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Tous Dam-Break flow simulation, using NAMROOD DamBreak coupled 1D-2D model

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Abstract

NAMROOD DamBreak coupled 1D-2D and 2D modelling approaches are, separately, implemented for simulation of Tous dam-break flood and the outcomes are juxtaposed. The Spanish dam's outflow hydrograph is used as upstream boundary condition and HLL as the preferred numerical method, assuming dry bed as initial condition. Both the models operate on basically the same unstructured triangular meshes. Results comparison demonstrates that the 1D-2D model predicts the water depth within the river stream far better than the 2D model, whereas for the flooded city, Sumacárcel- which is laterally flooded- no meaningful difference between these two models is seen.

Keywords: coupled 1D-2D, shock capturing, urban flooding, dam break model

Introduction

Catastrophic events- such as dam break floods- should be predicted, if possible, and simulated with enough accuracy to avoid their substantial costly sequences. Therefore, numerical simulators have been developed by scientists and engineers to satisfy the need. NAMROOD DamBreak is an Iranian model with which various projects, like Maroon, Karoon, Karkheh and Dez dam-break studies (Namin et al. 2008), have been carried out. Herein, the model is implemented for mathematical reproduction of Tous dam-break flow and its downstream inundation.

The Spanish dam, Tous, is the last flood control structure in the Jucar river basin, covering 21000 km^2 of Spain's Mediterranean central part. The rock-fill dam, with almost 122×10^6 m^3 water, burst in October 1982 and produced a great wave which swept its downstream. Field data of the event and full description of Tous dam is provided (Alcrudo et al. 2007). These data include 21 gauging points- where maximum water levels are determined-, topography and initial condition.

NAMROOD DamBreak is a finite volume model that simultaneously solves one and two dimensional equations on an unstructured triangular mesh, with capability of applying numerical methods like Harten Lax vanLeer- HLL- and Roe. In the current work, HLL as an approximate solution of the Riemann problem is used because of its supremacy in catching wet/dry front condition (Harten et al. 1983). The model employs depth-averaged Navier-Stokes equations. It must be born in mind that the equations' validity is undermined if considerable vertical velocity component exists and velocity distribution in depth is not hydrostatic (Toro 2001). The model allocates varied Manning numbers to separate grids