Numerical modelling of non-equilibrium graded sediment transport in a curved open channel

The computer code FAST3D has been developed to calculate flow and sediment transport in open channels. In the code, the flow field is calculated by solving the full Reynolds-averaged Navier–Stokes equations with k–ε turbulence model; the bed-load transport is simulated with a non-equilibrium model containing an important parameter, the so-called non-equilibrium adaptation length, which characterizes the distance for sediment to adjust from a non-equilibrium state to an equilibrium state; the bed deformation is obtained from an overall mass-balance equation for sediment transport. The governing equations are solved numerically with a finite volume method on an adaptive, non-staggered grid. The former model assumed uniform bed material. In order to take into account the influence of grain-size distribution of the bed-surface on the evolution of the bed topography and consequently also on the flow field, a sediment transport module has been presently developed by the authors at the Institute of Hydraulic and Water Resources Engineering, Technische Universität München, Germany, for fractional sediment transport using a multiple layer model.
This paper presents the numerical results for sediment sorting and the bed deformation in a curved alluvial channel under unsteady-flow conditions according to Yen and Lee (1995). The calculations were compared with data from laboratory measurements. Further, the sensitivity of the simulated results to the non-equilibrium adaptation length is investigated.

Stichworte: Alluvial channel; Graded sediment transport; Numerical model

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