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Winter storm sequencing and seasonal recovery of open sandy beaches

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Sandy beaches have been studied extensively driven by major societal issues because beaches are attractive environments that drive important economic development associated with tourism but also because they often exhibit sand dune systems that together with beaches act as the first natural line of defense against flooding and erosion hazards. And yet, long-term erosion of beaches (and dunes) is already a widespread phenomenon at the regional scale and global scale, and has been a major challenge for governance actors.

Shoreline evolution can be variable over a wide range of different temporal and/or spatial scales and this is especially the case for wave-dominated environments. This highly dynamic behaviour is essentially due to the fact that wave-dominated sandy coasts are characterized by low relaxation time that is a measure of the morphological inertia within the system; basically sandy coasts are dynamic systems, undergoing adjustments of form and process (termed morphodynamics) that can be very rapid (several meters within a few hours if one considers the shoreline or the dune foot). Periods of accretion and erosion are generally coupled to low- and high-energy wave conditions but the response also exhibits highly site-specific variations.
Storm-induced extreme waves and water-level conditions are key drivers in shoreline erosion. Single storms can result in meters of shoreline change within hours (e.g. Coco et al., 2014 among others) and a sequence of storms, for example during a winter-season may cause a seasonal, cumulative shoreline response (Komar, 1998). However recent studies (e.g. Senechal et al., 2015) showed that the same cumulative shoreline response (in term of magnitude) can be observed under variable ranges of winter conditions characterized by their number and/or intensity of storm events experienced during this period and that even after an extremely energetic winter, beaches can recover relatively fast (e.g. Castelle et al., 2017). As underlined by Jimenez et al. (2011), managing erosion-induced problems will also depend on the resilience of the beach to extreme events: (i) by measuring the capability of the beach to recover (rebuild) from storm erosion or, (ii) by measuring the ability of the beach to withstand changes induced by the storm. Beach recovery is thus an important process in evaluating coastal vulnerability but recovery periods have received much less attention in the literature, being even neglected in studies evaluating the cumulative impact of storm clusters on beach erosion (e.g. Splinter et al., 2014).
In this presentation we propose to provide new insight in the seasonal recovery of an open sandy beach by analysing both the sequencing of the winter storm events and the environmental conditions during the seasonal recovery period. To achieve these goals, we use a nearly 10-year long data set consisting of bi-monthly topographic surveys and 3hourly wave data.