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# Investigating the interactions between data assimilation and post-processing in hydrological ensemble forecasting

François Bourgin, Maria-Helena Ramos, Guillaume Thirel, and Vazken Andreassian
Irstea, Hydrology Research Group, Antony, France (maria-helena.ramos@irstea.fr)

Statistical post-processing and data assimilation (also called real-time model updating in the engineering community), although generally dealt with separately, can be intrinsically related in the hydrological forecasting framework. Both represent techniques that may be used in a forecasting system to improve the quality of the forecasts (i.e. to provide more accurate and reliable forecasts) and to, ultimately, enhance the usefulness of the forecasts in decision-making. In this study, we investigate how data assimilation and post-processing contribute, either separately or together, to the skill of a hydrological ensemble forecasting system. Based on a set of 202 unregulated catchments spread over France, we compare four forecasting options: without data assimilation and post-processing, without data assimilation but with post-processing, with data assimilation but without post-processing, and with both data assimilation and post-processing. A short-range meteorological ensemble prediction system, the Météo-France PEARP EPS, and the GRP hydrological model, a continuous, lumped storage-type model specifically designed for flood forecasting, were used to produce hourly hydrological ensemble forecasts. The data assimilation procedure used exploits the last available observed discharge to directly update the routing store state of the hydrological model, and the last relative error to correct the model output with a multiplicative coefficient. For post-processing, we used a hydrological uncertainty processor (HUP) that assesses model simulation uncertainties and compute empirical uncertainty bounds to flow simulations. Results indicate that both strategies have complementary effects. Data assimilation has mainly a very positive effect on forecast accuracy. Its impact however decreases with increasing lead time. Post-processing, by accounting specifically for hydrological uncertainty, has a very positive and longer lasting effect on forecast reliability. As a consequence, the use of both techniques is recommended in hydrological ensemble forecasting.

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