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A probabilistic approach of the Flash Flood Early Warning System (FF-EWS) in Catalonia based on radar ensemble generation

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Early Warning Systems (EWS) are commonly identified as the most efficient tools in order to improve the preparedness and risk management against heavy rains and Flash Floods (FF) with the objective of reducing economical losses and human casualties. In particular, flash floods affecting torrential Mediterranean catchments are a key element to be incorporated within operational EWSs. The characteristic high spatial and temporal variability of the storms requires high-resolution data and methods to monitor/forecast the evolution of rainfall and its hydrological impact in small and medium torrential basins.

A first version of an operational FF-EWS has been implemented in Catalonia (NE Spain) under the name of EHIMI system (Integrated Tool for Hydrometeorological Forecasting) with the support of the Catalan Water Agency (ACA) and the Meteorological Service of Catalonia (SMC). Flash flood warnings are issued based on radar-rainfall estimates. Rainfall estimation is performed on radar observations with high spatial and temporal resolution (1km2 and 10 minutes) in order to adapt the warning scale to the 1-km grid of the EWS.

The method is based on comparing observed accumulated rainfall against rainfall thresholds provided by the regional Intensity-Duration-Frequency (IDF) curves. The so-called “aggregated rainfall warning” at every river cell is obtained as the spatially averaged rainfall over its associated upstream draining area. Regarding the time aggregation of rainfall, the critical duration is thought to be an accumulation period similar to the concentration time of each cachtment. The warning is issued once the forecasted rainfall accumulation exceeds the rainfall thresholds mentioned above, which are associated to certain probability of occurrence. Finally, the hazard warning is provided and shown to the decision-maker in terms of exceeded return periods at every river cell covering the whole area of Catalonia.

The objective of the present work includes the probabilistic component to the FF-EWS. As a first step, we have incorporated the uncertainty in rainfall estimates and forecasts based on an ensemble of equiprobable rainfall scenarios. The presented study has focused on a number of rainfall events and the performance of the FF-EWS evaluated in terms of its ability to produce probabilistic hazard warnings for decision-making support.