One year of monthly beach morphological changes in Mariakerke (Oostende) related to their forcing factors

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Sea level rise and an increase in extreme weather events due to climate change are expected to change the hydrological and meteorological conditions at the Belgian coast in the coming decades. At present, more than half of it is already in an erosive state. To protect the beach from further erosion in the future, a profound understanding of coastal processes is needed. For the Belgian coast there is a good understanding of storm thresholds for erosion impact and long-term morphological evolution. However, a relation between forcing and morphological response on a short- or medium-term is still lacking. Therefore, the aim of this study is to assess the morphological variability of the beach at Mariakerke over the year 2016 and to relate morphological changes to meteorological and marine forcing factors.

The study site is at Mariakerke near Oostende (Belgium). The beach is oriented SW-NE, with prevailing winds and waves from the WSW to NW. The wide, sandy (D_{50} = 170-250 µm) beach is flat and ultra-dissipative, typical for a macro-tidal environment. The beach is protected with groins, a dike and sand nourishments. At Mariakerke, beach topographic profiles have been measured at two different sections with an RTK-GPS (Real Time Kinematic GPS) every month from January to December 2016, except for July and October. From these profiles the morphological and volumetric changes of the intertidal and dry beach were analyzed. Wave height, water level and wind speed have been measured continuously near the research area.

The volumetric changes of the beach from the mean low water line to the dike are in the order of 0-18 m^3 per meter beach width. No clear seasonal cycle is observed, but it seems that accretion dominated in April, June/July and September, that the beach was stable in January, February and May and that erosion occurred in March and August. The beach (from the dike to the mean low water line) narrowed with up to 24 m in April and widened with up to 25 m in May. This is remarkable compared to the changes in beach width over the rest of the year, which were only up to 12 m. The beach narrowed in March, August and September/October and was stable in the other months.

At the beginning of 2016, the waves were small (< 2 m high), but during a storm in January peaks in wave height of 4 m, with a water level reaching 5.3 m TAW, were observed. The marine conditions were rather calm between March and April, followed by a more energetic period in May, when a storm occurred characterized by wave heights up to 3.9 m and a water level of 4.4 m TAW. After this storm, the sea state returned to calm.

Although the hydrodynamics show a clear seasonal cycle with more energetic wave conditions in winter, the beach morphology does not. Nevertheless, the storm event in May resulted in a lowering and widening of the intertidal beach for all the profiles. Interestingly, the intertidal beach was not affected by the storm event in January. Although the wave characteristics were similar between the two storm events, the lower water level in May resulted in a larger wave impact in the intertidal zone. Moreover, it seems that a narrowing of the beach occurred during the months with calm wave conditions.

Keywords: storm impact; beach recovery; hydrodynamics; wind