Turning the tide: Effects of mud supply on large-scale estuarine morphology

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Project summary

Potentially, sandy river estuaries have great economic and ecologic values, but a better understanding is required about the effect of mud on large-scale morphodynamics to optimise maintenance strategies. Very few studies actually include the effects of mud on morphodynamics on decadal and centennial timescales due to model limitations and lack of spatially and temporally dense data of mud in the bed. Here we aim to isolate the effects of cohesive sediment supply on equilibrium estuary shape, bar-channel patterns and dynamics.

Modelling results



Fig. 1. Final bathymetries of model runs with and without mud supply from river or sea.



Fig. 5. Braiding index, estuary width, area and velocity along estuary for runs with no mud, marine supply, fluvial supply and both.

Method Delft3D numerical modelling (depth-averaged) 7.5 💼 tidal ampli = 0-2 m 2.5 fluvial mud supp -2.5 marine mud -5 | **↑** = 0-100 mg/L -7.5 10 -10

Morphology

- Marine mud confines the estuary mouth and extends the coast
- Fluvial mud is spread through the whole estuary and has a
- stronger confining effect
- Channel width decreases with fluvial mud, but not with marine mud supply
- Estuary length decreases with fluvial mud supply
- Less meandering upstream with fluvial mud supply



Fig. 2. Final mud deposits of model runs with mud supply from river or sea.

Fig. 6. Mud supply plot against braiding index, estuary width and surface area. All model runs represented as one point.

percentages of surface area covered with mud of the total area.

Parth-Kr Q = 0-150 [m3 = 0-100 mg10 ⊆ 15 -20





time [days] Fig. 4. Mud deposit timestack of cross section near the mouth of model runs with mud supply from river or sea.

Fig. 3. Bathymetry timestack of cross section near the mouth of model runs with and without mud supply from river or sea.

Fig. 7. Hypsometric curves for a range of fluvial mud supply. Dotted lines are the cummulative

Future experiments



Conclusions

- Mud supply confines estuaries

- effect by confining the whole estuary.

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Widening with sand, narrowing with mud Less migration of channel with mud supply



Fig. 8. Pilot experiment in small tilting flume with nutshell acting as cohesive

• More area is coverd with mud for higher supply concentrations.

• Marine mud supply narrows the estuary mouth and has limited effect upstream. • Fluvial mud is distributed over the whole estuary and had therefore a stronger

• Less estuarine dynamics are observed with an increase in mud supply.