Geophysical Research Abstracts
Vol. 13, EGU2011-8239, 2011
EGU General Assembly 2011

A fully coupled hydrodynamic and breach formation model to simulate floodplain inundation: the case study of the Muson dei Sassi River (Italy).

Daniele Pietro Viero (1), Andrea D'Alpaos (1), Luca Carniello (2), Andrea Defina (2), and Rinaldo Genevois (1)
(1) Department of Geosciences, University of Padova, Italy (daniele.viero@unipd.it), (2) Department IMAGE, University of Padova, Italy.

In this work we present a numerical hydrodynamic model which couples a previously described model solving the two-dimensional shallow water equations modified in order to deal with partially wet and very irregular domains with a conceptual model simulating the process of breach formation and development in fluvial levees. The fully coupled resulting model allows us to simulate flood propagation over unchanneled areas adjacent to the river segment thus providing a quantitative estimate of the consequent inundations of such areas.
The two dimensional depth integrated momentum and continuity equations are modified to take into account the bottom irregularities that strongly affect the hydrodynamics in partially dry areas, as for example, in the first stages of an inundation process. The breach formation module allows one to simulate the formation of failures either by piping or by overtopping of existing levees.
Because in general a river has a limited inner capacity with respect to reservoirs, the fully coupling of the above models makes it possible to account for the highly variable hydraulic conditions, both in space and time, which occur close to the breach. This is deemed to be a necessary feature of this type of models because the evolution of the breach itself, and therefore the extension of the flooded areas, strongly depend on the altered driving hydrodynamic conditions which characterize the flow field both within the channel and over the adjacent areas. The model therefore provides a better description of the process of breach formation compared to classical models which assume static driving hydraulic conditions in proximity of the breach. Moreover, the use of a conceptual model for breach formation, either by piping or by overtopping, reduces the computational effort therefore allowing for the extensive application of the coupled model to actual case studies.
Applications to a case study are presented in which the effects of breach formation across the Muson dei Sassi River (North-eastern Italy) are examined. The results of the numerical simulations, both in terms of urban and rural flooded areas and breach dimensions, compare quite favourably with those actually surveyed during the flood event occurred in 2009.