MODELING BIO-PHYSICAL INFLUENCES ON SANDWAVE DYNAMICS

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The bottom of the North Sea shows a wide variety of bedforms, among which sandwaves are the most mobile. Understanding the dynamic character of the bottom of the seabed is of high economic value, for example for selecting suitable locations for sandpits and windfarms, as well as to determine a safe burrowing depth for pipelines and telecommunication cables, and a safe navigation depth for vessels.

Studying the dynamics of the bottom of the seabed is not only of interest from an engineering point of view, but also from an ecological perspective. Given the high biodiversity in the subtidal area, insight is needed in the relation between geomorphodynamic processes and biota for the conservation and management of the biodiversity in the coastal zone. Moreover, these benthic organisms are known to influence their habitat, resulting in bio-geomorphological interactions.

At the site studied in this paper, the Marsdiep inlet in the Netherlands, the migration rate of the sandwaves is up to 90 m year^{-1}. This high migration rate is caused by the relatively high flow velocities in the tidal inlet (up to 2 m s^{-1}), compared to the more moderate flow velocities in the offshore areas and coastal sites studied thus far. Evaluation of the model results is based on the seasonally averaged sandwave length and migration rate in the Marsdiep inlet, obtained from an ADCP which was mounted under the ferry, which navigates between the south and north border of the study area.

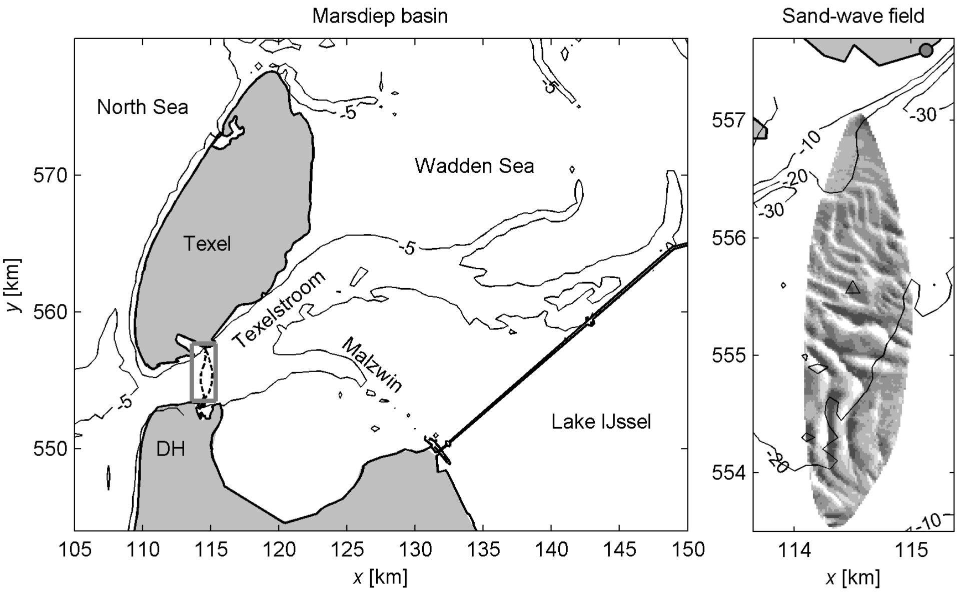

Figure 1: Overview of sandwaves in the Marsdiep inlet.

To model the sandwave dynamics, we constructed an idealized bio-geomorphological model, in which sandwaves are seen as instabilities of the coupled system (hydrodynamics, sediment dynamics, biota). By applying a linear stability analysis to the coupled system, growth rates for every wavelength are calculated independently. The wavelength with the fastest growing mode is considered to represent the occurring sand wave. Based on information on waterdepth, grain size, flow velocity and biomass tube building worms we are able to determine the wavelength and migration rate of the occurring sandwave. The tube building worm *Lanice conchilega* is shown to reduce the near bottom flow, and in this way reduces the ripples on top of the sandwaves, which is parameterized in the model.

As model input, the measured variation in (i) flow velocity and (ii) water temperature is used and moreover, (iii) the biomass variation of the tube building worm *Lanice conchilega* is included in the bio-geomorphological model, based on field measurements.

Model results reveal that both the temporal and spatial variation in sandwave dynamics can be reconstructed by the bio-geomorphological model.