

Influence of geometry, initial bathymetry and sediment availability on the morphodynamic evolution of the Scheldt mouth area, based on numerical modelling

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We investigate effects of different geometries, initial bathymetries and sediment availability on the morphodynamic evolution of the Scheldt mouth area. Specifically, our investigation started from a simple model, excluding as many processes as possible (such as waves and winds), and schematizing tidal forcing and bathymetry. A comparison of observed characteristics of the flow field throughout the estuary with modeling results illustrates that this approach is sufficient to describe the main dynamics of the flow field.

When considering a real geometry, resemblance between modeled and measured bathymetry is obtained, but also significant differences. The simulated ebb-tidal delta (elongated channels on both the south and north sides of the mouth area, and the shoal area in between these channels) is comparable to present bathymetry. However, the shallow area in between these main channels is characterized by many small-scaled secondary channels, which do not occur in field observations.

Moreover, along the southern bank in the estuary (near Breskens), model results show the formation of an additional channel, which does not occur in observed bathymetry. Results in case of using an idealized funnel-shaped geometry reveal that an ebb-tidal delta develops in the mouth area only in case of a narrow transition between this area and estuary. This result suggests that the present narrow transition between estuary and its mouth area plays a profound role on the present-day bathymetry.

Results regarding different initial bathymetries demonstrate that increasing the initial depth of the mouth area weakens the channelization of the ebb-tidal delta that forms in this area. Moreover, the resulting ebb-tidal delta in this area expands less seaward than those that develop in case of a shallower initial depth. These results highlight the significant influence of depth changes on morphodynamics of the mouth area, thereby pointing out possible importance of sea level rise on the present-day morphology.

When accounting for spatial variations of thickness of erodible sediment layers, results show that simulated channels are less pronounced compared with the case when layer thickness is constant. Moreover, small-scale secondary channels seem to be reduced in the shoal area.

Keywords: morphodynamics; Scheldt estuary; ebb-tidal delta; elongated tidal bars