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MORPHODYNAMIC IMPACT OF A EXTREME STORM ON A CUSPATE DELTAIC SHORELINE

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The impact of extreme storms on low-lying coastal areas produces an impulsive response generally dominated by erosion, overwash and, potentially, inundation. Although, a large improvement on the prediction of this response has been reached by the scientific community and different morphodynamic predictive models do exist, still they are not able to fully reproduce observed responses without an *ad-hoc tuning* (calibration). Within this context, the main aim of this paper is the analysis of the response of a sandy cuspate deltaic shoreline, Tordera delta, to the impact of an extreme storm. The analysis will focus on the quantification of erosion and overwash induced processes and to assess their predictability using different tools and models).

The action of strong NE winds in the Gulf of Lyon generated an extreme wave storm, with large wave heights only present at the north third of the Catalan coast whereas the rest remained fairly protected. At this north part, recorded *Hs* at the peak of the storm reached a maximum value of 7.5 m with a value of *Hs* = 4.7 m just on front of the study area, the Tordera delta. The study area is a cuspate coarse sand wave-dominated delta with the left-hand coastline being oriented towards the E and the right hand one to the S. This configuration produces a different degree of exposure to storm generated E waves and, as a consequence, a different coastal response.

To characterize the coastal response, deltaic coastal topography before and after the impact of the storm was obtained with an airborne scanning Lidar. In addition to this, a 6 months later campaign was launched to measure the capacity of recovery of the study area. In the N beach, the impact of the storm produced a generalized erosion ranging from 50 m^3/m to 20 m^3/m. This difference, originally unexpected in a quite alongshore uniform beach, could be explained taking into account that the area subjected to larger erosion had been previously nourished (6 months earlier). The S beach, although was also eroded, presented smaller erosion volumes ($\Delta V \sim$ 10 m^3/m). It also showed alongshore differences in the coastal response (type and magnitude) with the presence of some significant accretion spots. This differentiated response is probably due to the very oblique orientation of this part of the coast to incident E waves during the storm which significantly modified wave characteristics before their impact on the coast.

Observed coastal erosion was modelled with Sbeach and Xbeach models. Obtained results showed that the use of Sbeach produced good results in the N beach (fully exposed to E wave action) whereas, as expected, it was unable to reproduce the observed alongshore variability in the S beach. On the other hand, the Xbeach model reasonably reproduced observed alongshore variability

In addition to this erosion, overwash deposits up to 10 m^3/m were measured in the backshore, which indicated the presence of significant overtopping during the storm in some stretches. As a simple way to assess the potential contribution of overwash to beach response during the storm, wave-induced run-up was calculated. Obtained results showed that the use of the Stockdon et al (2006) model tended to underpredict the run-up. Due to this, the application of such model failed to estimate the presence of overtopping conditions in profiles where overwash deposits was measured (Fig 1). To overcome this, other runup models were successfully tested. With this, following the approach of Jiménez et al (2006), measured sediment overwash volumes were directly related to storm-integrated overtopping volumes (Fig 1).

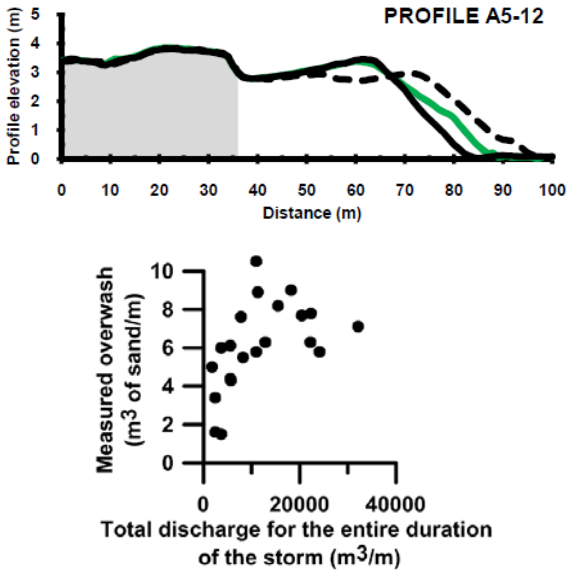

Figure 1. Top: Example of profile with overwash deposits (dashed: pre-storm; solid: post-storm; green: 6 months later recovery). Bottom: measured overwash deposits *vs* calculated overtopping discharges

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