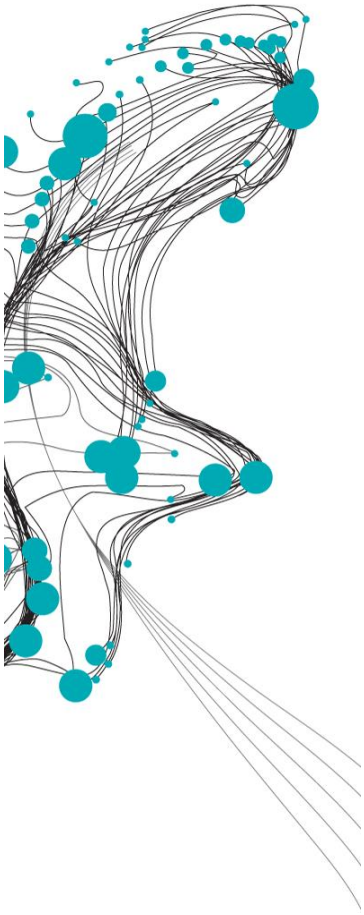
Extrapolation of morphodynamics for the estimation of future seabed changes in the Europlatform area



Background Sand waves typically occur in sandy shallow seas and they are induced by tidal currents. Sand waves are dynamically active features with migration rates up to a few meters per year posing a serious threat to the safety of submarine structures. Thus, a detailed study of the sand wave characteristics could be used in the strategy formulation process of offshore wind farms.

Objectives This study aims to calculate the main characteristics (height, length, asymmetry, migration and growth rate) and to identify correlation patterns between the migration rate and the sand wave shape. The study area is a sand wave field located in the vicinity of the Europlatform (North Sea), see Figure1. The second objective of the study is to create a statistical predictive model that can be used to estimate future seabed levels.

Methods We use the Fourier analysis to filter bedforms, with shorter and longer wavelengths, from the sand wave signal. From the filtered seabed profiles, we determine the positions of crests and troughs and we calculate the sand wave characteristics using the method suggested by Knaapen (2005). The least square method has been used to define the best fitted regression model. The selected regression model has been extrapolated and we use the prediction bounds to define future maximum vertical positions of sand wave crests and troughs.

Results The results suggest that the sand wave field retains more or less its shape during the investigated period. The predominant migration direction of the sand wave field is North East, coinciding with the steeper slope. The field comprises individual sand waves with average lengths and heights ranging from 117 to 347m and from 1.9 to 8.4m respectively. The mean (per individual sand wave) migration rates vary between 0.3 and 1.86m/yr to the North East. A statistically weak negative correlation has been revealed between migration rate and sand wave height and length. We found no correlation between migration rate and sand wave asymmetry. Lastly, the maximum seabed level rising and lowering in 2030 are 0.9m and -0.4m, respectively (with respect to 2018 bathymetry).

Conclusion The proposed model could be used to improve the decision-making process by predicting minimum and maximum seabed levels. However, it is not valid outside of the study area.

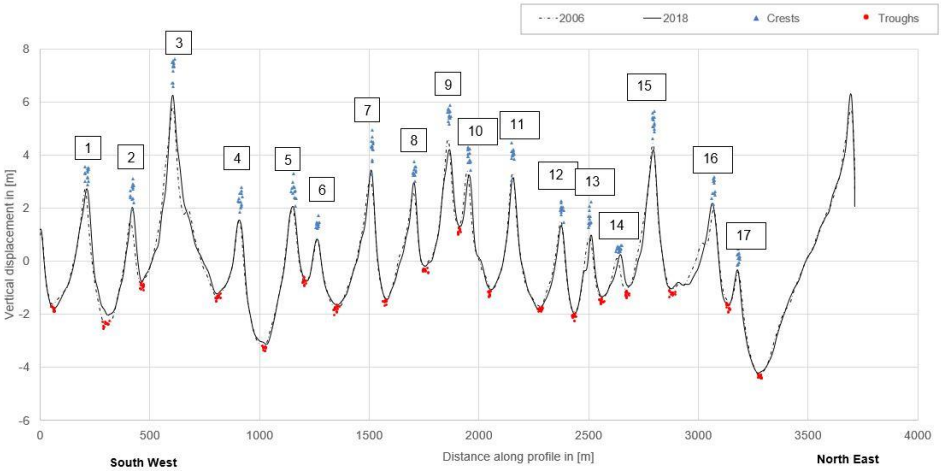


Figure 1: The seabed development between 2006 and 2018.

Knaapen, M. A. F. (2005). Sand wave migration predictor based on shape information. Journal of Geophysical Research: Earth Surface, 110.

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