BEACH RESPONSE TO EXPOSED RIVERINE SEDIMENT AND BEACH NOURISHMENT

Yu-Qi Huang, National Cheng Kung University, x8223195@gmail.com
Jing-Hua Lin, Tainan Hydraulics Laboratory, National Cheng Kung University, ljh0514@thl.ncku.edu.tw
Ray-Yeng Yang, NCKU, Tainan Hydraulics Laboratory, National Cheng Kung University, ryyang@mail.ncku.edu.tw
Yang-Yih Chen, National Sun Yat-sen University, yichen@faculty.nsysu.edu.tw
Jia-Lin (Julie) Chen, National Cheng Kung University, jialinchenpsu@gmail.com

INTRODUCTION

Studying the process of riverine sediment at mouths and continental shelves is a critical subject for many engineering applications, such as dredging, navigation, dispersal and remobilization of contaminants. Sediment deposits also determine seabed properties, coastal geomorphology, and the health of coastal habitat/ecology. During extreme conditions, episodic river discharge triggered by large rainfall due to tropical cyclones may contribute significant amount of riverine sediment into the ocean. In the past decade, evidence of severe seabed erosion (up to 1m/year, see Fig1a) along the sandy coast of Yunlin County has raised concerns regarding the sustainability of coastal structures.

The exposed riverine sediment from the Jhuoshuei River is considered as one of major sources for sediment supply in this region. Bottle samples collected from bridge station in the Jhuoshuei River during the passage of tropical cyclones suggest sediment concentration can exceed 40 g/l for the major duration of the storm (Milliman et al. 2007). To mitigate the damage caused by shoreline retreat, 600,000 cubic meters per month of sand has been placed in two specific locations near the offshore industry park (see Fig1b). The overarching goal of this study is to clarify the contribution of exposed riverine sediment and beach nourishment to enhance our understanding on the observed sediment transport and morphological evolution.

DATA ANALYSIS

Empirical orthogonal function (EOF) analyses are applied to identify the spatially coherent effect. EOF decomposition separates the observed variability of bathymetry into independent spatial and temporal modes. The resulting modes can be interrelated to understand the correspondence of the spatial component of known geomorphic features or the temporal dependence to environmental forcing such as morphological changes due to exposed riverine sediment, man-made barriers, and beach nourishment.

NUMERICAL MODEL

A curvilinear nearshore circulation model, SHORECIRC (Svendsen & Putrevu 1994), has been adapted into a hybrid finite-difference/finite-volume, TVD-type scheme and coupled with the wave-spectrum model SWAN (Booij et al., 1999). Conventional finite-difference schemes often produce unphysical oscillations when modeling coastal processes with abrupt changes or discontinuities, such as tidal bore formation, breaker zones, and moving shorelines. In contrast, the TVD-type finite volume scheme allows for robust treatment of discontinuities through the shock capturing mechanism. NearCoM-TVD, couples SWAN and SHORECIRC, reproduces water levels, waves, currents observed at the Yunlin coast reasonably well.

RESULTS

Our analyses using EOF method demonstrate that the 1st mode of the eigenfunction is related to riverine sediment and the 2nd and 3rd mode of the spatial eigenfunction indicate higher variability near the region of beach nourishment (between section 26 and 36). The notable topographic changes were also observed inside surfzone (depth <5m) in several beach profiles after the first year of beach nourishment. To understand the transport process of exposed riverine sediment and reclaimed sand, model results are used to provide insights into the patterns of flow residual for a range of spring-neap tidal forcing and wave conditions over the complex bathymetry, which includes dredged channels, ebb tidal shoals, and reclamation lands. Further analysis of the residual flow patterns, sediment transport, and morphological evolution will be discussed to identify the role of tidal currents and wind-driven waves during the northeast monsoon season.

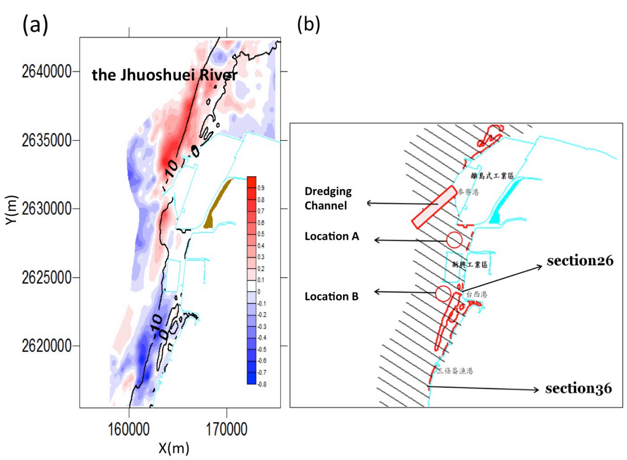

Figure 1 (a): Averaged rate of topographical changes (color contours: negative indicate erosion. Unit: Meter). Figure 1 (b): Locations of the dredging channel and beach nourishment.

REFERENCES

Booij, Ris, and Holthuijsen (1999), A third-generation wave model for coastal regions, J. Geophys. Res., 104(C4), 7649-7666

Milliman, Lin, Kao, Liu, Liu, Chiu, Lin (2007) Short-term changes in seafloor character due to flood-derived hyperpycnal discharge: Typhoon Mindulle, Taiwan, July 2004, Geology, 35 (9), 779-782.

Svendsen, and Putrevu (1994), Nearshore mixing and dispersion, Proc. R. Soc. London A, 445, 561-576