Numerical experiments of investigating storm impacts at Sefton coast, UK

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Recent winter storms in Germany, Burgling and Friederike, remind us the catastrophic nature of impacts causing to stand-still of daily activities, and loss of properties and human lives. During storms, coastal areas are particularly impacted by accelerated marine forces (surge, wind and waves). Beach/dune systems on coasts act as natural barriers against storm erosion which leads to hinterland flooding [3]. Hence erosion is of major concern for coastal safety and sustainable development in the areas where frontal dune systems are present. Numerical experiments are increasingly applied to investigate the storm impacted beach/dune erosion and to support the decision makers [5]. This talk describes 2DH numerical experiments undertaken to investigate the beach/dune evolution at the Sefton coast during the impacts of 2013/2014 winter storms of which several storms occurred within a cluster [4]. We used three open-source numerical models (Delft3D, SWAN and XBeach). Delft3D generated temporal and spatial varying water levels which were used by SWAN to transform offshore storm waves into the nearshore area. This information was subsequently used by the high resolution nearshore model of XBeach to predict the storm impacted morphodynamic evolution [1].

Fig. 1 Predicted erosion/sedimentation between Formby and Southport of Sefton coast during the first storm.

Nearshore ridge/runnel pattern moves towards dunes during storm impacts (Fig.1). Analysis showed the effect of storm clustering on the Sefton beach/dune system when compared with the impact of isolated events occurring on the fully recovered coast. Clustering of storms prevented system recovery extending the erosion area continually southward along the coast. Storm chronology in a storm cluster had a little effect on the cumulative evolution within storm clusters whereas the bed evolution during a storm event depends on the sequence of occurrence within a storm cluster [2]. These experiments enhance the understanding of beach/dune response to storm clusters, to interpret observed morphological changes and to develop tools for sustainable coastal management particularly in the Sefton coast and generally in the similar systems elsewhere.

Key words: storm cluster, beach/dune erosion, Delft3D, SWAN, XBeach