

Assimilating water table elevation data into a catchment hydrology modeling framework to estimate hydraulic conductivity

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Abstract. Groundwater models, often used to enhance understanding of hydrologic and chemical processes in local or regional aquifers, are often hindered by inadequate representation of the parameters which characterize these processes. Furthermore, attempts to estimate these parameters are usually limited to studies employing simplified aquifer representations. In this study we present preliminary results of using a data assimilation algorithm, the Ensemble Smoother, to provide enhanced estimates of aquifer hydraulic conductivity within a fully-coupled, surface-subsurface flow modeling framework through assimilation of water table elevation measurements. Based on the Kalman Filter methodology, the algorithm uses residuals between forecasted model results and assimilated measurement data, together with the covariance of model results, to correct model results throughout the model domain. Parameter estimation is achieved by incorporating spatially-variable hydraulic conductivity values into the algorithm, thereby allowing the correlation between water table values and hydraulic conductivity to correct the hydraulic conductivity fields. The applicability of the Ensemble Smoother scheme is demonstrated via a synthetic three-dimensional catchment system incorporating variably-saturated subsurface flow, overland flow, and channel flow. Results indicate that assimilating water table measurements provides an improved estimate of the hydraulic conductivity fields. Estimates are further enhanced if hydraulic conductivity measurements are also assimilated. Sensitivity analyses show the influence of (1) the number of assimilated measurements (2) the error assigned to the measurements, and (3) number of assimilation times on the degree of hydraulic conductivity estimate improvement.