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Integration of rainfall/runoff and geomorphological analyses flood hazard in small catchments: case studies from the southern Apennines (Italy)

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We present the first results of an analysis of flood hazard in ungauged mountain catchments that are associated with intensely urbanized alluvial fans. Assessment of hydrological hazard has been based on the integration of rainfall/runoff modelling of drainage basins with geomorphological analysis and mapping.
Some small and steep, ungauged mountain catchments located in various areas of the southern Apennines, in southern Italy, have been chosen as test sites. In the last centuries, the selected basins have been subject to heavy and intense precipitation events, which have caused flash floods with serious damages in the correlated alluvial fan areas. Available spatial information (regional technical maps, DEMs, land use maps, geological/lithological maps, orthophotos) and an automated GIS-based procedure (ArcGis tools and ArcHydro tools) have been used to extract morphological, hydrological and hydraulic parameters. Such parameters have been used to run the HEC (Hydrologic Engineering Center of the US Army Corps of Engineers) software (GeoHMS, GeoRAS, HMS and RAS) based on rainfall-runoff models, which have allowed the hydrological and hydraulic simulations. As the floods occurred in the studied catchments have been debris flows dominated, the solid load simulation has been also performed. In order to validate the simulations, we have compared results of the modelling with the effects produced by past floods. Such effects have been quantified through estimations of both the sediment volumes within each catchment that have the potential to be mobilised (pre-event) during a sediment transfer event, and the volume of sediments delivered by the debris flows at basins' outlets (post-event). The post-event sediment volume has been quantified through post-event surveys and Lidar data. Evaluation of the pre-event sediment volumes in single catchments has been based on mapping of sediment storages that may constitute source zones of bed load transport and debris flows. For such an approach has been used a methodology that consists of the application of a process-based geomorphological mapping, based on data derived from GIS analysis using high-resolution DEMs, field measurements and aerial photograph interpretations.
Our integrated approach, which allows quantification of the flow rate and a semi-quantitative assessment of sediment that can be mobilized during hydro-meteorological events, is applied for the first time to torrential catchmenmts of the southern Apennines and may significantly contribute to previsional studies aimed at risk mitigation in the study region.