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Flood forecasting using analogue-based rainfall prediction ensembles

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An ensemble of hourly quantitative precipitation forecasts (QPFs) provided by an analogue-based method constitutes a number of different input for the distributed rainfall-runoff model TOPKAPI tested on the Reno river basin, in Northern Italy. The ensemble of possible future flows so generated allows to convey a quantification of uncertainty about the discharge forecast. The Probabilistic Quantitative Precipitation Forecasts are obtained selecting past situations (analogues) similar to the day at hand in terms of synoptic circulation pattern defined by the combination of geopotential at 500 hPa and vertical velocity at 700 hPa. A fifty members subset of such analogues is singled out from an eleven-years long archive collecting ECMWF analyses and the relative rainfall measurements, recorded for the next 72 hours by the raingauges spread over the catchment of interest, are treated as the precipitation forecast. These fifty rain time-series represent a probabilistic input for the hydrological model, thus generating an ensemble of discharge forecasts. This probabilistic information on future flows is considered complementary, and not alternative, with the deterministic one coming from the TOPKAPI model fed with precipitation forecasts provided by LAMBO, a Limited Area Model. Indeed it is proposed a joined employment of these two different estimates applying a Kalman filtering approach which optimally combines, in a Bayesian sense, each member of the a priori discharge forecast ensemble with the discharge forecast based on LAMBO. The new a posteriori ensemble of discharge forecasts so obtained enables to improve the operational flood prediction and to reduce its uncertainty.