NUMERICAL SIMULATION OF DAM BREAK ON ERODIBLE BED

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Simulation of dam-break induced waves over a mobile bed is an hard test for numerical models for both mathematical and physical modelling reasons. From a mathematical point of view capturing of wave front celerities requires adequate numerical schemes. About the physical aspects it is important to point up that the special features of the phenomenon lead to reject the hypothesis of immediate adaptation of solid transport to hydrodynamics. Experimental investigation has shown that the scouring wave evolves with timescales which are rather close to that of hydrodynamics, and the strong coupling between solid and liquid phase markedly weakens the hypothesis under which common morphodynamical models can be applied. Then non-equilibrium transport models are required.

In the present work available literature data by different Authors are compared against numerical results obtained by a non-equilibrium lagrangian model.

The experiment which will be considered in this paper belong to the series reported in Fraccarollo and Capart (2002) and Leal et al. (2003). All tests are characterized by a dry bed downstream and differ for diameter and weight of the material. Very different behaviours are observed for light and heavy particles and this aspect greatly influences the hydrodynamics.

The one-dimensional morphodynamical model proposed by Iervolino et al. (2004) will be used in this paper to simulate the propagation of a dam break wave over a mobile bed. The model couples a dynamical equation and a bed evolution equation based upon the balance between erosion and deposition, in order to describe the sediment dynamics in unsteady conditions (Iervolino et al. (2004)). The model has been already used in order to simulate rapid transients involving severe erosion and deposition, permitting to achieve significant improvements.

Numerical results appear encouraging. The principal features of phenomenon are well reproduced and the agreement between simulations and data is good for the heavier particles experiments, as can be seen from figure 1, referring to one of the experiments by Leal et al. (2003), in which comparisons are made also with numerical results from the cited Authors. Experiences with extremely light material are characterized by global movement of the bed, that cannot be reproduced by purely hydrodynamical models.

Results permit to affirm that the use of a non-equilibrium model improves reproduction of such kind of phenomena.

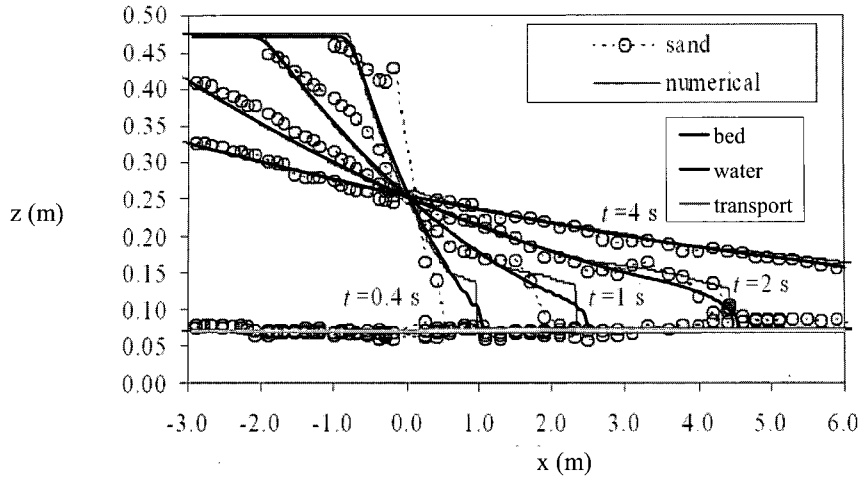

Fig. 1 Comparison between numerical simulations and experiments from Leal et al. (2003) with sand. t = 0.40 s; 1.00 s; 2.00 s; 4.00 s.

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