

Impact of natural and antropogenic changes on hydro- and sediment dynamics in tidal estuaries

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Processes governing the water motion, sediment transport and accumulation of sediments in tidal estuaries are very complex and often interact in a strongly nonlinear way. Alterations in for example external forcing conditions, bathymetry and/or geometry, either by natural causes or antropogenically induced, can result in unforeseen and unwelcome changes in water motion and sediment dynamics.

To assess the influence of these alterations in separation, a so-called exploratory (or idealised) model is used: this type of models focuses on the essential dynamics, relevant for the processes under study. The outcomes of the exploratory model are compared with results obtained by more complex numerical models.

In this presentation, I will discuss the influence of the construction of a weir, channel deepening, the (dis)appearance of

multiple channel systems, and changes in basin geometry (land reclamation and construction of retention basins) on water motion, salinity dynamics and sediment trapping. Using the exploratory model, I will show that the changes can result in totally different estuarine dynamics (tipping point behavior): sediment might be trapped far upstream in the freshwater zone and salinity profiles may suddenly shift far upstream. The mechanisms resulting in these regime shifts will be presented and possible measures to restore the estuary to a more natural state will be discussed. The findings will be illustrated with observations of the Ems, Elbe and Scheldt estuary, typical examples of estuaries where these interventions have been implemented.