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Performance assessment of sequential data assimilation methods on streamflow forecasting using a distributed hydrologic model

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Flood disaster is the main cause of losses from natural hazards in the world and is responsible for a greater number of damaging events than any other type of natural disaster. Effective early-warning system is needed where floods regularly claim victims and rob people of their livelihoods. However, due to uncertainty of simulation model and observation, it is very hard to get accurate flood forecasting results for required lead time. Therefore, the applications of assimilation techniques have been increasing to estimate and reduce uncertainty in the predictions by updating state variables according to observation sequentially.

In this study, performance of sequential data assimilation methods such as the ensemble Kalman filters (EnKF) and the particle filters (PF) is assessed for short-term streamflow forecasting with a distributed hydrologic model. For both the EnKF and the PF, sequential data assimilation is performed within a lag time window to take into account of lag and response times among internal hydrologic processes in a hydrologic model.

Proposed methods are applied for several catchments in Japan and Korea to assess their performance. Model ensembles, perturbed by noises of states and parameters, are assimilated by streamflow observation. Improvement of forecasting accuracy is found in both the EnKF and the PF when sufficient lag times are provided. The EnKF is sensitive to lag times and shows limited forecasts in short lead times, while the PF shows more stable forecasts for overall lead times. Filtering in a lag time window also presents improved performance with a limited number of ensembles.