Sediment management in the Seascheldt - risk of hyper turbidity

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Recent studies (Winterwerp, 2013ab) have indicated the risk of regime shifts in small, narrow and converging estuaries. Large scale engineering works including deepening, embankments and straightening works have led to tidal amplifications. As a result the sediment (sand and mud) dynamics in the estuary have changed, leading to changes in maintenance dredging volumes. Similar changes in other estuaries have led to increased suspended sediment concentrations and even regime shifts to hyper-turbid conditions.

The Upper-Seascheldt is a navigable (class IV) tidal river in the region of Flanders (Belgium). The connection is identified as a major European bottleneck for inland navigation on the Mediterranean – North Sea corridor. Within the framework of the project "Integrated plan Upper-Seascheldt" commissioned by the Seascheldt division of the Waterwegen & Zeekanaal NV, alternatives to improve navigation (to class Va) are investigated. It is the goal of this integrated study to look for synergy in order to mitigate negative impacts of the proposed measures or even to improve the functioning of the system. This study investigates whether solutions (e.g de-poldering) or strategies can be identified that may reduce the risk of a change towards hyper-turbid conditions.

This paper will illustrate and discuss the relation between observed changes in sediment concentrations, the evolution in maintenance dredging volumes and bathymetric adaptations. By means of a combination of the theoretical framework developed by Winterwerp (2013a) and numerical simulations that are envisaged within this project it will be demonstrated how the proposed alternatives will affect the risk of hyper-turbidity.

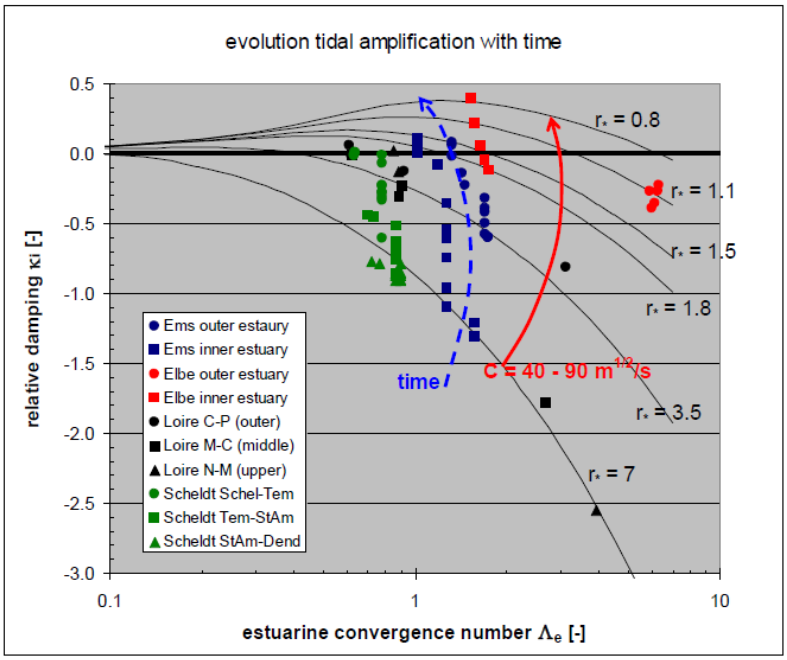

Fig. 1. Comparison of tidal evolution in four European rivers, a shift of position indicates an increased risk on hyper-turbidity (from Winterwerp, 2013b).

In Fig. 1 (taken from Winterwerp, 2013b) the black lines indicate different states (for different values of hydraulic drag) of the estuary in function of the estuarine convergence number and the relative damping, based on the theoretical framework of Winterwerp. The dots represent (historical) states of various European estuaries. For some estuaries the shift over time is indicated towards a state where damping is small (or absent) and the system is insensitive to further changes. The reduced drag indicates a state of strong mud depositions or high near-bed concentrations. The dots are based on field observations and historical bathymetric surveys. By using numerical simulations the application of this graph will be extended to include future states of the Seascheldt Estuary. Based on the outcome of these simulations and (the shift of) position of the dots in the graph the impact of the proposed measures to improve navigation on the risk of regime-changes toward hyper-turbid conditions is estimated.

References

Winterwerp J.C. and Z.-B. Wang. 2013a. Man-induced regime shifts in small estuaries. I. Theory. Ocean Dynamics. DOI 10.1007/s10236-013-0662-9.

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