MOZES: RESEARCH ON THE MORPHOLOGICAL INTERACTION BETWEEN THE SEA BOTTOM AND THE BELGIAN COASTLINE

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INTRODUCTION

The sandy Belgian coast is situated along the southern North Sea (Figure 1). The tide in this area is semi-diurnal and is macro-tidal (ca. 4 m). The wave regime is moderate with an average significant wave height in front of the coast of 60 cm and 10% of the time 2 m is exceeded (Verwaest et al, 2022).

Figure 1 - the Belgian coast is situated along the southern North Sea.

Within the framework of a new research project called MOZES, carried out in the years 2022-2026, the importance of the seabed for sustainable coastal protection of the Belgian coast will be addressed. It is well known that the dunes act as natural sea defenses, but less is known about these dunes along the Belgian coast being formed through a process of natural feeding from the channel-bank system (via the shoreface-connected sand ridges to the beach). The hypothesis of such a natural feeding is supported by the fact that the locations of three wider dune areas coincide with the landward ends of the three shoreface-connected ridges (Figure 2).

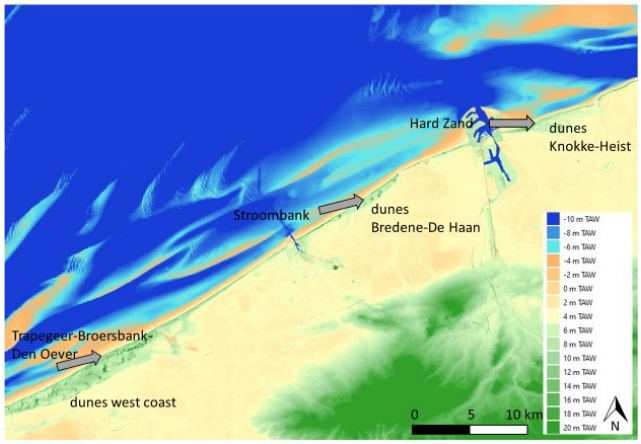

Figure 2 - Bathymetric map showing shoreface-connected ridges co-occur with wide dune areas at the Belgian coast

This suggests that these ridges have provided sand to shape these dunes, a process that took place on centennial time scales. By order of magnitude, this involves about a sand transport rate of 200,000 m^3/year over a period of 1000 years (Houthuys et al, 2021). Furthermore, there are zones along the coast with encroaching channels that threaten the stability of beaches. Slowly but steadily, these channels are moving onshore and/or are deepening. These processes are slow but, in the long term (on decadal time scale), the onshore movement of these channels is expected to lead to an increase of nourishment works to maintain coastal protection at these locations.

METHODS

The 2022-2026 MOZES research project combines data-analysis with numerical model development and application. Historic topobathymetric maps are vectorised in order to map the decadal and centennial morphological evolution of the coast. The numerical models will address the slow morphodynamics of the shoreface-connected sand ridges and their interaction with the coastline through alongshore and cross-shore sand transport. The former is resulting from differences in wave climate due to changes in bathymetry (channel-bank system) and coastline orientation. The latter either through a natural feeding related to the presence of a coastal bank, or through erosion due to the presence of a coastal channel.

RESULTS

Results achieved in the first phase of the MOZES project will be presented in this contribution. A main result from the data-analysis is the quantification of the coastal squeeze that occurred during the past 40 years. Figure 3 shows that, overall, the dry beach has shifted seaward (green arrows) while the depth of closure (i.e. the -7 m below msl depth contour line) has shifted landward (red arrows), resulting in steepening of the active profile (beach+shoreface). The reduction in width of the zone is in the order of 50-100 m over 4 decades. This results in average slopes of the active profile increasing from e.g. 1/45 to 1/35 over the past 40 years.

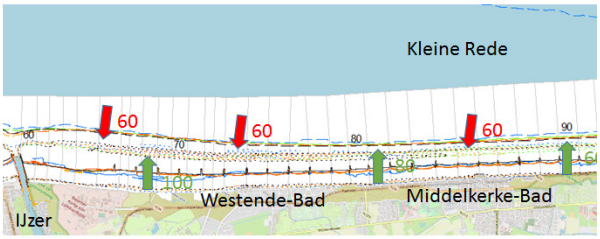

Figure 3 – coastal squeeze 1983-2023 for a typical part of the Belgian coast

A main result from the numerical modelling is the quantification of the combined effect of waves and tides on the alongshore sand transport in the active zone and the neighbouring sea bottom (Figure 4). Overall, results show that waves are the dominant driving force for alongshore sand transport in the active zone (beach+shoreface; slope ca. 1/40) while tides are dominant in the area seaward of this zone (sea bottom; slope ca. 1/1000). The overlap between the wave-dominated and the tide-dominated areas is small.

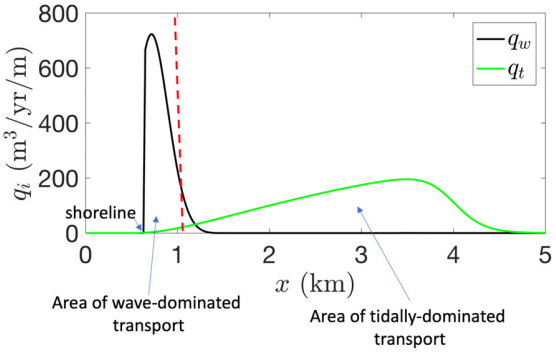

Figure 4 – distribution of the alongshore sand transport along a typical Belgian cross-shore profile (shoreline on the left; seaward towards the right)

OUTLOOK

In the coming years the MOZES research will continue investigating the morphological interaction (cross-shore) between the beach+shoreface zone and the neighbouring sea bottom on decadal time-scales using both data analysis and numerical models.

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