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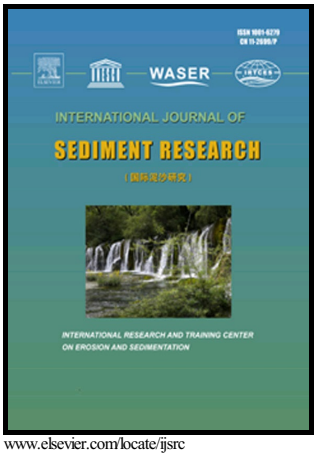

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Flow fields and particle trajectories beneath a tidal bore: A numerical study

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Abstract

Tidal bores may appear in some estuaries when the tides quickly reach a high level. This phenomenon is rare but has a strong impact during its short duration: i.e. the river bed is significantly eroded and sediments are then transported. In this paper, the trajectories of suspended particles induced by this flow are numerically studied. Four undular bores with Froude numbers between 1.1 and 1.2 are studied. Despite similar Froude numbers, various initial flow conditions were selected to produce or not an inversion of the flow direction during the bore passage. The particle trajectories associated with each distinct flow configuration are presented and analyzed. These trajectories, estimated by solving the Maxey-Riley equation, appear to be very different even though the Froude numbers of flows are similar. These observations are important because the Froude number is often used to characterize a tidal bore as it describes well the free surface, however, it cannot describe the sediment transport. Finally, Chen's model of wave-current interactions is adapted to fit the cases studied and is applied to the four bores simulated. The results highlight that this latter model can reproduce the observed trajectories and dissociate their different components. From this model, it is shown that the inertial and Basset history effects can be neglected compared to the gravity and flow entrainment effects due to the viscous drag when one wants to determine the long-term trajectories of suspended particles.

Keywords: Tidal bores, Sediment transport, Trajectories, Physical modeling, Numerical modeling