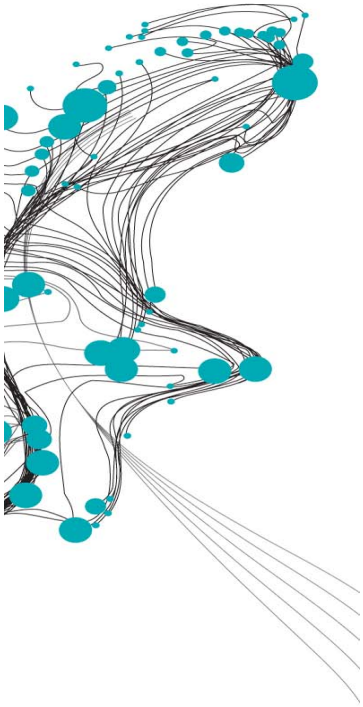
ACCELERATED MORPHOLOGICAL MODELLING

A SCHEMATIZED CASE STUDY INTO THE MEDIUM- AND LONG-TERM MORPHOLOGICAL ACCELERATION TECHNIQUES MORFAC AND MORMERGE



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In simulating the long-term morphology of a natural coastal and offshore system, the most restrictive element is the computational capacity available. To overcome this crucial disadvantage, input reduction for real-time measurement signals and an acceleration of morphological changes can be applied. In this thesis both approaches are tested for engineering practice. Based on progressive insight in morphodynamic modelling, two techniques for acceleration the morphological changes are commonly used nowadays, i.e. Morfac and Mormerge. The performance of both methods and their possibilities and limitations for a uniform sandy coast, including a navigation channel and a harbour entrance is the subject of this study.

A schematized Delft3D model in 2DH mode for the coastal and offshore area of IJmuiden has been set up. Requirements for input reduction have been assessed. The accelerated simulations are compared mutually and against non-accelerated simulations and the performance of the different acceleration techniques is determined.

The tidal signal was reduced by deriving a so-called morphological tide. This tide matches the morphological developments for a complete spring-neap tidal cycle in terms of the linear correlation coefficient. The morphological tide was made harmonic using the M_2, M_4, M_6 and M_8 tidal constituents to make it applicable for the long-term simulations. The Brier Skill Score of the morphological development by the harmonic morphological tide compared to the morphological development of the simulated spring-neap tidal cycle is 0.96.

The wave signal was reduced by schematizing it into directional and height bins. The so-called OPTI-method was used to determine the sequence of importance of all wave conditions for the morphological development of the study area. This resulted in four wave scenarios (i.e. one, two, six or ten wave classes) to be applied in the long-term simulations.

The long-term simulations showed the formation of nearshore bars, migration of the navigation channel, sedimentation around the harbour moles and a deep scour hole directly in front of the harbour moles. This study showed that for water depths of approximately > 6 m, the acceleration factor and acceleration method are not decisive for the accuracy of the results. Wave input reduction appeared an important factor determining model performance. A minimum of six wave classes is required for good model performance.

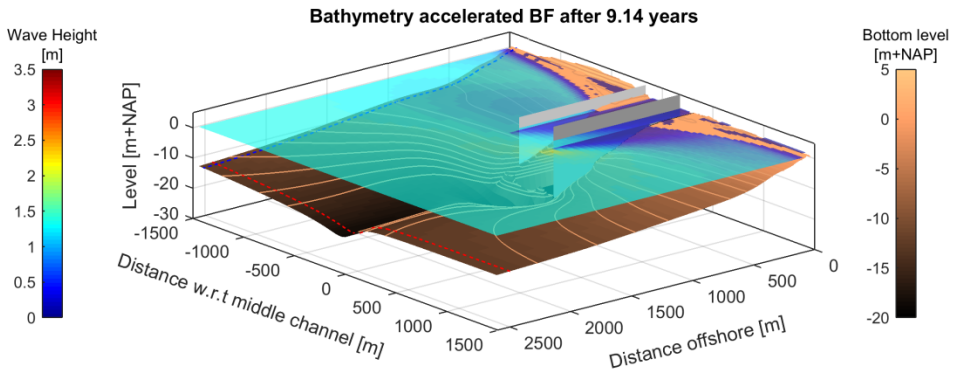

Figure 1 - Overview of model layout, reference simulation. Bathymetry after 9.14 years. In the top layer, the water level height, wave height and wave direction are shown

A Multi-Criteria analysis was done to determine which method and acceleration is most appropriate in a particular situation. Run times are more decisive in choosing a particular acceleration method and factor. For Mormerge, especially when including additional wave classes, the run times are much shorter. Morfac is only favourable when using the highest acceleration factors and a small number of wave conditions. In addition, Mormerge is more flexible in parameter settings, easier to set-up and physically more justified.

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