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Tracking the role of streamflow uncertainty in hydrological ensemble predictions

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The quantification of uncertainties in hydrological predictions is a key step in improving the reliability and usefulness of flood forecasts. In this study, we investigate the impact of uncertainty from streamflow data used in flood forecasting models for real-time updating of hydrological ensemble predictions. The GRP hydrological forecasting model, a lumped rainfall-runoff model, is used over a selected number of catchments in France, for which gaugings and rating curves are available.
Rating curve uncertainty is estimated for each catchment using a Bayesian approach. In the first step, the uncertainty in individual gaugings is quantified. It depends on the gauging method (e.g. velocity-area method, tracer dilution, ADCP, surface velocity measurements, etc.) and the operational characteristics of the gauging (e.g. spatial sampling of velocity and depth throughout the cross-section, unsteadiness of the flow, etc.). These uncertain gaugings are then used to estimate the rating curve and related uncertainties, using hydraulics-based priors on the rating curve coefficients.
In the second step, the GRP model is used to produce streamflow forecast series. The model uses the last observed discharge and its related uncertainty to update the state of the routing reservoir at the time of forecasting. Errors in streamflow data are considered jointly with errors in precipitation forecasts. For the latter, the hydrological model is driven by the 10-day ECMWF deterministic and ensemble (51 members) precipitation forecasts for a period of about 3.5 years (March 2005 to September 2008). Ensemble streamflow predictions are evaluated against observed discharges (and judged in terms of bias, reliability, spread, ability to detect exceedances of critical discharges or water levels in advance, etc.) and as a function of forecast lead-time and warning thresholds. The results obtained by enabling/disabling the treatment of streamflow uncertainty are then compared and discussed, contributing to a better understanding of the role of streamflow errors in the total predictive uncertainty.