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Reconstruction and numerical modelling of a flash flood event: Atrani 2010

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The work intends to reproduce the flash-flood event that occurred in Atrani (Amalfi Coast – Southern Italy) on the 9 September 2010. In the days leading up to the event, intense low pressure system affected the North Europe attracting hot humid air masses from the Mediterranean areas and pushing them to the southern regions of Italy. These conditions contributed to the development of strong convective storm systems, Mesoscale Convective Systems (MCS) type. The development of intense convective rain cells, over an extremely confined areas, leaded to a cumulative daily rainfall of 129.2 mm; the maximum precipitation in 1hr was 19.4mm.
The Dragone river is artificially forced to flow underneath the urban estate of Atrani through a culvert until it finally flows out into the sea. In correspondence of the culvert inlet a minor fraction of the water discharge (5.9m3/s), skimming over the channel cover, flowed on the street and invaded the village. The channelized flow generated overpressure involving the breaking of the cover of culvert slab and caused a new discharge inlet (20 m3/s) on the street modifying the downstream flood dynamics. Information acquired, soon after the event, through the local people interviews and the field measurements significantly contributed to the rainfall event reconstruction and to the characterization of the induced effects. In absence of hydrometric data, the support of the amateur videos was of crucial importance for the hydraulic model development and calibration.
A geomorphology based rainfall-runoff model, WFIUH type (Instantaneous Unit Hydrograph Width Function), is implemented to extract the hydrograph of the hydrological event. All analysis are performed with GIS support basing on a Digital Terrain System (DTM) 5x5m. Two parameters have been used to calibrate the model: the average watershed velocity (Vmean = 0.08m/s) and hydrodynamic diffusivity (D=10E-6 m2/s). The model is calibrated basing on the peak discharge assessed value (98.5 m3/s) and the observed hydrological response time (1hr).
The flood hydrograph, thus obtained, constituted the upstream boundary condition for the simulation of the propagation processes in the urban area. The flow propagation has been simulated through 2D FLATModel code. FLATModel is a numerical code for solving the 2D system shallow-water equations; it belongs to the family of explicit Godunov schemes. In this work the code is tested on unstructured mesh. The unstructured mesh is particularly useful for detailed analysis and small scale hydraulic studies; it allows the adapting of digital surface to complex urban real estate improving significantly the resolution of the simulation results. The use of unstructured meshes also entails a significant reduction of the computational burden allowing the thickening of the cell domain where a better resolution is required.
The results of simulations are in good agreement with the field observations, therefore the implemented approach seems suitable for the simulation and prediction of possible future flash flood events in similar context areas.