Introduction

The Belgian coast is highly vulnerable to storms, combining high water levels and large waves, with a serious risk of flooding of the densely inhabited. The Flemish Government established a Masterplan for Coastal Protection (2011) to reinforce the weak coastal sections and guarantee the required safety levels in case of a catastrophic storm event. These are realised through sustainable coastal protection measures, with a lower impact on the environment: respect to the traditional ones, a sand nourishment. To evaluate the efficiency, safety and sustainability of the nourishment, Mariakerke beach, located in west of Oostende, has been selected for a full scale pilot experiment on shoreline nourishment and it is intensively monitored. This study aims to improve the knowledge about the dynamics of the investigated area, with a special focus on the relationships between hydrodynamics and sediment dynamics in this area.

Field Measurements

Waves, currents, suspended sediment concentrations (SSC) and water level are monitored at four locations: two at Baarsbeke area (Section 101 and two at Mariakerke area (Section 104) and at the depths of -3.5 m and -4.5 m TAW. At each location, a frame is deployed with instruments to measure the hydrodynamics for the entire water column (Vector and OBS) and in one fixed location (Hercules) and in one fixed point (Hylas I) and sediment concentration (Optical Backscatter Sensors – OBS) at three different depths within the first 1 meter above the seabed.

Data and Methods

A field campaign took place in Mariakerke between 23/09-14/10/2015. We focused on the Vector and OBS time series, analyzing the results of 16 day of simultaneous measurements of 10 meters, collected every four hours. The Vector reports velocity current data in ENU components East, North and Up. From them, the turbulent kinetic energy (TKE), the Reynolds stress and current direction were calculated. These were related to the water level variations and the SSC to examine the effects of the hydrodynamics conditions on the distribution patterns of suspended sediment concentrations.

Observations

The dynamics of water and sediments are strongly affected by the tide induced currents. During normal weather conditions the tide induced-currents show a strong and sudden inversion in direction, during which the velocity component and the TKE values are near zero. In absence of large waves and strong wind, the SSC at -4.5 m TAW show one or two peaks per day, corresponding exactly to the rising tide. From the OBS at -3.5 m TAW, the peaks in SSC can be found in correspondence with lower water level. The higher energy levels correspond to the high water level, when the currents direction at the vector depth is regularly set toward East North-East. However, a global view to the data shows that the larger values of SSC are connected also to the highest levels of TKE. Higher values of SSC were found at -6.5 m depth than at -3.5 m TAW.

Final Considerations

Larger sediment suspension is not strictly connected to the higher levels of TKE. During normal hydrodynamic conditions, the major force driving to higher concentration of suspended sediment seems to be the water level range and probably the turbulence induced by the change in the currents direction due to the tide. However, a global view to the data shows that the larger values of SSC are connected also to the highest waves. During the analysed campaign just one storm event occurred, but research is still ongoing to analyse data from other field campaigns. Our future work aims to correlate the wave induced currents and peaks in SSC in order to derive sediment transport in the study zone. Spatial variation of the SSC, both along and the peaks in SSC corresponding to the rising tide are reinforced. From the OBS at -3.5 m TAW, the peaks in SSC can be found in correspondence with lower water level. The higher energy levels correspond to the high water level, when the currents direction at the vector depth is regularly set toward East North-East. However, a global view to the data shows that the larger values of SSC are connected also to the highest levels of TKE. Higher values of SSC were found at -6.5 m depth than at -3.5 m TAW. However, a global view to the data shows that the larger values of SSC are connected also to the highest levels of TKE. Higher values of SSC were found at -6.5 m depth than at -3.5 m TAW.