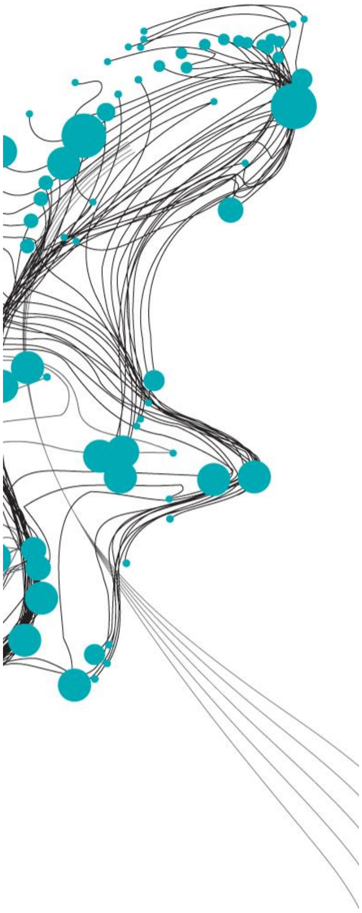
Modelling sediment transport pathways in the mouth of the Scheldt estuary



The renewed interest of the Flemish government to explore the feasibility of large-scale morphological interventions in the mouth of the Scheldt estuary addresses the need to develop knowledge and prediction tools for this area. Often, this knowledge is obtained by performing morphodynamic calculations with advanced computer models. Whereas these calculations can compute the erosion and sedimentation rates, they do not provide clear overviews of the sediment flows and links to the sink and source locations. This research studied these aspects by using numerically calculated sediment transport pathways of tracers. The pathways can be a useful additional source of information for the development of effective sediment management strategies.

Traditionally, the numerical modelling of tracer dispersals is based on the graded sediment approach. It mimics the processes that are also found in the physical experiments; the dispersal of tracers is influenced by the decay in tracer availability due to bed mixing and lag effects due to the burial and resurfacing of sediment to/from deeper layers in the bed. Because of these processes, tracer dispersal rates quickly decrease after the tracers have been released and eventually even become negligible. As a result, the approach generally requires a long computational time to get an impression of the transport pathways in a large area. To solve this, one could use the newly developed visualisation tool that visualizes time series of sediment transport maps. In this study, these sediment transports are the output of the process-based Delft3D-NeVla model. The pathways are visualized by following the movements of numerical tracer particles step by step through the vector fields. Particles are displaced according to the directions and the magnitudes of the sediment transports. Because the tool assumes that there is no interaction with the bed, the particles are continuously moving and are not slowed down by processes in the bed. As result, the dispersal rates of tracers are overestimated compared to what is seen in reality. However, the assumption makes it possible to obtain large-scale transport pathways with minimum computational efforts. As the tool has not been fully documented nor thoroughly tested, this study proposed some guidelines to choose appropriate values for the different parameters. The mouth of the Scheldt estuary formed the real-life case to test the tool and the guidelines.

By releasing the tracer particles at various locations within the mouth, the tool was able to visualize and sometimes even reveal dominant sediment transport pathways. At the large shallow area Vlakte van de Raan for example (Figure 1), the tool demonstrated that flows of sediment converge and are directed towards the north-eastern corner of the mouth. The analysis of various transport pathways helped to get a better understanding of the modelled erosion and sedimentation patterns in the current bathymetry. Finally, the study also demonstrated the added value of the tool for management purposes. The pathways showed to be useful source of information when analysing the behaviour of disposal locations and the changes in the sediment transports after the construction of two large-scale interventions (island and a new channel).

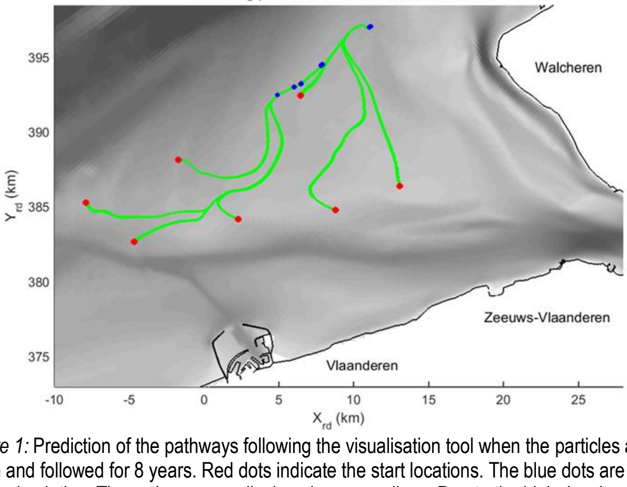


Figure 1: Prediction of the pathways following the visualisation tool when the particles are released at the Vlakte van de Raan and followed for 8 years. Red dots indicate the start locations. The blue dots are the particles' locations at the end of the simulation. The pathways are displayed as green lines. Due to the high density, the pathways of the various particles are stacked together and form a green area. The grey colormap shows the bathymetry.

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