

Evolution of submerged large transversal bedforms in a shallow nearshore area along a macrotidal sandy coast.

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Introduction: Nearshore channels and sandbanks play an important role in nearshore hydrodynamics especially in relation to the coastline. Shallow morphological bedforms including sandbars, shoreface-connected ridges and large submerged dunes can result in feedback with tidal flow and wave action in the surf zone [1]. Unlike most other macrotidal coasts, a shoreface-connected ridge is present at the Belgian coast at Koksijde. Intriguingly, the shallow ridge is covered by large, compound hydraulic dunes, with wavelengths of 100-200 m and > 1000 m long crests (Fig. 1). This work presents results from a series of high resolution bathymetric surveys. Their morphological change and migration are documented over the longer term (> 1 year).

Methods: Koksijde beach is located on the west coast of Belgium. The coastline is oriented SW-NE and consists of broad, gently sloping sandy beaches up to 600 m wide at low tide. The tide along the Belgian coast is subject to moderate wave energy and is macro-tidal, ranging from 3.5 m at neap tides to 5 m at spring tides. The net longshore sediment transport is estimated to be 200,000 m³/year in an eastward direction. High-resolution nearshore bathymetry surveys were conducted with multibeam in 2013, 2018, 2021, and 2022. Bathymetric surveys were converted to a Digital Elevation Model (DEM) of 1 m cell size. Hillshade raster, an illuminated representation of the surface, was also derived for each survey.

Results: The surveys indicate the presence of sandy bedforms in the nearshore zone between -0.5 and -4 m TAW (Belgium Ordnance Datum corresponding to the low spring tide in Ostend). They are transverse to the coastline, up to 1500 m in length and 1-2 m in height (Fig 1). Typically, the lee face is steeper than the stoss slope. Their spacing is in the range of 125-250 m. Some parts of the crests emerge at low tide. Repeated surveys of the bedforms field over 9 years revealed significant changes in morphology and their position. The large bedforms are very active, adapt to changing meteo-hydrodynamic conditions and migrate at rates of 20-25 m/year to the east.

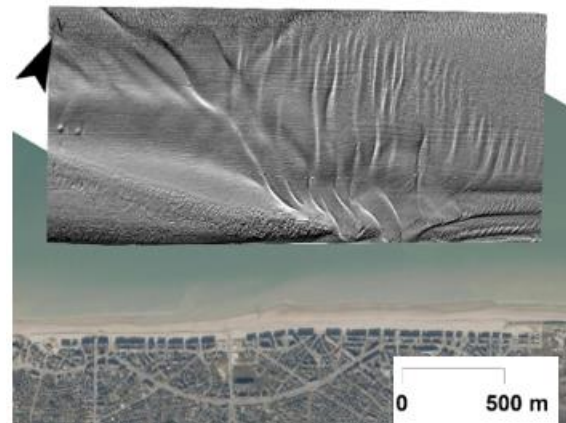


Fig. 1: Hillshade raster of the bedforms in 2022.

Discussion:

The morphological bedforms at Koksijde beach are singular features for sandy tidal beaches and they are not expected to occur so close to the coast and in very shallow water. They are very dynamic and migrate in the direction of the longshore sediment transport. The morphological characteristics of the submerged large transversal bedforms suggest that they are complex hydraulic dunes with a high degree of response with tide. Their role and presence is not well understood. It is intended to further analyze the available bathymetric surveys and to perform dedicated hydrodynamic measurements.

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References:

[1] Shepard, F. P. (1952) Revised nomenclature for depositional coastal features, *Bulletin American Association of Petroleum Geologists*, **36** (10), 1902-1912.