



Effect of shelf morphodynamics on coastline change: modelling free behaviour and response to interventions on the shelf

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The dynamics of the surf zone strongly depend on the characteristics of incoming sea waves,. The latter are determined by the local wind climate, but also by the bathymetry of the inner shelf, e.g. sand ridges cause wave refraction and dissipate part of the wave energy. As the shelf bathymetry evolves on decadal to centennial time scales, due to spatial variations in tide- and wave-induced sand transport, knowledge on how shelf bathymetry affects the large-scale coastal evolution is important.

This study investigates the natural hydro- and morphodynamics of a mesotidal coastal system (shelf and surf zone) and their response to interventions on the shelf. For this, the coupled Delft3D-SWAN numerical model is employed to solve for tides, waves, sand transport and bed level update on the inner shelf. A one-line model is used to calculate large-scale evolution of the coastline from gradients in the longshore sand transport in the surf zone. This transport is given by the CERC formula, where its input is derived from the wave output of the shelf model.

Results will be shown for a domain that crudely mimics the Belgian continental shelf. The natural behaviour of the inner shelf is studied by conducting spin-up runs for a period of 1000 years, starting from an initially linear bottom profile in the cross-shore direction. Subsequently, several interventions are created (in particular artificial islands) and the response of the system to these perturbations is studied.

It will first be shown that a full process-based morphodynamic model is able to simulate the formation of mature tidal sand ridges on a shelf with a sloping bottom. The variable bathymetry of the shelf has a substantial impact on coastal erosion and accretion patterns. Second, the construction of an island strongly affects the dynamics of the sand ridges and also gives rise to substantial accretion of the coast behind the island and erosion further downstream. Third, shelf dynamics and coastal accretion and erosion rates will be presented for different positions and sizes of the island, as well as for multiple islands.