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Optimization of a coupled groundwater-unsaturated zone model through the assimilation of remotely sensed evapotranspiration data

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Numerical models are used extensively in hydrogeological studies. However, because models are a simplification of reality, model outputs (e.g. net recharge) are inevitably affected by uncertainties. Improving the confidence in model products through the reduction of these uncertainties is one of the most active and challenging areas of research.

Model-data fusion techniques, such as data assimilation, aim to find the best results from the combination of observations and model forecasts of state variables. In this study, a framework for the assimilation of actual evapotranspiration into a coupled groundwater-unsaturated zone model through the Ensemble Kalman filter is developed.

Results produced by the combination of different ensemble perturbations and observation errors are explored through a synthetic study. This was designed to assess the benefits of the assimilation under conditions of shallow and deep water table levels.

The method produces improvements in the model states (i.e. soil moisture and piezometric heads) over the whole domain. Furthermore, it results in a reduction in the uncertainties of net-recharge volumes. This reduction is particularly evident under shallow water table conditions, where vegetation transpiration from the water table is higher.

The encouraging results of the study indicate the possibility of applying the method to a regional scale groundwater model.