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Long-term evolution and morphodynamic equilibrium of a tidal channel flanked by tidal flats

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This contribution investigates the long term morphodynamic equilibrium of a movable bed tidal channel flanked by tidal flats. The two dimensional shallow water equations, the bed evolution equation, and the advection-diffusion equation for suspended-load are solved numerically.

As far as the channel evolves, starting from a given straight configuration, with spatially constant depth and width, it turns out to be always ebb dominated near the inlet and flood dominated in the landward part. As a consequence, the net sediment flux within a tidal cycle is directed seaward near the inlet and landward in the remaining part of the channel, leading to sediment scour in the outer part of the channel and deposition in the inner part, where a sediment front propagates landward. The system evolves asymptotically toward an equilibrium configuration characterized by an approximately symmetric suspended-load transport rate during the tidal cycle. Moreover a nearly constant value of the maximum flood/ebb speed along the channel is observed, that implies a important morphologic adjustment toward a constant erosion potential in all the sections of the channel. The width of the channel is found to decrease exponentially toward the land.

The numerical results show that tidal flats are progressively carved by channels, with a spacing varying between 200 and 1000 m. The relationship between inlet cross section of these channels and their watershed is approximately linear.

Keywords: tidal environments, long term evolution, tidal flats.