

Numerical simulation of sediment transport in shallow-water flows

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A numerical approximation for modelling sediment routing in gradually and rapidly varying flows is presented in this study. A coupled approach is adopted to solve the Saint Venant and sediment transport equations that are able to model influence of flow on sediment transport and bed evolution. The effects of both suspended load and bed load are considered in the numerical scheme, as the former plays an important role in bed evolution under rapidly varying flows. A Godunov-type finite volume technique is used to solve the system of coupled equations. The fluxes through cell interfaces which carry the flow information are computed by Harten-Lax-van Leer-Contact (HLLC) approximate Riemann solver method at each time step, which has the ability to capture shocks resulting from discontinuities. A Second-order temporal and spatial accuracy is confirmed by employing Henn's method and high-order reconstruction technique with limited gradient, respectively. The C-property of the model is satisfied by maintaining well-balanced condition between conservative and non-conservative terms to preserve stability of the numerical scheme. The computational domain is discretized by triangular grids which facilitates local grid refinement in case of abrupt bed discontinuities and obstacles in flow path. Lastly, the numerical scheme is applied to some benchmark test cases to evaluate its adaptability and results are compared with previous studies.

Keywords

Sediment-transport; Finite volume method; Approximate Riemann Solver; Bed dynamics; Hydrodynamics.