Shoreface connected ridges as natural sand engines for coastline preservation

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1. INTRODUCTION

A sand engine is usually considered as a large sand nourishment that indirectly feeds the adjacent coastal area on a time scale of decades through the action of waves, currents and winds.

However, sand engines can also be present from natural morphodynamics, namely in the situation where a coastal bank attaches to the shoreline and supplies the neighbouring beaches with sand. In this abstract we explain how morphological research has led us to this hypothesis that shoreface connected ridges are/were natural sand engines for the Belgian coast.

2. SHOREFACE CONNECTED RIDGES AT THE BELGIAN COAST

Shoreface connected ridges are/were present at 3 locations along the Belgian coast (Figure 1).

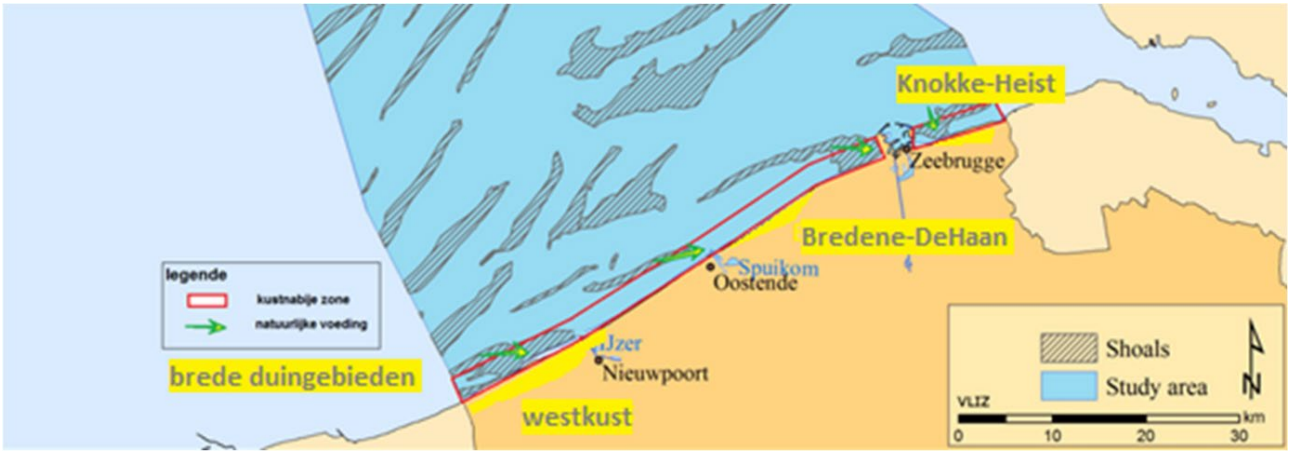

Figure 1: Correspondance between the location of wide dune areas and the location of (former) shoreface connected ridges along the Belgian coast

2.1 WEST COAST

A natural sand engine is present at Koksijde where the Trapegeer-Broersbank complex attaches to the coastline and feeds part of the Belgian west coast. Empirical evidence is found in the form of the coastline, in particular a local seaward protrusion between Koksijde-Bad and Oostduinkerke-Bad amounting to several hundred metres [Verwaest *et al.*, 2020]. Also modeling with Scaldis Kust numerical model reveals a mechanism of net sand transport via the bank/gully system across the depth of closure towards the active zone [Verwaest *et al.*, 2022]. The size of the young dunes on the west coast can be explained by a continuous feeding from the sea in this area during the last 1000 years. In order of magnitude, 120,000 m^3/year during 1000 year would explain the origin of the dune belt extending 12 km alongshore, 2 km in width and 5 m in height. This process is still active today [Houthuys *et al.*, 2021].

2.2 CENTRAL COAST

Before 1900, the Stroombank in Bredene-De Haan was attached to the coastline (Figure 2). At that time, beaches in that area were fed by a transport of sand along the crest of the Stroombank. This also

explains the existence of a relatively wide young dune belt in this zone, because this configuration lasted for several centuries. When a new, dredged channel to the port of Ostend cut through the Stroombank around 1900, the transport path was interrupted and the natural feeding of these beaches was cut off. A rough estimation of the accretion since about 1000 AD is given by an average coastal length of 10 km (Bredene to Wenduine), a young dune width of 500 m with an average terrain rise of 5 m. This results in a natural supply of 25,000,000 m³ during 1000 years, or 25,000 m³ per year [Houthuys *et al.*, 2021].

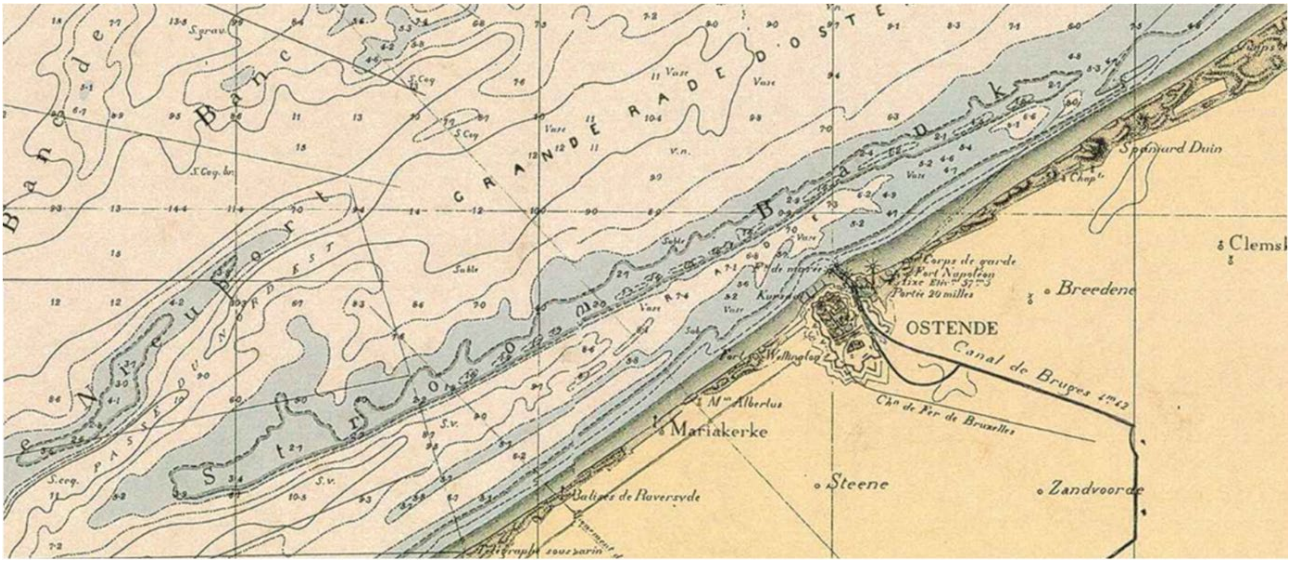

Figure 2: Stroombank attached to the coast in Bredene-De Haan in the 19th century [Stessels, 1866]

Nowadays still a remnant of the attachment of the Stroombank to the coastline is present. It might be possible to restore the mechanism of natural feeding by a large nourishment on the sea bottom in that area. Material available from infrastructure works or maintenance dredging might be used if sediment characteristics allow. The latter might be realized by choosing an optimal dumping location of the sand that is continuously dredged in the fairway to Oostende to maintain this access channel to the port of Oostende.

2.3. EAST COAST

A third shoreface connected ridge was located on the east coast. On old maps this bank is called Hard Zand. On more recent maps, the Wenduinebank-Paardemarkt complex is visible, which attaches to the coastline near Cadzand. The relatively wide strip of young dunes at Knokke-Heist can be explained by the supply of sand via this connection to the sea bed in the period before 1900. Afterwards, the expansion of the port of Zeebrugge into the sea thoroughly changed the sand circulation in this area. A rough estimation of the accretion since about 1000 AD is given by an average coastal length of 5 km (Heist to Het Zoute), an average young dune width of 1250 m with an average terrain rise of 5 m. This results in a natural supply of 31,250,000 m³ during 1000 years, or 31,250 m³ per year [Houthuys *et al.*, 2021].

3. ACKNOWLEDGEMENTS

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4. REFERENCES

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