass flux of water over the coral reef and offshore flows are found in the gaps of the reef. Seasonal cycles of alongshore transport in pocket beaches with bi-annual reversals are found due to the Trade Winds. Selected locations for sediment placement were sought at locations where divergences existed and where offshore flows were not dominant.