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Regional Sediment Management Program Coastal & Hydraulics Laboratory (CHL) and Jacksonville District (SAJ):

Improving CMS with CHIRP Data, San Juan, Puerto Rico, RSM

Description

Determining the amount of sand necessary for a successful beach nourishment project requires: (1) calculating the volume of sediment needed to stabilize the beach under the existing hydrodynamic regime; while (2) assuming this volume will not change in the along-shore component of the study region. Variations in nearshore and shoreface geology, however, can impact both the local hydrodynamics and the amount of sediment necessary to stabilize any one portion of the beach. Estimates of nourishment volumes that do not account for alongshore sediment variability risk under- or over-nourishing beaches. As a result, post-nourished beaches may either lack sufficient sediment to stabilize the beach even after the nourishment, or may lose excess sediment from the nourishment offshore and ultimately out of the littoral zone. Both options are costly in terms of sediment loss and, in the case of over-nourished systems, risk deleterious impacts by sediment escaping offshore into sensitive ecosystems, such as coral reefs.

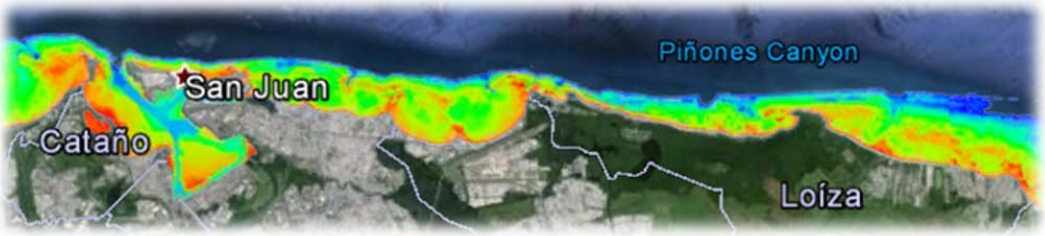

Figure 1: Study area showing the regional littoral cell bathymetry off of Condao Beach, San Juan Puerto Rico.

CHL and JAX will use Compressed High-Intensity Radar Pulse (CHIRP) sub-bottom imagery to map the spatially variable volume of transport-relevant sand within the littoral cell of Condado Beach near San Juan, Puerto Rico (Figure 1). These volumes will then be incorporated into the Coastal Modeling System's (CMS) framework in order to develop more targeted: (1) nourishment volumes; and (2) physical placement sites along the beach itself.

Issue/Challenge To Address

Status quo for numerical studies that determine the amount of sand necessary for a successful beach nourishment is to assume that the system is not sediment starved, and that typically there are no gradients in alongshore sediment transport at the model boundaries. In particular, tropical environments such as South Florida and Puerto Rico are characterized by alongshore spatial variation in sand volume, with hard-bottom (such as coral outcrops) coexisting with shallow, sandy lenses of sediment. The extent, location, and volume of these lenses of transport-relevant sand can dictate the nearshore morphology and beach response to physical forcings. At present, despite the capability of including spatial heterogeneity into numerical models and mapping frameworks, there exists no data for the validation of a morphology change model for the North Coast of Puerto Rico. Using CHL's Integrated CHIRP Sub-Bottom Profiler and Dual-Frequency Sidescan Sonar, we can quantify variations in the thickness and alongshore extent of transport-relevant sand, data necessary to validate the morphology module in CMS.

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Successes Lessons Learned

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

Expected Products

- Bottom type and isopach maps of the nearshore region of Condado Beach.
- CMS-predicted nearshore volumes and placement strategies that both do and do not incorporate spatially varying transport-relevant sand.
- Final Report and Presentation

Stakeholders/Users

Stakeholders include the Jacksonville District, the University of Puerto Rico, the Department of Natural and Environmental Resources, Puerto Rico, as well as local businesses that would be impacted by a beach nourishment project.

Projected Benefits Value Added

Benefits would include potentially refining the volume of sand needed for a successful beach nourishment to include alongshore variations in existing sand volume and hydrodynamics. This might yield a smaller estimate of volume of sand needed, potentially reducing nourishment costs. More targeted emplacements might also result in less sediment being lost from the beach post-emplacement, thus reducing the risk of eroding nourishment sediment being transported to, and accumulating within, the coral reef ecosystem offshore of Condado Beach. The specific objective will be to provide an informed decision and engineering plan for a placement area at Condado Beach in PR that can occur in coordination with the Federal San Juan Harbor project which is presently underway and for which a placement site is needed at this time.

Leveraging Opportunities

The sediment transport, budget, and morphology change component will be modeled using the existing Coastal Modeling System (CMS), with inclusions of limitations on nearshore sediment volume included as part of this study. In addition, working on an existing collaboration with UPR, several components of this study will be cost-shared by the university. UPR will provide vessel and logistical support, in addition to hydrodynamic measurements during the field effort itself.

Points of Contact

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Participating Partners

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The Department Natural and Environmental Resources, Puerto Rico