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Comparison of different filter methods for data assimilation in the unsaturated zone

Natascha Lange (1), Simon Berkhahn (1), Daniel Erdal (2), and Insa Neuweiler (1)
(1) Leibniz Universität Hannover, Hannover, Germany , (2) Universität Tübingen, Tübingen, Germany

The unsaturated zone is an important compartment, which plays a role for the division of terrestrial water fluxes into surface runoff, groundwater recharge and evapotranspiration. For data assimilation in coupled systems it is therefore important to have a good representation of the unsaturated zone in the model. Flow processes in the unsaturated zone have all the typical features of flow in porous media: Processes can have long memory and as observations are scarce, hydraulic model parameters cannot be determined easily. However, they are important for the quality of model predictions. On top of that, the established flow models are highly non-linear. For these reasons, the use of the popular Ensemble Kalman filter as a data assimilation method to estimate state and parameters in unsaturated zone models could be questioned. With respect to the long process memory in the subsurface, it has been suggested that iterative filters and smoothers may be more suitable for parameter estimation in unsaturated media.

We test the performance of different iterative filters and smoothers for data assimilation with a focus on parameter updates in the unsaturated zone. In particular we compare the Iterative Ensemble Kalman Filter and Smoother as introduced by Bocquet and Sakov (2013) as well as the Confirming Ensemble Kalman Filter and the modified Restart Ensemble Kalman Filter proposed by Song et al. (2014) to the original Ensemble Kalman Filter (Evensen, 2009). This is done with simple test cases generated numerically. We consider also test examples with layering structure, as a layering structure is often found in natural soils. We assume that observations are water content, obtained from TDR probes or other observation methods sampling relatively small volumes. Particularly in larger data assimilation frameworks, a reasonable balance between computational effort and quality of results has to be found. Therefore, we compare computational costs of the different methods as well as the quality of open loop model predictions and the estimated parameters.

Bocquet, M. and P. Sakov, 2013: Joint state and parameter estimation with an iterative ensemble Kalman smoother, Nonlinear Processes in Geophysics 20(5): 803-818.

Evensen, G., 2009: Data assimilation: The ensemble Kalman filter. Springer Science & Business Media.

Song, X.H., L.S. Shi, M. Ye, J.Z. Yang and I.M. Navon, 2014: Numerical comparison of iterative ensemble Kalman filters for unsaturated flow inverse modeling. Vadose Zone Journal 13(2), 10.2136/vzj2013.05.0083.