The ensemble Kalman inversion and its application into estimating parameters of a distributed rainfall-runoff model

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In data assimilation, the ensemble Kalman filter (EnKF) is a technique that based on sampling in estimating any system states given observations. Thus, uncertainties of the system state are represented by an ensemble of points which is propagated through time by a model and adjusted whenever observations are available. Compared with the variational methods, EnKF has two advantages: (1) the computation of EnKF is inherently parallel, and (2) the tangent linear model and its adjoint are not needed.

If we run a data assimilation scheme many times for the same observations, the system state would tend to overfit the observations. This simple fact shows that we can turn any data assimilation method to an optimization method. Now it becomes clear that for nonlinear optimization problems which have complicated nonlinear operators as complex models, EnKF suggests a viable derivative-free optimization method since we do not need to compute the derivatives of such nonlinear operators. The EnKF when applied in such problems is called the ensemble Kalman inversion (EKI) which inherits the two aforementioned advantages of EnKF. In this study we introduce and demonstrate the work of EKI by applying it into estimating parameters for a distributed rainfall-runoff model.

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