Title:
Morphodynamic influence on silting risk for infrastructure & unexploded ordinances (UXOs)

Assignment no.:	**Internal/External:**
27.21	Internal/External (Ministerie van Defensie)
Head graduation committee:	**Daily advisor:**
Dr. ir. Pieter Roos	Ir. David Ecclestone (Ministerie van Defensie)
Participating companies or institutes:	**Start of the project:**
University of Twente, Ministerie van Defensie	ASAP

Required courses:
Long waves and Tidal Morphodynamics, Seminar Morphology, Data Analysis, (Minor GIS at ITC)

Short description and objective of the project:

The sandy bed of coastal shelf seas is neither flat nor static. The dynamic behaviour of marine bed forms (in particular sand waves) poses serious threats to a range of offshore activities. For instance, the Dutch Department of Defence is tasked with mine detection in the North Sea. However, due to migrating sand waves mines could either get exposed or buried over time. Detailed information on bed form migration is therefore crucial. Recently a new method has been developed in QGIS which enables the detection and analysis of sand wave migration on a large spatial and temporal scale (see figure).

The primary objective of this project is to apply this data analysis and visualization tool to the Netherlands Coastal Shelf (NCS) to assess sand wave morphology and the way they evolve through time. To this end, a detailed analysis of the migration data in relation to different environmental variables (see e.g. Damen et al (2018) and van Dijk (2005)) can improve our understanding of the underlying mechanisms and processes governing sand wave migration.

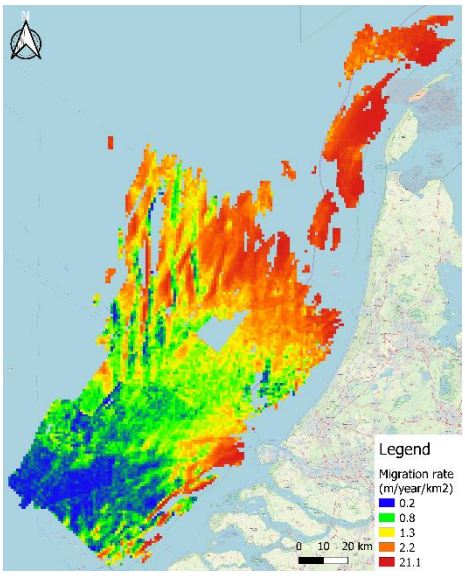

Figure 1 Migration map of the NCS (van der Meijden, 2021).

Although the project is a spatiotemporal analysis of the NCS, a next step could be generalized to other areas than the North Sea. Another output could be to generate a risk model for the NCS region where various environmental properties and characteristics can be accurately predicted based on time-series bathymetric input data. Such migration models could also be useful for maritime resurvey policy and infrastructure projects including pipelines, cables and wind farms.

Other steps could involve the use of machine-learning for further automating the QGIS migration tool and assessing the performance of the detection algorithms with synthetic data.

We are looking for a motivated student that is interested in analysing the physical processes behind sand wave migration in the marine environment. We are encouraging own creativity and are very open to new suggestions. Moreover, the student should be comfortable to work with software packages such as QGIS and Python. The project is to be carried out internally, but includes visits to the Department of Defense in Den Helder.

Further reading

Damen, J. M., van Dijk, T. A. G. P., & Hulscher, S. J. M. H. (2018). Spatially Varying Environmental Properties Controlling Observed Sand Wave Morphology. *Journal of Geophysical Research: Earth Surface, 123*(2), 262-280. doi:10.1002/2017JF004322

van Dijk, T. A. G. P., & Kleinhans, M. G. (2005). Processes controlling the dynamics of compound sand waves in the North Sea, Netherlands. *Journal of Geophysical Research: Earth Surface, 110*(F4). doi:10.1029/2004JF000173