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How does a tidal embayment morphodynamically react on sea level rise?

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Conditions for (assumed) equilibrium in tidal embayments have been studied extensively in the past years with morphodynamic 1D models (Van Dongeren and De Vriend, 1994; Schuttelaars and de Swart, 1996, 2000; Lanzoni and Seminara, 2002) and 2D models (Hibma et al. [2003], Van der Wegen and Roelvink [2008]) Van der Wegen et al 2008).
The current research addresses the impact of sea level rise on tidal embayments. Although effects of sea level rise may only become apparent after decades, the character of the embayment can change considerably. Examples are the (dis)appearance or re-allocation of intertidal flats, increased tidal resonance, shift from sediment export to import, deepening of channel area and other related (ecological) parameters.
The research applies a 2D morphodynamic model (Delft3D) in an idealized environment. The model is based on the 2 D shallow water equations, the Engelund -Hansen transport formula and includes bed slope effects, drying and flooding procedures and an advanced morphodynamic update scheme (Roelvink 2006). The initial condition of the bathymetry is generated by 3000 years of morphodynamic calculations in a 80 km long and 2.5 km wide rectangular tidal embayment under constant M2 tidal forcing conditions (Van der Wegen and Roelvink [2008]). After this period sea level rise gradually developing towards a rate of 0.4 m/century is added to the boundary conditions. Model results describe development towards less intertidal area and a transition from an exporting system to a importing system. Model results are evaluated in terms of M2, M4 and M6 tidal constituents as well as against Vs/Vc (shoal volume over channel volume) versus a/h (amplitude over water depth) relationship as proposed by Friedrichs and Aubrey (1988). Although the model describes morphodynamic development in a strongly idealized environment the results can provide an excellent tool to systematically study the impact of sea level rise in tidal embayments as well as the time scales of dominant underlying resulting transport mechanisms and processes.
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