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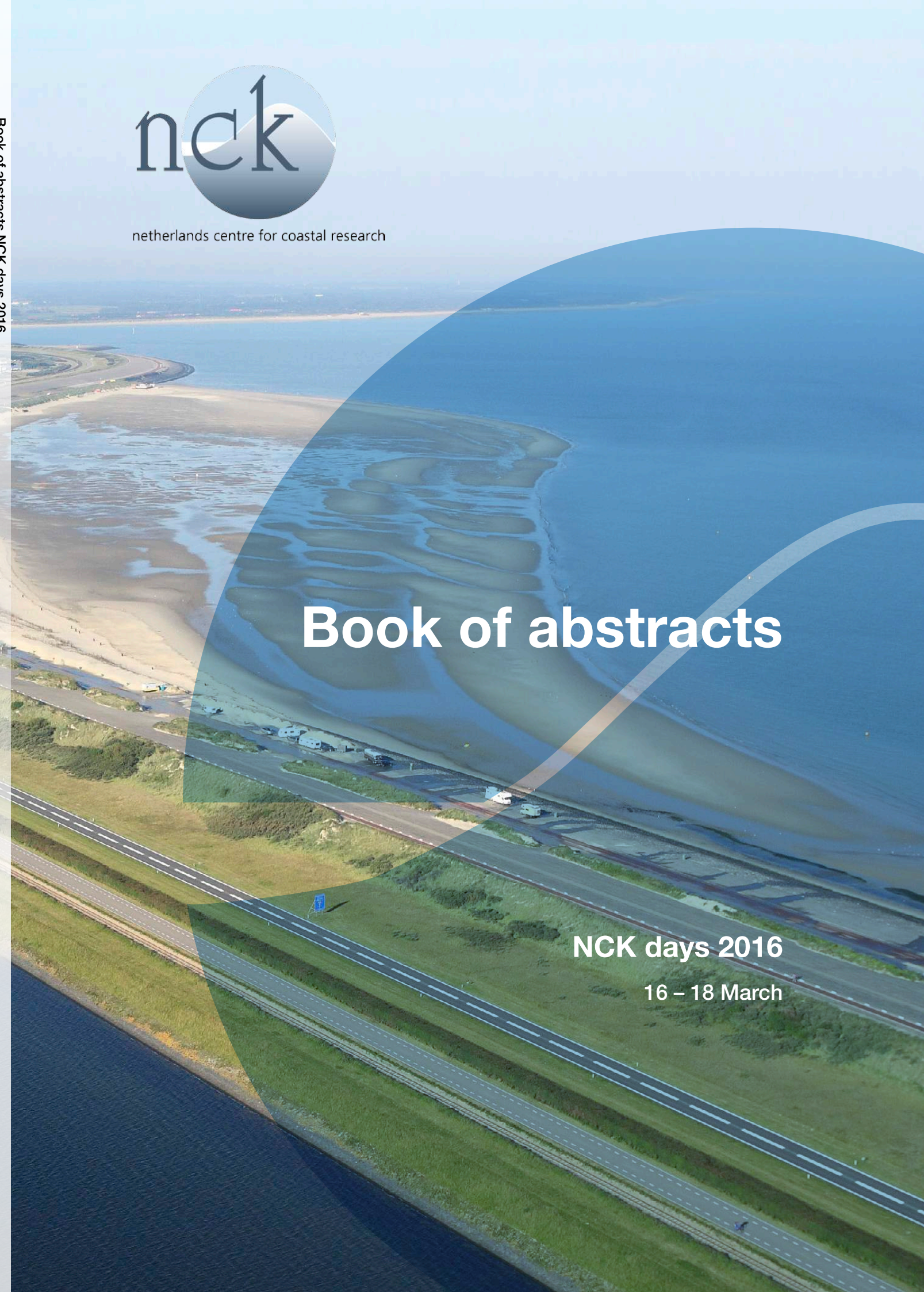

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THE INFLUENCE OF STORMS ON SAND WAVE DYNAMICS: MORPHODYNAMIC MODELING USING A LINEAR STABILITY APPROACH

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Tidal sand waves are large-scale rhythmic bed forms observed in many tide-dominated shallow seas that have a sandy seabed. They have typical wavelength of hundreds of meters and are several meters in height. The behaviour of sand waves is of practical interest because they tend to interfere with navigation, pipelines, cables and windfarms. Process-based morphodynamic models have been developed to increase our understanding of sand wave dynamics (e.g. see the review by: Besio et al., 2008). In particular, sand waves have been explained as free instabilities of the system (Hulscher, 1996) using a linear stability analysis.

Observations show that storms play a significant role in sand wave dynamics. In this research we qualitatively investigate the influences of storm-related processes on sand wave dynamics. These storm processes, such as wind waves and wind-driven flow, enhanced turbulent conditions and suspended load sediment transport act on top of the fair weather processes such as tidal currents and bed load sediment transport.

An idealized sand wave model, based on linear stability analysis, is developed to obtain preferred sand wave characteristics for given storm conditions. The obtained characteristics are wavelength, orientation, migration rate and growth rate associated with the so called fasted growing mode. For example, the influence of wind wave amplitude and direction on the preferred wavelength of bed forms is shown in Figure 1. The preferred wavelength increases for increasing wind wave amplitudes, and in particular for waves coming in approximately perpendicular to the tidal current. Other results show the influence of wind direction and magnitude on sand wave migration, and that wind waves can enhance migration.

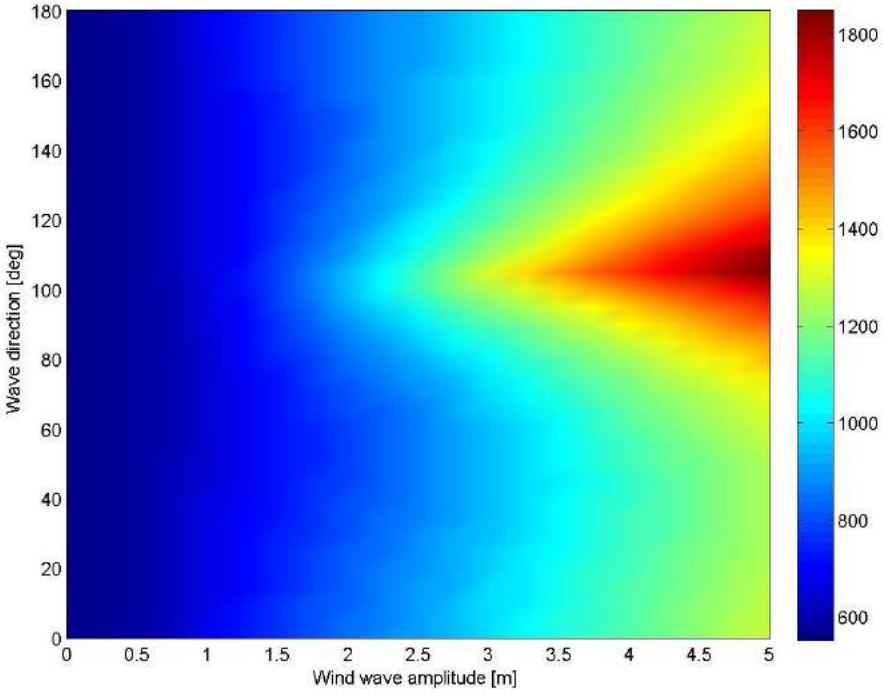

Figure 1 The wavelength [m] of the preferred bed form as function of wind wave amplitude and direction. The wind wave direction is with respect to tidal direction. The wind wave period is 6 seconds.

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Hulscher, S.J.M.H., 1996. Tidal-induced large-scale regular bed form patterns in a three-dimensional shallow water model. Journal of Geophysical Research 101, 20727–20744.