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Comparison of two uncertainty dressing methods: SAD VS DAD

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Hydrological Ensemble Prediction Systems (HEPSs) allow a better representation of meteorological and hydrological forecast uncertainties and improve human expertise of hydrological forecasts. An operational HEPS has been developed at EDF (French Producer of Electricity) since 2008 and is being used since 2010 on a hundred of watersheds in France. Depending on the hydro-meteorological situation, streamflow forecasts could be issued on a daily basis and are used to help dam management operations during floods or dam works within the river. A part of this HEPS is characterized by a streamflow ensemble post-processing, where a large human expertise is solicited. The aim of post-processing methods is to achieve better overall performances, by dressing hydrological ensemble forecasts with hydrological model uncertainties.

The present study compares two post-processing methods, which are based on a logarithmic representation of the residuals distribution of the Rainfall-Runoff (RR) model, based on "perfect" forcing forecasts - i.e. forecasts with observed meteorological variables as inputs. The only difference between the two post-processing methods lies in the sampling of the perfect forcing forecasts for the estimation of the residuals statistics:

(i) a first method, referred here as Statistical Analogy Dressing (SAD) model and used for operational HEPS, estimates beforehand the statistics of the residuals by streamflow sub-samples of quantile class and lead-time, since RR model residuals are not homoscedastic.

(ii) an alternative method, referred as Dynamical Analogy Dressing (DAD) model, estimates the statistics of the residuals using the N most similar perfect forcing forecasts. The selection of this N forecasts is based on streamflow range and variation.

On a set of 20 watersheds used for operational forecasts, both models were evaluated with perfect forcing forecasts and with ensemble forecasts. Results show that both approaches ensure a good post-processing of hydrological ensemble, allowing a noticeable improvement of reliability and performance of ensemble forecasts. The inter-comparison of the two dressing models shows that the SAD model approach does not sufficiently take the hydrological dynamic of the watershed and processes into consideration, i.e. sample heterogeneity. For a same streamflow range corresponds different processes such as rising limbs or recessions, where uncertainties differ, both in terms of bias, magnitude and variability. When compared in details, the dynamical approach reduces the confidence intervals during recessions where uncertainty is relatively lower and slightly increases the confidence intervals during rising limbs or snowmelt periods where uncertainty is greater. SAD and DAD post-processing approaches meets forecasters experiences in terms of representation of hydro-meteorological forecast uncertainties. Hence, we believe that DAD approach allows to improve forecasters analyses and communication of uncertainties to end-users, since DAD concepts better tracks the source of uncertainties.