

# Decadal evolution of an intensely nourished coast

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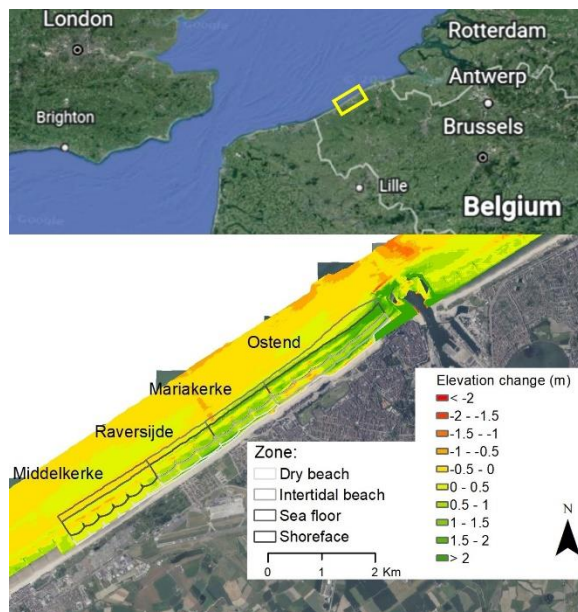
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**Introduction:** Coastal protection for sandy coasts is best done by artificial nourishments if sand is available. Such is the case of the Belgian coast where volumes between 0.5 to 1 million m<sup>3</sup> are supplied to weak spots along to its 65 km length every year. In the center of this coast, Middlekerke – Ostend area was in the past vulnerable to storms causing floods. However, starting early 2000's the active beach volume was increased by successive nourishments. The largest nourishments were carried out in 2013 – 2014 when over 2 million m<sup>3</sup> of sand was deployed on both the dry beach and the shoreface [1]. In 2018 and 2021, another 1.25 million m<sup>3</sup> were supplied to this coastal stretch (Fig. 1).



**Fig. 1:** Difference of DEMs 2013-2022.

**Methods:** The Belgian coast is intensely monitored with topographic surveys twice a year and bathymetric surveys once a year. Additional surveys are performed on the areas where interventions are carried out, such as the area of Middlekerke – Ostend. Based on these surveys, Digital Elevation Models (DEM) were generated for every year and difference of DEMs indicate how the nourished sand is re-organized along and across the active beach. Field observation, in situ measurements and sand budgets were also used to

better understand and quantify the sediment circulation in the study zone.

**Results:** The study zone rapidly reacted to the nourishments especially after 2013, when in less than one year sand started to migrate in the net alongshore direction, towards the Ostend harbor. The harbor's jetties, perpendicularly to the shore trapped much of the sand generating significant accumulation at Ostend beach. Simultaneously, sand was re-organized cross-shore by strengthening the beach bar systems in the shoreface. The intertidal area lost part of the nourished sand which was transported to the shoreface and the dry beach.

The efficacy of the nourishments is remarkable, the majority of the sand being still present on the active beach after almost a decade.

## Discussion:

The nourishments performed at the Middelkerke – Ostend coast in the last decade were a success, largely increasing the beach capacity to withstand extreme storms. Apart from the large volumes supplied to a relatively short coastal stretch (approx. 9 km), other important factors for the sand retention in the system were the local configuration (e.g. harbor's jetties), alongshore transport and a rather gentle submerged beach slope which limits the sediment loss in cross-shore direction. The re-organization of the sand in the area is ongoing and it is expected that the submerged sand bar system will continue to migrate back-and-forth. In contrast, the intertidal and dry beaches stay rather stable, which is also due to the human intervention. However, the large sand accumulation at Ostend beach can bypass the harbor jetties in the future with implications for the local sediment management.

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**References:** [1] Dan et al. (2019). Beach versus shoreface nourishment experiment, *Coastal Sediments, Tampa/St. Petersburg, Florida, USA*, pp. 287–295.