State updating of a distributed hydrological model with Ensemble Kalman Filtering: Effects of updating frequency and observation network density on forecast accuracy

Rakovec, O. (1), Weerts, A. (2), Hazenberg, P. (1), Torfs, P. J. J. F.(1), Uijlenhoet, R. (1)

(1) Hydrology and Quantitative Water Management Group, Wageningen University, Wageningen, The Netherlands, olda.rakovec@wur.nl,
(2) Deltares, P.O. Box 177, 2600MH Delft, The Netherlands,

This paper presents a study on optimal setup for discharge assimilation within a spatially distributed hydrological model (Rakovec et al., 2012a). The well-known ensemble Kalman filter (EnKF) is employed to update the grid-based distributed states of the hourly HBV-96 model. Synthetic and real world experiments are carried out for the Upper Ourthe (1 600 km2), a quickly responding catchment in the Belgian Ardennes. The uncertain precipitation model forcings were obtained using a time-dependent multivariate spatial conditional simulation method (Rakovec et al., 2012b), which is further made conditional on preceding simulations.

We assess the impact on the forecasted discharge of (1) various sets of the spatially distributed discharge gauges and (2) the filtering frequency. The results show that the hydrological forecast at the catchment outlet is improved by assimilating interior gauges. This augmentation of the observation vector improves the forecast more than increasing the updating frequency. In terms of the model states, the EnKF scheme is mainly changing the pdf's of the two routing model storages during situations when the uncertainty in the discharge simulation is larger than the defined observation uncertainty. This also holds for situations, where the uncertainty in the discharge simulations is smaller than the defined observation uncertainty.

Rakovec, O., Weerts, A. H., Hazenberg, P., Torfs, P. J. J. F., and Uijlenhoet, R.: State updating of a distributed hydrological model with Ensemble Kalman Filtering: effects of updating frequency and observation network density on forecast accuracy, Hydrol. Earth Syst. Sci. Discuss., 9, 3961-3999, doi:10.5194/hessd-9-3961-2012, 2012a.

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