Floods: From Risk to Opportunity (IAHS Publ. 357, 2013), 341-349

Sequential data assimilation for streamflow forecasting using a distributed hydrologic model: particle filtering and ensemble Kalman filtering

SEONG JIN NOH[1, 2], YASUTO TACHIKAWA[3], MICHIHARU SHIIBA[3] & SUNMIN KIM[3]

1 Dept. of Urban and Env. Eng., Kyoto University, Kyoto 615-8540, Japan
seongjin.noh@gmail.com

2 Water Resources & Environment Research Department, Korea Institute of Construction Technology, 2311 Daewha-Dong, Ilsan-Gu, Goyang-Si, Gyeonggi-Do 411-712, Korea

3 Dept. of Civil and Earth Resources Engineering, Kyoto University, Kyoto 615-8540, Japan

Abstract Accurate streamflow predictions are crucial for mitigating flood damage and addressing operational flood scenarios. In recent years, sequential data assimilation methods have drawn attention due to their potential to handle explicitly the various sources of uncertainty in hydrologic models. In this study, we implement two ensemble-based sequential data assimilation methods for streamflow forecasting via the particle filters and the ensemble Kalman filter (EnKF). Among variations of filters, the ensemble square root filter (EnSRF) and the lagged regularized particle filter (LRPF) are implemented for a distributed hydrologic model. Two methods are applied for short-term flood forecasting in a small-sized catchment located in Japan (<1000 km^2). Soil moisture contents are perturbed by process noises and model ensembles are updated by streamflow observation at the outlet. In the case of the LRPF, state updating is performed through a lag-time window to take into account the different response times of hydrologic processes. For different flood events and various forecast lead times, LRPF forecasts outperform EnSRF forecasts and deterministic cases. The EnSRF shows limited performance in both forecasting accuracy and probabilistic intervals, which require introduction of a lag-time window in the filtering processes.

Key words sequential data assimilation; flood forecasting; particle filter; ensemble Kalman filter; distributed hydrologic model