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Towards a flash flood early warning system through hydrological simulation of probabilistic ensemble forecasts

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In this work we test a flash flood early warning system based on state-of-the-art probabilistic weather forecasting input data. We make use of the Limited area Ensemble Prediction System (LEPS) provided by the Consortium for Small scale Modeling (COSMO). COSMO-LEPS ensembles are fed into a distributed hydrological model, to obtain discharge estimates. Likewise, discharge climatology is created from a continuous meteorological dataset based on 30-year COSMO-LEPS hindcasts, and used as reference to detect threshold exceedance in the operational ensemble hydrographs. Coherent reference climatology is particularly useful for flash flood events, as they often take place in small watersheds, where no gauge measurements are available. The concept of persistence of meteorological forecasts is also tested as a method to improve the detection of severe events.

Starting from the operational 5-km simulation at the European scale, when a signal for possible flash flooding is detected a regional catchment-scale simulation is activated on a finer spatial scale (1 km grid). Two targeted analyses are carried out to investigate: a) an automatic rule to activate the fine-scale analysis, and b) the influence of initial conditions on the estimated hydrographs, and in turn on threshold exceedances. The Gardon d'Anduze catchment, in the south of France, is chosen as a case study. A number of simulations are performed and results are analyzed and discussed.

Our findings show that flash floods can sometimes be detected with a considerable lead time, especially if compared to the response time of the catchments where these phenomena take place. However, the amount of uncertainty related to the forecast is considerable, therefore the choice of appropriate thresholds for flash flood detection is of crucial importance and should account for the maximum acceptable number of either false alarms and undetected events.