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Updating the soil hydraulic parameters in a 3D subsurface model

Natascha Brandhorst and Insa Neuweiler
Institute of Fluid Mechanics and Environmental Physics in Civil Engineering, Leibniz Universität Hannover, Hannover, Germany (brandhorst@hydromech.uni-hannover.de)

Soil moisture is an important variable for land surface processes. To make good model predictions of soil moisture, the flow processes in the subsurface need to be captured well. Flow in the subsurface strongly depends on the soil hydraulic parameters. Information about model parameters is often not available, at least not for the entire domain of interest. The resulting parameter uncertainty needs to be accounted for in the applied model. Data assimilation can account for parameter and model errors as well as for all other possible sources of uncertainty if observations are available that can be used to condition the model states. Thus, the parameter uncertainty might be reduced and model predictions improved. However, including the parameters increases the size of the state vector and thus the computational burden. Especially for large models, this can be a problem. Furthermore, the updates can produce unphysical parameter combinations which in unsaturated zone models often lead to numerical problems.

In this work, we test the effect of updating the soil hydraulic parameters along with soil moisture in a 3D subsurface hillslope model. We use the ensemble Kalman filter for data assimilation and synthetic observations of soil moisture. In a similar study using a 1D unsaturated flow model, parameter updates were found to be the best way to handle parameter uncertainty. Updating parameters resulted in improved predictions of soil moisture, although not necessarily in more realistic model parameters. The parameter updates should rather be considered a method of treating parameter uncertainty than a method for parameter identification. In the 1D settings, updating all uncertain parameters led to the best results. Whether this still holds and is feasible for a more complex 3D model is the question addressed in this presentation.