Relationship between water and sediment dynamics at Mariakerke beach

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Parts of the highly anthropized Belgian coast are vulnerable to storms which simultaneously combine high water levels and large waves. These storms can result in breaching the coastal defense causing the flooding of densely inhabited areas. To reinforce the weak coastal sections in order to meet the required safety levels in case of a catastrophic storm-event (with a return period of 1000 years), the Flemish government adopted the Master Plan for Coastal Protection in 2011. The Masterplan aims to find new sustainable coastal protection measures, alternative to the traditional ones, such as shoreface sand nourishments.

One of the weak links of the coast, Mariakerke beach, lies west of Ostend and it has been selected for a full-scale pilot experiment on shoreface nourishment. In order to evaluate the efficiency, safety and sustainability of the nourishment at Mariakerke beach is intensively monitored. Better insight into the relationship between hydrodynamics and sediment dynamics in this area is one of the objectives of the monitoring plan.

The waves, the marine currents, the suspended sediment concentrations (SSC) and the water level variations are monitored at four locations: two at section 100, Raversijde area, depths -3.5m and -6.5m TAW and two at section 104, Mariakerke area, at the same depths. At each location a metallic frame is deployed twice a year for approximately 6 weeks carrying instruments which measure the hydrodynamics for the entire water column (AWAC and Aquadopp ©Nortek) and in one fixed point (Vector ©Nortek) and sediment concentrations (Optical Backscatter Sensors - OBS). The OBS are mounted at three different levels within the first 1 m above the sea floor to capture the variation of sediment concentrations under various hydrodynamic conditions.

The objective of this work is to study the relationship between turbulent kinetic energy (TKE) and the contribution of waves and currents to the observed suspended sediment concentration distribution patterns. Consequently, the understanding of the sediment transport dynamics, both during normal weather conditions and during storm conditions and its variations with the depth are also set as objectives.

As expected, preliminary results indicate strong decrease of the sediment concentrations with the distance from the sea floor, mostly during normal hydrodynamic conditions. However, the largest sediment concentrations do not occur always during maximum velocity of the currents and maximum turbulent kinetic energy. The closer insight into these relationships which will be provided at the end of the study will significantly increase the knowledge on sediment dynamics at the Belgian coast.

Keywords: Belgian coast; hydrodynamics; sediment concentration; in situ measurements; shoreface nourishment