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Hydrologic Uncertainty Processor for Ensemble Forecasting

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Bayesian theory of probabilistic forecasting via deterministic hydrologic model provides a mathematical structure for decomposition of the total uncertainty about a predictand (e.g., a river stage process) into two sources: (i) input uncertainty (e.g., precipitation uncertainty) and (ii) hydrologic uncertainty — the aggregate of all uncertainties other than the input uncertainty. In ensemble forecasting, input uncertainty is quantified in real time by an ensemble of realizations of the input time series, whereas the hydrologic uncertainty is quantified off-line in a Hydrologic Uncertainty Processor (HUP).

A Bayesian formulation of the HUP for ensemble forecasting is presented. The presentation explains (i) the sources of hydrologic uncertainty that should be considered, (ii) the design of a simulation experiment that generates the sample for estimation, (iii) the equations of the Bayesian meta-Gaussian model, (iv) the estimation of parameters, (v) the identification of the likelihood and prior dependence structures, (vi) the family of posterior joint distribution functions of the actual river stage process, and (vii) the implementation of the HUP as a Monte Carlo generator within the ensemble Bayesian forecasting system.