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The effect of high resolution topography information on complex terrain flash-flood response modeling

Paolo Tarolli (1), Efthymios I. Nikolopoulos (1), Emmanouil Anagnostou (2), Enrique R. Vivoni (3), and Anastasios Papadopoulos (4)

(1) University of Padova, Dept. of Land and Agroforest Environments, Legnaro (PD), Italy (paolo.tarolli@unipd.it), (2) University of Connecticut, Civil and Environmental Engineering, Storrs, CT, USA, (3) School of Earth and Space Exploration and School of Sustainable Engineering and the Built Environment, Arizona State University, Tempe, AZ, USA, (4) Institute of Inland Waters, Hellenic Center for Marine Research, Anavissos, Greece

In recent years new remote sensing technologies, such as airborne and terrestrial laser scanner, have improved the detail and the quality of topographic information extracted over larger areas. As a result, new generation of high resolution ($\sim$1 m) Digital Terrain Models (DTM) are now available offering new opportunities for advancing research in the fields of geomorphology and hydrology. From a geomorphologic point of view, high resolution DTM are used for the analysis of surface morphology, modeling of land-sliding, extraction of channel network structure etc. While from a hydrologic point of view, accurate representation of a) the topography (local slopes and drainage areas) and b) the drainage network (density, flow direction) is essential for successful modeling of the rainfall-runoff response.

This study investigates how significant is the effect of high-resolution topographic data on simulating the hydrologic response during flash flood events. We conduct numerical experiments to examine this issue using a distributed hydrological model at different DTM resolutions that present different drainage densities and hillslope lengths. The analysis is carried out for a range of sub-basins with different areas in order to investigate the scale dependence of the results.

The study area consists of a sub-basin (7 km2) of the Fella catchment located in the Eastern Italian Alps. The case study is a major flash flood that affected the whole Fella basin in August 2003. For the simulations we considered two rainfall forcing that correspond to a) spatially distributed rainfall at 0.5 km resolution and b) spatially uniform basin-averaged rainfall, both derived from radar observations. This allowed us to examine the sensitivity of the results as a function of rainfall forcing.

Within the study area several field surveys were conducted during the past few years including a lidar survey (data acquired just after the major event of 2003). We will show that the spatial resolution of topographic data can significantly affect the modeling of rainfall-runoff response, and that there is a dependence on drainage density, hillslope length and basin scale. These conclusions highlight the opportunities, but also the challenges for the hydrologic community when considering landscapes at different spatial scale resolution, and so, for planning the real time analysis of flash floods events.