Gaussian noise addition approaches for ensemble optimal interpolation implementation in a distributed hydrological model

Manoj Khaniya[1], Yasuto Tachikawa[1], KodaiYamamoto[2], TakahiroSayama[2] andSunminKim[1]*

[1]Graduate School of Engineering, Kyoto University, Kyoto, Japan
[2]Disaster Prevention Research Institute, Kyoto University, Kyoto, Japan
**Corresponding Author: khaniya.manoj.73c@st.kyoto-u.ac.jp*

Abstract

The ensemble optimal interpolation (EnOI) scheme is a sub-optimal alternative to the ensemble Kalman filter (EnKF) with a reduced computational demand making it potentially more suitable for operational applications. Since only one model is integrated forward instead of an ensemble of model realizations, online estimation of the background error covariance matrix is not possible in the EnOI scheme. In this study, we investigate two Gaussian noise based ensemble generation strategies to produce dynamic covariance matrices for assimilation of water level observations into a distributed hydrological model. In the first approach, spatially correlated noise, sampled from a normal distribution with a fixed fractional error parameter (which controls its standard deviation), is added to the model forecast state vector to prepare the ensembles. In the second method, we use an adaptive error estimation technique based on the innovation diagnostics to estimate this error parameter within the assimilation framework. The results from a real and a set of synthetic experiments indicate that the EnOI scheme can provide better results when an optimal EnKF is not identified, but performs worse than the ensemble filter when the true error characteristics are known. Furthermore, while the adaptive approach is able to reduce the sensitivity to the fractional error parameter affecting the first (non-adaptive) approach, results are usually worse at ungauged locations with the former.