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Development and demonstration of real-time approaches for ensemble streamflow prediction at regional to national scales to support water management

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The hydrological forecasting enterprise is currently expanding beyond traditional local-to-regional scale systems to include continental and even global prediction systems. Many if not most traditional operational streamflow prediction systems rely on a forecaster-in-the-loop approaches that require the hands-on-effort of an experienced human forecaster to generate high-quality forecast products. The success and usability of the new, larger-domain, 'over-the-loop' systems will depend critically on their ability to leverage automated methods to emulate this human expertise, including parameter optimization, data assimilation, statistical post-processing, weather and climate forecast downscaling, verification, and uncertainty estimation through the use of ensembles.

We describe efforts to develop and demonstrate operationally-viable ensemble-based methods, modeling and system workflows to achieve real-time medium-range to seasonal ensemble-flow predictions for the western US and ultimately the entire continental US. The experimental system relies fully on ensemble techniques, including: an ensemble of meteorological model forcings and a particle filter data assimilation for initializing watershed states; analog/regression-based downscaling of ensemble weather forecasts from the NCEP GEFS; and statistical post-processing of ensemble forecast outputs, all of which run in real-time within a workflow managed by ECWMF's ecFlow libraries. We describe system elements, which currently include the SUMMA hydrological modeling framework implemented on intermediate-scale hydrologic watershed units, and coupled to the mizuRoute channel routing model for the fine-scale NHDPlusv2 stream network. We present early hindcast results and discuss nascent adaptations of the forecasting philosophy to an experimental application using WRF-Hydro in support of US National Water Model forecasting efforts.