MOZES: Research on the morphologic interaction between the sea bottom and the Belgian coastline

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The MOZES-project (MOrfolgische interactie kustnabije ZEebodem en Strand) focuses on the morphological interaction between the nearshore seabed (inner shelf), covered by a field of so-called *shoreface-connected sand ridges* (sfcr), and the shoreline of the Belgian coast on time scales of months to centuries. The knowledge gained in this project aims to improve system understanding of the regional morphodynamics, as well as to establish numerical models, which is essential for an efficient coastal management.

Within the MOZES-project Flanders Hydraulics (Waterbouwkundig Laboratorium) is collaborating together with Antea Group Belgium, Utrecht University and Deltares, for whom a one year contract was granted. The project started in 2022 and is three times extendable for another year, resulting in a maximum duration of four years. At the start of the first working year, four Work Packages (WP) were defined. WP1 involves data collection to expand the overall covering of the historic elevation dataset of the Belgian coast. WP2 addresses the coupled shelf-shoreline long-term morphodynamics (10-100 years) by developing new idealized morphodynamic models. WP3 investigates the hypothesis of natural feeding of the beach by sediment transport over the sfcr using complex process-based numerical models (Delft3D Flexible-Mesh FlemCo model, openTELEMAC Scaldis-Coast model). Finally, WP4 addresses effects of the observed deepening of nearshore tidal channels on beach erosion and beach nourishments.

WP1: Inner shelf, nearshore bathymetric and beach topographic maps of the mid-1980s have newly been vectorized and converted to DEMs, showing the situation just after the extension of the Zeebrugge harbour breakwaters. Another DEM was built for the year 1866: a coastline without harbour breakwaters and three sfcr (Trapegeer – Broersbank – Den Oever; Stroombank; and Wenduinebank – Paardenmarkt), as opposed to only the first one nowadays.

WP2: A new idealized morphodynamic shelf model was developed, which is capable of reproducing ridges that resemble the sfcr observed on the Long-Island shelf (New York, USA), which were used to validate this new model. Furthermore, an existing shelf-shoreline coupled model, which was designed for the Long-Island micro-tidal coast, was modified so that it is more representative for the Belgian coast. Preliminary results are promising, but still many adjustments are needed in both models (inclusion of tides, waves and sea-level rise, using more realistic bathymetry,…).

Ultimately, once the morphodynamic shelf model would be able to successfully reproduce the gross characteristics of the observed sfcr on the Belgium inner shelf, it will be also coupled to the shoreline evolution model. With this new (fully morphodynamic) coupled shelf-shoreline model, the impact of human interventions (e.g., construction of harbours, nourishments, ...) and sea-level rise on the evolution of sfcr and the shoreline can be investigated.

WP3: Preliminary results from the complex morphological models for years 1866 and 2015 indicate landward sediment transport over the nearshore parts of sfcr towards the beaches. Further detailing of the cross-shore sediment transport mechanisms is needed to examine whether this landward directed sediment transport indeed nourishes the beaches (so-called natural feeding).

The use of other process-based models renowned for nearshore and beach morphology, like e.g. XBeach, is recommended.

WP4: Analysis of the large-scale morphological changes between 1984 – 1987 and 2022 showed a landward and north-eastward movement of the sfcr and the tidal channels that separate these ridges from the coastline. A deepening of those channels is observed, although doubts on the vertical accuracy of the 1980's map prohibited the execution of reliable volume balances.

An analysis of beach and shoreface nourishment intensity from the last decennia in Flanders showed that storm events, changes in (safety) policy or nourishment method and other human factors are the main drivers behind nourishment intensity and obscure a possible correlation with the deepening of nearshore tidal channels. Nourishment intensities from the last decennia in the Netherlands correlate spatially with the presence of deep channels close to the coastline. More research is needed in order to be able to quantify the effect of these channels on coastline maintenance and nourishment needs.

Keywords
Coastal Morphology; Morphological Nearshore – Beach Interaction; Sediment Transport; Data Analysis; Numerical Modelling