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ASSESSMENT OF COASTAL MORPHOLOGICAL CHANGE

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The coastal environment is highly dynamic with waves and currents acting as the primary driving force for changes in the nearshore area. Inlet regions are influenced by these forces causing migration of the ebb shoal, channel, and other morphological features. Mapping the three dimensional spatial variation for this highly dynamic coastal region is invaluable for monitoring morphological change.

High-resolution elevation and imagery data is collected along the sandy shoreline of the U.S. as part of the United States Army Corps of Engineer's National Coastal Mapping Program (NCMP), executed by the Joint Airborne Lidar Bathymetry Technical Center of Expertise to provide support for regional sediment management, navigation, asset management, and storm response and recovery efforts. A need exists to develop tools and methods to utilize this type of spatial data to improve the understanding of morphological changes and identify sediment pathways to assist with safe navigation through inlets and beneficially manage sediment.

Studies have shown lidar bathymetry has been used to monitor inlets for migration of the ebb shoal features with particular emphasis on the processes affecting navigation (Irish and Lillycrop, 1997; Wozencraft, 2001) in addition to identify the boundary and limiting depths of these features (Buonaiuto and Kraus, 2003). Identifying the boundary and migration of the ebb shoal features along with volume and volume change provides the data needed to 1) identify viable fill material and quantify impacts from mining the ebb shoal, 2) delineate sediment pathways to provide input to sediment budgets, 3) determine trends for the migration of the ebb shoal that could impact navigation, and 4) develop a long term sediment management plan.

The recurring surveys collected as part of the NCMP are valuable data sets for monitoring morphological changes, particularly in the highly dynamic environment around coastal inlets. The spatial variability makes analysis using three dimensional data important for quantifying the sediment entering and leaving the system to determine sediment budgets which are used for understanding and delineating sediment pathways. The tools and methods can be used for volumetric and contour change, identifying hot-spot areas and characteristic features of the inlet, and monitoring migration. Utilizing the high resolution of the bathymetric data, the inlet features can be delineated using semi-automated techniques that provide a more standardized approach.

Once the delineation of the features can be done routinely, then volumes/volume change can be efficiently calculated along with the migration of the feature or changes within the feature to compute pathways. This all leads to input to the sediment budget for sediment transport pathways or fluxes. The panhandle and west coast of Florida exhibits complex bathymetric features which include nearshore bars and well defined shoal systems. Several surveys of this region were used to analyze changes in the nearshore region around inlets and to develop techniques for automating the process of delineating the characteristic shoal features.

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To identify morphological change, the ebb shoal characteristic features need to be identified. These features include the bypassing bar and attachment bar, but the complexity of the delineation depends on sediment pathways. Figure 1 (left) shows an example of a complex ebb shoal system at Longboat Pass, FL where the features have been divided into regions around the main navigation channel. The figure shows the delineation of the characteristic features which include the north and south bypassing bar, north and south ebb shoal on either side of the channel, and a margin shoal. Sediment that is trapped by the jetty to the north of the inlet should also be considered. Figure 1(left) quantifies the elevation difference comparing a 2004 and 2010 survey where sediment has migrated to the south. This migration is clearly evident in the contour plot of the 2004 and 2010 survey shown in Figure 1 (right).

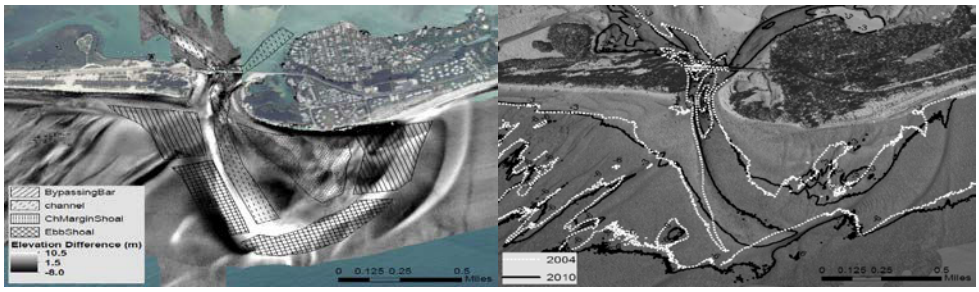

Figure 1 Delineation of the characteristic ebb shoal features and elevation difference of the ebb shoal features where erosion (black) observed along south shoreline near the inlet (left) in addition to the south-ward migration of the navigable channel shown with the -3m and -6m contours for 2004 (dashed white line) and 2010 (solid black line) (right).

Delineating inlet features, such as the navigation channel and ebb shoal, allows engineers to quantify shoaling and migration, which can compromise safe navigation through the inlet. In addition, the three dimensional spatial data can enable engineers to standardize the process of delineating sediment budgets. The methods and advanced information metrics developed using the NCMP lidar bathymetry will enable coastal engineers to efficiently assess the sediment pathways and evolution of inlet features to 1) identify areas of concern for maintenance, 2) provide input into sediment budgets and models to better facilitate morphologic analysis, and 3) predict future conditions.

REFERENCES

Buonaiuto, F.S. and Kraus, N.C. (2003). “Limiting slopes and depths at ebb-tidal shoals” Coastal Engineering, 48, pp. 51-65.

Irish, J.L. and Lillycrop, W.J. (1997). “Monitoring New Pass, Florida, with High Density Lidar Bathymetry,” Journal of Coastal Research, 13(4), pp. 1130-1140.

Wozencraft, J.M. (2001). “The coastal zone revealed through SHOALS lidar data,” Proceedings Hydro 01, Norfolk, Virginia, USA