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TITLE: Impacts of natural and human drivers on the multi-decadal morphological evolution of tidally-influenced deltas

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ABSTRACT:

The world's deltas are at risk of being drowned due to rising relative sea levels as a result of climate change, decreasing supplies of fluvial sediment, and human responses to these changes. This paper analyses how delta morphology evolves over multi-decadal timescales under environmental change using a process-based model. Model simulations over 102 years are used to explore the influence of three key classes of environmental change, both individually and in combination: (i) varying combinations of fluvial water and sediment discharges; (ii) varying rates of relative sea-level rise; and (iii) selected human interventions within the delta, comprising polder-dykes and cross-dams. The results indicate that tidal asymmetry and rate of sediment supply together affect residual flows and delta morphodynamics (indicated by sub-aerial delta area, rates of progradation and aggradation). When individual drivers of change act in combination, delta building processes such as the distribution of sediment flux, aggradation, and progradation are disrupted by the presence of isolated polder-dykes or cross-dams. This suggests that such interventions, unless undertaken at a very large scale, can lead to unsustainable delta building processes. Our findings can inform management choices in real-world tidally-influenced deltas, while the methodology can provide insights into other dynamic morphological systems.

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