Cohesive sediment in scale-experiments of estuaries

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Objective

Alluvial river estuaries are typically dominantly build of sand, but are generally flanked by mudflats and tidal marshes. Mud plays an important role in these systems in relation to ecological restoration and harbour maintanance, but is rarely considered in long-term models of these tidal systems. After an extensive study of mud in the numerical model Delft3D, we conducted complementary research in the tidal experimental facility: 'the Metronome'.

The **objective** of this research is to isolate the effects of cohesive sediment on width, elevation, size and dynamics of estuaries.

Method

The flume tilts periodically to simulate tidal flow.

- Period = 40 s
- Maximum slope = 4 mm/m
- River discharge = 0.1 l/s during ebb
- Waves during flood
- Initial sand bed, expotential shape
- Nutshell as mud simulant
- Nutshell supply of 0, 1 and 5 ml/cycle

Mudflat distribution

Examples of mud flat deposits and the spatial distribution of mud in orange. Most of the mud settles on the intertidal areas and a limited amount in the channels. Mud settling at lower ellevations is mostly filling of abandoned channels or temporary deposits.



low mud supply cycle 9355





Width, depth and pattern



Mud storage

Mud is longer preserved at high elevations, even though mud

Mud deposits on intertidal areas and increases the elevation of bars. decreasing **dynamics** -0.5 deposits near high water level increases 10000

Channel dynamics

Time-stacks of cross-sections at 7 m (red line in DEMS) show slower channel migration with mud. Mudflats limit migration.

Conclusions

The effects of cohesive sediment supply on the long-term morphology are:

- Estuaries with mud stay narrower than estuaries without mud
- Sediment export is larger for the run with only sand, leading to a larger estuary
- Mud decreases dynamics in the estuaries
- The effect of mud supply is largest upstream due to a relative larger amount of mud deposits
- Mud increases the elevation of bars and can transform it from intratidal to supratidal areas

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