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Short-term ensemble streamflow forecasting using operationally-produced single-valued streamflow forecasts

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We present a statistical procedure that generates short-term streamflow ensemble forecasts from single-valued, or deterministic, forecasts operationally produced by the National Weather Service (NWS) River Forecast Centers (RFC). The resulting ensemble forecast provides an estimate of the uncertainty in the single-valued forecast to aid risk-based decision making by the emergency managers and by the users of the forecast products and services. The single-valued forecasts are produced at a 6-hr time step for 5 days into the future, and reflect single-valued short-term quantitative precipitation and temperature forecasts (QPF, QTF) and various run-time modifications (MOD), or manual data assimilation, by human forecasters to reduce various sources of error in the end-to-end forecast process. The proposed procedure generates 5 day-ahead ensemble traces of streamflow from a very parsimonious approximation of the conditional multivariate probability distribution of future streamflow given the single-valued streamflow forecasts, QPF and recent streamflow observations. For parameter estimation and evaluation, we used a 10-year archive of the single-valued river stage forecasts for six forecast points in Oklahoma produced operationally by the Arkansas-Red River Basin River Forecast Center (ABRFC). To evaluate the procedure, we carried out dependent and leave-one-year-out cross validation. The resulting ensemble hindcasts are then verified using the Ensemble Verification System (EVS) developed at the NWS Office of Hydrologic Development (OHD).