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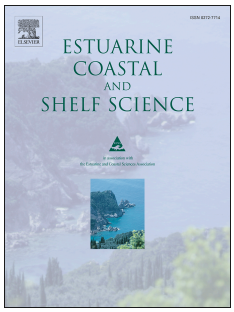

Low-angle dunes in the Changjiang (Yangtze) Estuary: Flow and sediment dynamics under tidal influence

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Highlights:

Low-angle dunes composed of fine sediment were studied;

Flow and sediment dynamics over dunes were measured in the Changjiang Estuary;

Sediment composition attributes to sediment transport mechanism;

Evolution process of low-angle dunes within a tidal cycle was elaborated;

Clockwise hysteresis loops were found between flows and bedform features.

Abstract: It has long been highlighted that important feedbacks exist between river bed morphology, sediment transport and the turbulent flow field and that these feedbacks change in response to forcing mechanisms. However, our current understanding of bedform dynamics is largely based on studies of steady flow environments and cohesionless bed conditions. Few investigations have been made under rapidly changing flows. Here, we examine flow and sediment dynamics over low-angle dunes in unsteady flows in the Changjiang (Yangtze) Estuary, China. Topography, flow and sediment data were collected over a reach *ca* 1.8 km long through a semi-diurnal tidal cycle in a moderate tide of flood season. The results show that: (1) roughness length derived from the upper flow changes little with the flow reversing and displays the same value on both the ebb and flood tide. Moreover, the variability of individual bedform features plays an important role in roughness length variation. (2) Shear stress over the crest of low-angle dunes roughly represents the total spatially averaged stress over dunes in this study area, which has significant implications for advancing numerical models. (3) Changes in morphology, flow and sediment dynamics over dunes through time reveal how low-angle dunes evolve within a tidal cycle. (4) The clockwise hysteresis loops between flow dynamics and bedform features (height and aspect ratio) are also observed. The combination of suspended sediment transport and bedload transport on dune transformation and migration attributes to the clockwise hysteresis. The specific sediment composition of the riverbed, in some extent, affects the mechanism of sediment transport related to the exchange between suspended sediment and riverbed, but further investigation is needed to figure out the mechanism behind this for extended series of tides, such as spring/neap tide and tides in flooding and dry season.