EFFECTS OF DREDGING AND DUMPING IN LABORATORY SCALE EXPERIMENTS OF ESTUARIES

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Description of research and research question

Shipping fairways are continuously dredged to maintain and increase access of large ships to major ports located in estuaries, for example the port of Antwerp in the Western Scheldt. However, it has been shown in various estuaries worldwide that there are several adverse side effects of these actions including loss of ecologically valuable intertidal area, increased muddiness and turbidity. The Western Scheldt estuary is one such estuary having undergone both channel-enlargement events (capital dredging) and maintenance dredging, which takes place on a continuous basis to maintain a minimum depth required for shipping. Here we study the effect of dredging and dumping in a scale experiment by creating a Scheldt-type estuary to answer the question: what is the effect of dredging and dumping on the morphology of the side channels, shoals and main channel? The results are compared with data from and observations in the Western Scheldt.

Description of the experiment and methodology

A scale experiment was designed using a periodically tilting tidal flume: the Metronome. The periodic tilt mimics reversing tidal flow in tidal periods of 40 seconds on an initially converging channel in a straight sand-bed. For this experiment a shipping fairway was dug with dimensions scaled on measures taken in the Western Scheldt. The dimensions of this channel were maintained during the experiment, with removed material being dumped back into the estuary. Dumping locations were also based on current practices in the Western Scheldt. Results from the experiment are compared with a control experiment without dredging or dumping.

Results, discussion and conclusion

The implications of dredging and dumping were seen on both an estuary-wide scale and for individual morphological features. The overall estuary width decreased due to dredging and dumping. Moreover, the estuary displayed increased stability: for several thousand tidal cycles after the dredging was stopped, the pattern of channels and shoals remained the same and channels were non-migrating (Figure 1). On a smaller scale, dredging and dumping resulted in a main channel that filled in more quickly than in the non-dredged experiment. The main channel and associated side channels all saw increased tidal range in response to dredging and dumping. Shoals became higher and narrower with steeper shoal margins in the dredged experiment, which led to an increase in supratidal area and a corresponding decrease in intertidal area. These findings match with observations in the Western Scheldt, implying that experiments like these can be useful in testing future dredging and dumping strategies.

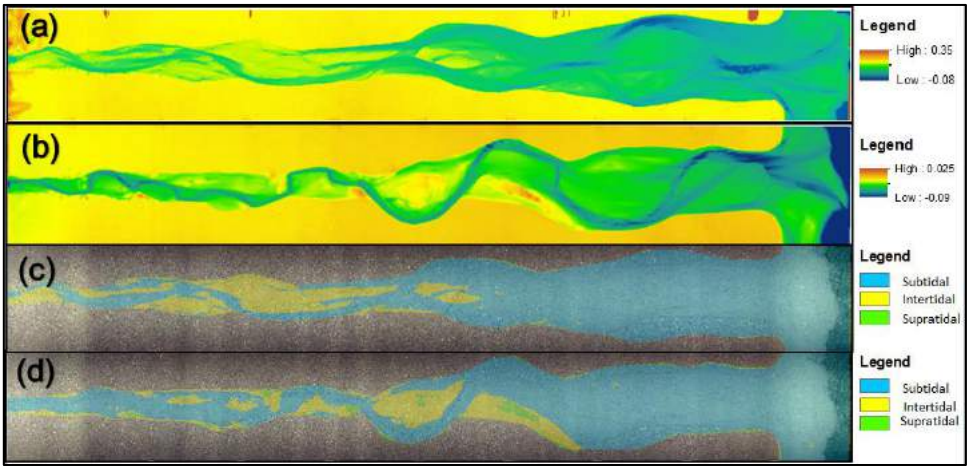

Figure 1. The state of the estuary at tidal cycle 4900 (out of a total of 13,000 cycles). (a) DEM of non-dredged estuary, (b) DEM of dredged estuary (c) Map of subtidal, intertidal and supratidal areas based on water level data for the non-dredged estuary, (d) Map of subtidal, intertidal and supratidal areas based on water level data for the dredged estuary.