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NCK Days 2018

Geo-logic in coastal and shelf research: a matter of multi-disciplinarity

March 21-23

Teylers Museum – Haarlem

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A CLASSIFICATION METHOD FOR THE PRESENCE OF TIDAL SAND WAVES AND MAINTENANCE DREDGING DESIGN

R. de Koning[1]*, J. van Thiel de Vries[1], B. Borsje[2]
[1] Royal Boskalis Westminster N.V., [2] University of Twente
* rick.de.koning@boskalis.com

Tidal sand waves and Port of Melbourne maintenance dredging

Tidal sand waves are bedforms that grow under the influence of residual tidal currents driving sediment particles to the crest of the sand wave. Generally, tidal sand waves are several meters high, hundreds of meters long, and migrate up to tens of meters per year. Tidal sand waves can cause failure of offshore structures when migrating waves expose buried pipelines or structure foundations. Sand waves can also cause hindrance to vessel navigability. After dredging, monitoring of the Melbourne port shipping channel (South Channel) bathymetry revealed fields of bedforms with high growth rates. These bedforms threaten to hinder marine traffic and the matter requires an adequate maintenance strategy. The dimensions and growth rate of the local bedforms are remarkable and, therefore, classical sand wave theory does not automatically apply.

Research questions and methodology

The central research questions are: 1) whether bedforms can be classified as tidal sand waves on the basis of low-detail hydrodynamic data and 2) how dredging affects the suppression of tidal sand waves. To study the research questions, bathymetry and (numerical) flow data are analyzed alongside established sand-wave literature to investigate if the bedforms can be classified as tidal sand waves. New maintenance strategy concepts are designed with the prevention and delay of sand-wave growth in mind. A 2DV Delft3D numerical model is used to evaluate the different dredging strategies.

Main findings

To determine if bedforms in South Channel can be classified as tidal sand waves, both the physical dimensions and the hydraulic environment of the bedforms are studied. Hulscher (1996) defined a spectrum of hydrodynamics in which tidal sand waves are able to grow. Borsje *et al.* (2014) revealed how an upper boundary to this spectrum is added, based on the transition from bedload to suspended load sediment transport. Subsequently, a 74% agreement was found between the predicted and actual bedform presence in the channel (Figure 1). The results also indicate local generation of sand waves, which defines the focal point of the maintenance strategy design. A probabilistic approach shows similar regrowth time for the simulated and measured sand waves. Furthermore, smoothing the bed may increase the maintenance interval by 3 years while removing more sand from the system increases that period substantially.

Outlook

The project provides the knowledge, methods and tools required for the classification of bedforms as tidal sand waves using only low-detail hydrodynamic data. Our approach also shows the potential as a predictive tool for sand-wave presence. Additionally, the numerical study enables the design of dredging strategies that require less volume of material moved and are less intrusive on the environment. Including sand-wave migration in the method will provide additional design-optimization potential.

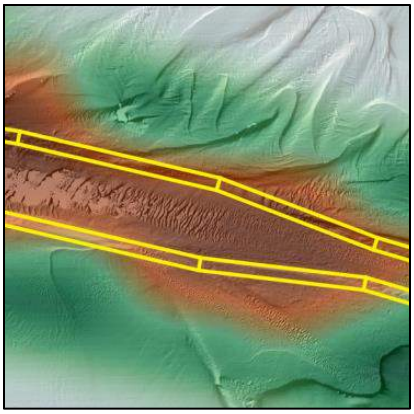

Figure 1. Result of predicted presence of tidal sand waves in South Channel. Red indicates presence, green indicates absence.

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