Numerical modeling of sediment transport applied to coastal morphodynamics

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Quantifying the interaction between sediment transport and water flow is crucial for a wide range of phenomena such as nearshore and river morphodynamic evolution, river management, and river adjustment after the installation of hydraulic structures. A typical example is the morphodynamics of coastal areas, where sediment transport has a leading role in understanding the formation and evolution of beach zone. To progress on quantifying such interactions, it becomes necessary to develop numerical models that accurately simulate the fluid flow over a movable bed. Numerical modeling of free surface flows with load transport over erodible bed in realistic situations involves transient flow and movable flow boundaries. In this work, two-dimensional (2D) bed-load transport simulations based on the depth-averaged non-linear shallow water equations and the Exner equation will be presented. The Exner equation is written assuming that bed-load transport is governed by a power law of the depth-averaged flow velocity and by a flow/sediment interaction parameter acting as a calibration coefficient. In our work, a single system of equations (fully-coupled approach) is numerically solved by a high-resolution finite volume scheme finite volume scheme of the relaxation type. Simulations produced by the proposed numerical model are compared with field data and other standard models.