Storm Surges Congress, Hamburg, Germany
13–17 September 2010
SSC2010-64-2

Storm surges, barrier islands and coastal overwash: curse or blessing ?

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1. Coastal overwash

Coastal overwash is defined as the flow of water and sediment over the crest of the beach that does not directly return to the water body where it originated. The depositional features created by overwash are called washovers or washover fans. It is anticipated that for meso-tidal barrier island systems – such as the West Frisian barrier islands in the Netherlands – overwash during storm surges will positively contribute to the sediment budget of the system. This opens new perspectives in coastal zone management strategies and may partly solve two major (future) challenges for the West Frisian barrier islands:
1) How to cope with (accelerated) sea level rise and local subsidence ?
2) How to stimulate the ecological rejuvenation of the islands to restore and/or increase the natural values of ecosystems, the associated biodiversity and the degree of robustness ?

In this pilot study we will analyse and evaluate the option to reactivate old and develop new washover systems during major storm surges. For the present study we focus on the barrier island Schiermonnikoog. During storm surges, the maximum recorded set-up in water level is about 3.5-4 m. At present, the north coast of the island has an extremely wide and dissipative beach (> 500 m. of “green beach”).

2. Inundation overwash and deposition during storm surges

We determined hydrodynamic processes and conditions during overwash based on monitoring data, field observations and initial modeling with Delft3D. During the pilot study the effect of two major storms (in November 2006 and November 2007, respectively) was recorded and the morphological impact was established afterwards. During both storm surges the basin water levels during rising tide were higher than at open sea due to wind stresses and additional input of water into the tidal basin. Consequently, inundation overwash at the seaward side was simultaneously accompanied by flooding from the basin side. Hydrodynamic modeling clearly supports this observation and also demonstrates that sea water masses and basin water masses during flood meet each other at the transition zone of washovers and upper marsh, along the central axis of the island. Video-based field observations clearly demonstrate that dune-erosion is mainly a product of the impact of low-frequency waves.
Surprisingly enough though, this dune erosion is hardly reflected in the amount of washover deposition and most of the sediment is simply deposited in front of the duneface. The lack of deposition due to inundation overwash seems to be the result of the lack of wave-driven longshore and oblique currents. Apparently, the wide and dissipative (green) beach results in two major effects: 1) the total dissipation of short wave energy; the long waves will only act as a local stirring factor and 2) the lack of mobility of beach sediments due to the presence of small primary dunes (with vegetation) and algal mats. Therefore, either the presence or absence of a green beach seems to play a vital role in the potential use of overwash to compensate for sea level rise and/or to establish ecological rejuvenation.