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Morphological change by overwash on a microtidal backshore: Bevano beach, Northern Adriatic Sea

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The Bevano beach is a small microtidal shore facing the Adriatic Sea located south of Ravenna, in the Emilia-Romagna region, northern Italy. This beach corresponds to the old Bevano river spit which was abandoned after the relocation of the river mouth some 500 m to the south of the previous inlet position. The old river mouth was cut off from the Adriatic by massive sand dumping and the sediments on the newly created beach were fixed by aeolian fences and vegetation. This 600 m long featureless beach looks like a sand barrier: it is backed by the abandoned channel of the Bevano River and is one of the lowest dune system of the region (around 1 m height), causing the beach to still being vulnerable to coastal flooding, storm surges and overwash. This study presents the morphological changes of the "microtidal barrier" in response to one of the highest surges recorded in the last 100 years. Two topographic surveys of the Bevano beach were conducted before and a few hours after the exceptional high tide level recorded on 01 December 2008 (high tide level of 1.59 m above MSL and surge of 0.97 m, combined with an offshore significant wave height of 1.45 m). The lack of height and sand volume of the lower dune crest of the Bevano beach caused the entire barrier to be inundated during the high tide, resulting in important overwash processes. The inundation event was preceded by increasing water levels that were recorded in the old river channel which is the landward limit of the Bevano barrier. Seven separate washover fans were distinguished together with severe damages to fences and dune vegetation. The washover fans had different dimensions, the most important one being around 18 m wide, and generating a $\sim$ 9 m landward migration of the back-barrier limit. The cross-shore profile response to the overwash event can be categorized into two types (1) barrier disintegration and (2) barrier rollover relative to the dune crest height. Furthermore, the study area was subjected to a series of storm-surges between December 10th and December 15th with surge values fluctuating between 0.6 m and 0.8 m and offshore significant wave heights reaching up to 2 m. This caused important wave run-up and water level set-up on the upper beach. The previously developed washover fans continued their landward migration and the most important one is now at few meters from the landward side of the old river channel, threatening to form a lake. The other washover fans that were originally less developed merged into a single large washover terrace. This study demonstrates that the exceptional surge of December 1st was the instigator of initial morphological changes (formation of seven washover fans) which then facilitated successive morphological changes caused by the subsequent storm surges and, as a result, generating the complete change of the morphologic configuration of the microtidal setting. The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement n° 202798 (MICORE Project).