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Abstract

Potentiality of hydro-meteorological ensemble forecasting of flash floods for risk assessment: Application to the Agly catchment (Eastern Pyrenees)

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The Western Mediterranean region is prone to heavy precipitations resulting in devastating flash floods. In order to improve the predictability of this kind of events and to increase the forecasting lead time, accurate predictions of small-scale convective systems are needed. But quantitative precipitation forecasts (QPFs) are arduous due to the uncertainties arising from both the physical parameterizations of numerical weather prediction models and the representation of the atmospheric states. These uncertainties can result in deficient QPFs for hydrological forecasting purposes, especially over small-to-medium sized basins.
Nowadays, short-range ensemble prediction systems (EPSs) provide the state-of-art framework to generate quantitative discharge forecasts (QDFs) and to cope with the different sources of external-scale uncertainties. We examine the performance of two distinct hydrological EPSs (HEPSs), specially designed to explicitly cope with uncertainties in the initial and lateral boundary conditions of the meteorological state (IC/LBCs), and model physical parameterizations (MPS). Deterministic and probabilistic 48 h atmospheric forecasts have been generated using the Weather Research and Forecasting (WRF) model.
This study focuses on a catchment of the Eastern Pyrenees, the Agly catchment, as a test case for implementing the ensemble hydro-meteorological predictions. With a drainage area of 1050 km², the Agly is the second coastal river of the Eastern Pyrenees. It originates from an elevation of approximately 700 m and drains the Pyrenees foothills. It flows into the Mediterranean Sea at Barcarès with a length of around 80 km. A dam dedicated to flood and water management controls approximately 400 km² of the catchment.
The MARINE distributed model, flash-flood dedicated and process-oriented, has been chosen for this study. This model has been extensively tested on a large panel of hydrologic behaviors around the French Mediterranean area. WRF-driven QPFs have been used to feed the MARINE hydrological model for the medium-size Agly river basin as a support tool for early warning and mitigation strategies. We also explore the uncertainty transference from the atmospheric context down to the hydrological system. Results highlight the benefits of accounting for uncertainties in QPFs and the value of the proposed set-up for the short-range forecasting of floods. Combination of both ensembles (hydrological and meteorological) helps limiting a possible inadequacy of calibrated set of parameters on one hand and takes into account meteorological and parametric uncertainties on the other hand.

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