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Comparison of Laboratory Experimental Data to XBeach Numerical Model Output

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Coastal zones are living and constantly changing environments where both the natural events and the human-interaction results come into picture regarding to the shoreline behavior. Both the nature of the coastal zone and the human activities shape together the resultants of the interaction with oceans and coasts. Natural extreme events may result in the need of human interference, such as building coastal structures in order to prevent from disasters or any man-made structure throughout a coastline may affect the hydrodynamics and morphology in the nearshore. In order to understand and cope with this cycle of cause and effect relationship, the numerical models developed. XBeach is an open-source, 2DH, depth average numerical model including the hydrodynamic processes of short wave transformation (refraction, shoaling and breaking), long wave (infragravity wave) transformation (generation, propagation and dissipation), wave-induced setup and unsteady currents, as well as overwash and inundation and morphodynamic processes of bed load and suspended sediment transport, dune face avalanching, bed update and breaching (Roelvink et al., 2010). Together with XBeach numerical model, it is possible to both verify and visualize the resultant external effects to the initial shorelines in coastal zones. Recently, Baykal et al. (2015) modelled the long term morphology changes with XBeach near Kızılırmak river mouth consisting of one I-shaped and one Y-shaped groins.

In order to investigate the nature of the shoreline and near shore hydrodynamic conditions and morphology, the five laboratory experiments are conducted in the Largescale Sediment Transport Facility at the U.S. Army Engineer Research and Development Center in order to be used to improve longshore sand transport relationships under the combined influence of waves and currents and the enhancement of predictive numerical models of beach morphology evolution. The first series of the experiments were aimed at generating data sets for testing and validation of sediment transport relationships for sand transport in the presence of waves and currents. In these series, there is no structure in the basin. The second and third series of experiments were designed to generate data sets for development of tombolos in the lee of detached 4m-long rubble mound breakwater that is 4 m from the initial shoreline. The fourth series of experiments are conducted to investigate tombolo development in the lee of a 4m-long T-head groin with the head section in the same location of the second and the third tests. The fifth series of experiments are used to investigate tombolo development in the lee of a 3-m-long rubble-mound breakwater positioned 1.5 m offshore of the initial shoreline. In this study, the data collected from the above mentioned five experiments are used to compare the results of the experimental data with XBeach numerical model results, both for the “no-structure” and “with-structure” cases regarding to sediment transport relationships in the presence of only waves and currents as well as the shoreline changes together with the detached breakwater and the T-groin. The main purpose is to investigate the similarities and differences between the laboratory experimental data behavior with XBeach numerical model outputs for these five cases.

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