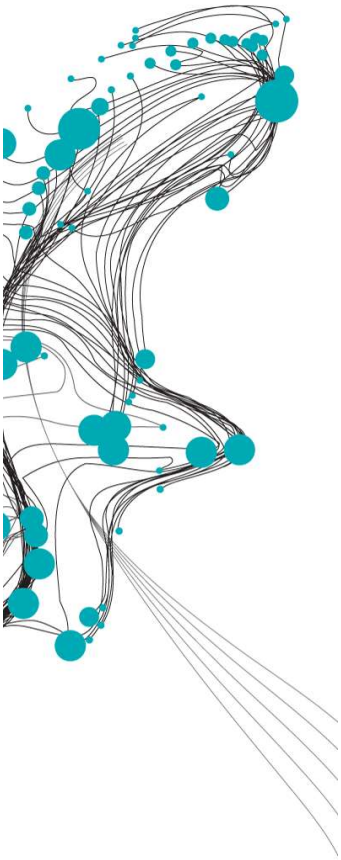
Impact of ship waves on sediment transport at two tidal flats in the Western Scheldt



Recent accidents involving ship waves on the beach of Vlissingen have strengthened the belief that ship waves could influence sediment transport in estuaries. One of the areas that could largely be affected by ship waves is the Western Scheldt estuary, which sees large numbers of ships going towards the Port of Antwerp and the North Sea Port (Vlissingen, Terneuzen and Ghent). Due to a recent deepening of the navigation channel in this protected natural estuary, nature compensation is required under EU Natura 2000 legislation. Consisting of a total of 57 ha, the Knuitershoek-Baalhoek project is part of the required amount for nature development and consists of the construction of several groynes alongside the Western Scheldt estuary. To study if this construction indeed would lead to the creation of two low-dynamic tidal flats at Knuitershoek and Baalhoek, site measurements were conducted and utilized to study the hydrodynamic, morphological and ecological developments after construction. One of the processes influencing these developments could be the relative impact of ship waves on the sediment transport, which is the research topic of this MSc thesis.

Ship waves consist of both primary and secondary waves. Primary waves are formed by the displacement of water caused by a ship passing by, which in turn causes a return current. Secondary waves are formed by the bow and stern of a ship moving at a certain speed. To study both their occurrence and effect on sediment transport at the tidal flats, pressure sensor measurements were used.

The results give the relative impact of waves and currents on the sediment transport. Here, It was shown that when looking at the individual (event-averaged) impact of waves and currents on the bed shear stress, the secondary waves are the dominant factor in both bed shear stress and sediment transport (left in Figure 1). When looking at the current situation in the Western Scheldt, a time-integrated approach has been taken (right in Figure 1). In both cases it was shown that the (secondary) ship waves had a significant effect on the sediment transport. After the construction of the groynes, the impact of both the secondary waves and the currents reduced significantly. In general, this means that ship waves have a significant effect on the sediment transport on the two tidal flats of Knuitershoek and Baalhoek, while the wind waves are the dominant contributor to the sediment transport.

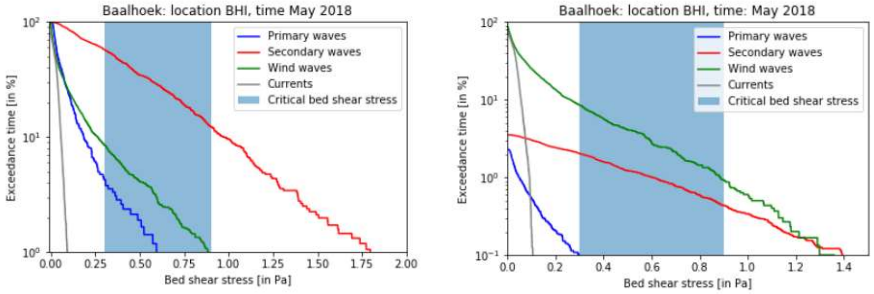


Figure 1. Impact of a single event-averaged (primary and secondary) ship wave (left) and the time-integrated impact of (primary and secondary) ship waves (right) on sediment transport when compared to the wind waves and currents

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