

**STATE UPDATING OF DISTRIBUTED HYDROLOGIC MODELS VIA
VARIATIONAL DATA ASSIMILATION FOR REAL-TIME ANALYSIS AND
PREDICTION OF STREAMFLOW**

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Abstract

Distributed models have been gaining wider acceptance and use in operational hydrologic forecasting at the NWS River Forecast Centers (RFC) for flood forecasting and water resources applications. Like lumped models, distributed models are subject to various sources of error and, to keep the model states in line with the actual state of the system inferable from the observations, some form of state updating is necessary. Due to the high dimensionality and scale-dependent nonlinear dynamics involved, however, state updating of distributed models poses more challenges than that of lumped models. To address these challenges, the National Weather Service (NWS) Office of Hydrologic Development (OHD) has developed a prototype state updating technique for the NWS Hydrology Laboratory's Research Distributed Hydrologic Model (HL-RDHM). This technique utilizes 4-dimensional variational assimilation (4DVAR) to update the states of the Sacramento Soil Moisture Accounting (SAC-SMA) and kinematic-wave routing models of HL-RDHM by assimilating streamflow, precipitation, potential evaporation and, if available, in-situ soil moisture data. To evaluate the performance of the prototype data assimilator (DA) for analysis and prediction of streamflow, we designed and carried out real-world experiments for selected basins in Oklahoma and Texas with stream gauges at interior locations in addition to the outlet. In emulation of the reality where the outlet flow is most likely the only available streamflow observation for most headwater basins, we used only the outlet flow data for state updating and used the interior flow data for verification. In addition, to evaluate the sensitivity of DA-adjusted streamflow to the dimensionality of the assimilation problem formulated, we designed and carried out experiments where the initial soil moisture states and antecedent precipitation are adjusted at different spatio-temporal scales. In this talk, we present the results and identify issues and challenges.