

Extension of (a) numerical tool(s) for the investigation of coastal safety measures: a 2D and 3D hydrodynamical model for the IJzermonding and harbour of Nieuwpoort

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The goal of this master's thesis was to provide a basis for future studies to study the influence of a storm surge barrier at Nieuwpoort and the effects of climate change on the tidal flats of the IJzermonding. For this purpose a three-dimensional model of the IJzermonding was set up, which is based on a two-dimensional model from a previous study. This three-dimensional model should make it possible to get a better approximation and a better understanding of the physically related processes

occurring in the IJzermonding. Furthermore, the three-dimensional model enables to take into account flow directions which might be in opposite directions. These flow directions should not be neglected as they have an important contribution to sediment transport processes. In estuaries and coastal areas, sediment transport processes are strongly present and are thus important to understand.

To implement and interpret the three-dimensional model in a thorough way, multiple new theories were studied. A new bottom roughness law was studied, which enables to describe the bottom roughness on the tidal flats better than the classically used constant bottom roughness law. For a three-dimensional model the constant viscosity turbulence closure model is not sufficient and a more complex model, the

$k - \varepsilon$ turbulence closure model or the low-Reynolds mixing-length and $k - \varepsilon$ turbulence closure model, should be used. Although in the end only one model is implemented, both were studied. Similarly more advanced theories were studied for the morphodynamics. The formulas of mixed sediments and these of a new erosion and deposition criterion were analysed.

The modelling of the hydrodynamics and morphodynamics is performed with the OpenTELEMAC-MASCARET software. The hydrodynamic modelling is obtained by TELEMAC-3D and the morphodynamic modelling by SISYPHE. This software is open source and made it possible to implement the above mentioned theories. As mentioned above, the low-Reynolds mixing-length and $k - \varepsilon$ turbulence closure model is not implemented, since research is still ongoing.

Validation of these theories has proven to be impossible in the scope of this master's thesis due to inexplicable vertical eddy viscosity profiles. Further research on these profiles is recommended, since the eddy viscosity is of major importance for both the hydrodynamics and the morphodynamics.