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Long-term morphodynamic evolution in an embayment using a numerical, process-based approach

M. Van der Wegen (1), **Z.B. Wang** (2,3), H.H.G. Savenije (3) and J.A. Roelvink (1,2)

(1) UNESCO-IHE, the Netherlands (2) Deltares|Delft Hydraulics, the Netherlands (3) Delft University of Technology, the Netherlands

The morphodynamics in estuaries is characterized by a complex interaction between processes of different spatial scales and time scales. In order to gain insight into the characteristics of morphodynamic estuarine evolution, previous research focused on schematized modeling of distinct and (assumed) dominant processes.

The current study aims to investigate the long-term morphodynamic evolution using an integrated, process-based approach.

Use is made of a 2D, numerical model (Delft3D) describing the shallow water equations, the Engelund-Hansen transport formulation, bed slope effects, bank erosion and an advanced morphodynamic update scheme. Calculations were made for 20 km, 80 km and 350 km long basins for a period of about 7000 years. The models were forced by a diurnal tide with an amplitude of 1.75 m. Grid resolution is in the order of 200m so that the model leads to relatively detailed results describing the bed evolution.

Starting from a flat bed, results show that the model evolves towards stable patterns and a state of less morphodynamic activity and less energy dissipation, although, even on this long time scale, equilibrium is not reached. Comparing the model results to empirical relationships (like between the tidal prism and the cross sectional area and the channel volume) shows good results. This suggests that equilibrium in terms of channel cross section is present , despite continuing evolution on the longer term.