

Modelling the effect of intertidal area changes on tidal hydrodynamics in estuary channels

Jeroen Stark¹, Yves Plancke², Stefaan Ides³, Patrick Meire¹ and Stijn Temmerman¹

¹ University of Antwerp, Universiteitsplein 1, 2610 Antwerpen, Belgium
E-mail: jeroen.stark@uantwerpen.be

² Flanders Hydraulics

³ Port of Antwerp

Historically, intertidal areas along the Scheldt estuary have been embanked for agricultural and industrial purposes, reducing the intertidal habitat from ~100000 ha around 1000 years ago to ~9000 ha nowadays. Recently, large scale marsh restoration projects are being realized to restore intertidal habitat and reduce flood risks along the Sea Scheldt in Belgium. Along with such intertidal area changes, tidal hydrodynamics are expected to change. This study aims at gaining fundamental insights in the role of intertidal area geometry on tidal hydrodynamics along the Scheldt estuary. The impact on tidal asymmetry is herein of special interest as tidal asymmetry induces residual sediment transport and is therefore of importance for estuarine morphodynamics. A validated TELEMAC-2D model of the Scheldt estuary is used to assess the effect of the size, elevation and location along the estuary of intertidal areas on estuarine tidal hydrodynamics through several geomorphological scenarios.

Model results indicate that the location and size of intertidal areas determine the intensity and reach along the estuary over which tidal hydrodynamics are affected. For equally sized intertidal areas, the impact on tidal hydrodynamics increases if they are located further upstream, as the additional storage volume increases relative to the tidal prism. The elevation of intertidal flats affects the magnitude and direction of tidal asymmetry along the estuary channels. Based on the ratio between maximum cross-sectional averaged velocities during flood and ebb, flood dominance prevails if all tidal flats are high (~MSL +2m) or low (~MSL -2m) in the tidal frame. However, if tidal flats are around MSL, flood-dominance decreases significantly and the tidal asymmetry even becomes locally ebb-dominant. Besides, flood-dominance in the estuary channel peaks in the vicinity of the additional intertidal areas and generally reduces upstream and downstream of these areas.