BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Wave-Bottom Interaction and Bottom Boundary Layer Dynamics in Evaluating Sand Mining at Sabine Bank for Coastal Restoration, Southwest Louisiana (GM-92-42-94)

Planning Area: Central and Western

Total Cost: $345,172 **Period of Performance:** FY 2002-2012

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEM Contact: Geoffrey L. Wikel

Description:

Background: Sabine Bank, offshore southwestern Louisiana in the Gulf of Mexico, has been identified as a potential source of sand for beach renourishment and coastal protection projects in western Louisiana, as well as eastern portions of coastal Texas. As recently as 2002, Sabine Bank was considered for use in a project involving the placement of 1.75 million cubic yards of sand at Holly Beach, LA.

Previous research in the area indicates the potential for major changes in the local wave regime should large quantities of sand be removed from the Bank, as it appears to play a significant role in wave dissipation, particularly during high energy events. Modeling using a simple monochromatic model showed significant changes in wave dissipation, refraction, and focusing should larger-scale dredging occur. The area may provide on the order of 10-20 million cubic yards of sand for future beach projects; thus, it is essential that the physical effects of dredging be examined prior to authorizing any large-scale excavations. Before those impacts can be evaluated, the coupled hydrodynamic and sediment transport processes must be better understood.

Objectives: The objectives of the study are to provide critical information relative to:

- physical processes affecting bottom boundary layer dynamics and sediment transport;
- the potential effects of large-scale dredging of sand; and
- the skill of numerical models in representing the local wave and current regime.

Methods: Instrumented tripods were deployed at three sites on the eastern flank of Sabine Bank over three different periods: 3/11-4/23/04, 12/7/06-1/20/07, and 5/29-7/8/08. The tripods were deployed to collect directional wave and bottom boundary layer data in both sandy and muddy environments of the shoal and examine the influence of freshwater plumes from the Sabine and Atchafalaya Rivers and advected fine-grained

sediments on bottom boundary layer dynamics. The instrument arrays consisted of acoustic doppler velocimeters, pulse-coherent Doppler profiles, and acoustic Doppler profiles coupled with pressure sensors CTS sensors, and turbidity sensors (Kobashi *et al.*, 2005). Shear velocity, shear stress, and wave-current suspended sediment transport were calculated from observational data. Observational data were used to force the coupled numerical model, MIKE21 SW/MIKE3 HD, to examine the sediment transport regime in the vicinity of Sabine Bank, as well as evaluate the physical effects of storms on local and regional hydrodynamics. Skill assessments were performed comparing data derived from the model to measured data and other in-situ observational data to test the skill and accuracy of MIKE21 SW/MIKE3 HD. A suite of wave transformation studies were also completed using MIKE21, SWAN, and WAVEWATCH III to compare hypothetical post-dredging bathymetry to existing conditions. The incident wave conditions during Hurricanes Gustav and Ike were modeled and analyzed.

Products: Final report, refereed journal publication(s), and geospatial data.

Importance to BOEM: The information provided by this study will be used to assess the physical impacts associated with large-scale removal of sand from Sabine Bank, especially given that prior research indicates that the Bank plays a role in mitigating the wave field during cold front and storm events. Bottom observation data show that the eastern flanks of the bank are characterized by fine-grained silt and clay, suggesting the dispersal influence of Sabine Pass and Atchafalaya River. Modeling shows that approximately 25% of the offshore wave energy is currently dissipated while propagating over the shoal. Observational data show the response of the bottom boundary layer to high energy events, including winter cold fronts and extratropical storms. The results of this study will be used to evaluate and support future requests for negotiated agreements to access sand from Sabine Bank.

Current Status: The draft report has been reviewed; the final report is in final formatting.

Final Report Due: December 2011

Publications:

Kobashi, D., F. Jose, and G. W. Stone, 2005. Hydrodynamics and sedimentary responses within bottom boundary layer: Sabine Bank, western Louisiana, *Gulf Coast Association of Geological Societies Transactions*, v.55, 392-399.

Kobashi, D., F. Jose, and G.W. Stone, 2006. Wave and bottom sediment interactions over a submerged sand bank during the winter cold-front season, western Louisiana. *Gulf Coast Association of Geological Societies Transactions*, v. 56, 395-401.

Stone, G.W., Kobashi, D., and Jose, F., 2006. Wave bottom interaction and bottom boundary dynamics in evaluating

sand mining at Sabine Bank for coastal restoration, southwest Louisiana. Annual Report to MMS, 35 pp.

Jose, F., Kobashi, D., and Stone, G.W., 2007. Spectral wave transformation over an elongated sand shoal off south-central Louisiana, USA., Journal of Coastal Research, SI 50, 757-761.

Affiliated WWW Sites: http://wavcis.csi.lsu.edu/publication.asp

Revised date: March 2012

ESPIS **ESPIS** - All ***completed*** ESP Studies:
Full Text, Online, Right Now!
Environmental **S**tudies **P**rogram **I**nformation **S**ystem