Post-Processing Hydrologic Ensemble Forecasts to fix Bias and Spread Problems

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Hydrologic ensemble forecasts tend to underestimate ensemble spread and are affected by systematic hydrologic model biases. A major cause of spread underestimation, especially in short range forecasts, is caused by neglecting uncertainty in initial conditions and neglecting uncertainty in model predictability. Short term forecast errors also may partly be caused by not adjusting model variables to account for recent differences between observed and modeled streamflow. Some of these effects may possibly be reduced by explicitly considering some of their causes as part of the hydrologic ensemble modeling process. But some form of post-processing will likely remain an essential step to produce reliable, unbiased hydrologic forecasts.

The variability of streamflow and the uncertainty associated with hydrologic model predictions is temporally scale dependent and likely depends on the state of the hydrologic system being modeled as well, especially for short lead-time predictions. In theory, at least, if the input ensemble forcing (e.g. precipitation and temperature) is unbiased and probabilistically reliable, then the major cause of bias and spread problems may possibly be inferred by analysis of model simulations of past events. Accordingly, a procedure based on the total probability law and that assumes unbiased, reliable input forcing has been developed to adjust "raw" probability forecasts derived directly from hydrologic ensemble members to produce unbiased, reliable probability distributions of these events. These adjustments include adjusted values for the values given by the raw ensemble members. The adjustments consider the time-scale dependent variability and uncertainty in the observed and modeled streamflow values.

The approach is being integrated into the NWS Water Supply Web Server and a pilot study is underway to test the possibility of its use in adjusting the raw ensemble time series. Example experimental results will be presented together with a summary of some of the science issues that need more study.