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Robust inference methods for post-processing multiple lead-time precipitation forecasts

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Generating ensemble streamflow forecasts requires ensemble forecasts of catchment precipitation that are unbiased, coherent and statistically reliable for individual locations and lead times, and for accumulations in space and time. Raw forecasts produced by numerical weather prediction (NWP) models rarely display these characteristics and therefore require post-processing. Establishing post-processing methods requires an archive of historical forecasts and concurrent observations. As NWP models are evolving rapidly and are computationally expensive to run, archives of historical forecasts are often short (e.g. <24 months).

In this presentation we describe methods to improve the robustness of post-processing precipitation forecasts when short archives of NWP forecasts are available. We apply a Bayesian rainfall forecast post-processing (RPP) approach (Robertson et al., 2013) to forecasts of 3-hour catchment precipitation for lead times of up to 10 days from the global version of the ACCESS NWP model. The RPP applies a simplified form of the Bayesian joint probability (BJP) modelling approach to reduce bias and quantify forecast uncertainty at each location and lead time, and uses the Schaake Shuffle to produce ensemble forecasts that have appropriate spatial and temporal structures.

We show that BJP model parameters are strongly related to either lead time or time of day, and identify simple statistical methods to describe these relationships. The RPP parameter inference is reformulated to make use of these statistical relationships and reduce the overall number of parameters requiring estimation. The reformulation recognizes that the marginal distributions of NWP forecast and observed precipitation vary diurnally. The reformulation also takes advantage of the consistent decline in the correlation between NWP forecast and observed precipitation to make parameter inference more robust.

Post-processed forecasts are generated with the RPP using both the original and reformulated parameter inference strategies. When long archives of NWP forecasts are available, the two inference strategies generate post-processed forecasts that have similar performance characteristics. However, forecasts generated using the reformulated inference strategy are found to be more stable across lead times and less sensitive to the length of record used for parameter inference.

Robertson, D. E., Pokhrel, P., and Wang, Q. J.: Improving statistical forecasts of seasonal streamflows using hydrological model output, Hydrol. Earth Syst. Sci., 17, 579-593, 2013.