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Short to long-term evolution of the shoreline and the subaerial sand beach driven by extreme forcings : Wan-Tzu-Liao, Taïwan

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This study aims at investigating the interactions between wave conditions, water level and morphology of a sand barrier driven by paroxysmal conditions over instantaneous swash event, storm event, monsoon/typhoons seasons and decadal time scales.

In the framework of the KUN-SHEN project, 7 months of monitoring (2011-2012) provided 20 topobathymetric surveys (from the subtidal zone to the back-barrier) and acquisitions of offshore, nearshore and shallow water hydrodynamics including velocity profiling, free surface measurement and absolute pressure. Offshore waves were extracted at Cigu buoy (18 m of water depth). Nearshore waves were acquired from the current profiler deployed 400 m off the coast in 4 m of water depth and water level on the subaerial beach were acquired from pressure sensors deployed from the subtidal zone to the dune crest. Morphologic changes of the emerged beach were monitored using D-GPS each week during the winter monsoon season and just before and after each event during the summer typhoons season. The long-term shoreline changes (1993-2009) of the sand barrier is based on aerial photographs and satellites images.

The short-term study focus on the sand bed elevation changes associated with individual swash events during the most energetic storm recorded. During this Talim tropical storm (offshore significant wave height up to 10.3 m with period about 14.6 s), pressure sensors deployed in the subaerial beach display a sand bed nourishment about +3.02 cm/h during the storm rising. The numerous swash-swash interactions during the falling period of the storm appear more erosive.

Morphological changes of Talim storm in the whole emerged beach included 6.7 m of dunefoot retreat and a sand transfer from a dune breach to wash-over deposits in the lagoon. Additionally, the foreshore was nourished +2261 m3 +/-268 m3 as well as the whole sand barrier (+1920 m3 +/-1071 m3). The summer season of typhoons appears to be an accretive period (3556 m3 +/-1071 m3) with a foreshore nourishment and 10.4 m of shoreline seaward shift. Conversely, the regular collision regime driven by moderate storms during winter induces erosion (-4995 m3 +/- 1071 m3), 28.9 m of shoreline retreat, dune scarp and 28 m of dune-foot retreat. Over the annual time period, the sand barrier recorded 18.4 m of retreat coupled with a small sand loss (-1439 m3 +/- 1071 m3).

The long-term shoreline changes evidence cross-shore processes in the north part of the barrier (41 m/yr of shoreline retreat) and a strong losses of barrier area since 2004 (-1154 km3).