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Estimation of water table, soil states and parameters of integrated subsurface-land surface models by data assimilation

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Estimating states and fluxes of the water cycle with terrestrial system models needs a large amount of input data, including soil and vegetation parameters, resulting in large uncertainties in model predictions. Assimilation of pressure head and/or soil moisture data can better constrain states and parameters of a terrestrial system model. Here we assimilate pressure head data and soil moisture data in a terrestrial system model over the Neckar catchment (13928 km^2) with a spatial horizontal resolution of 800 m. We use the Terrestrial System Modeling Platform (TSMP), which consists of an atmospheric model component (not used in this work), the Community Land Model version 3.5 (CLM3.5), and the subsurface hydrological model Parflow, coupled by OASIS. TSMP is coupled to the Parallel Data Assimilation Framework (PDAF), which allows the assimilation of land surface and subsurface observations to estimate the model states and parameters. In this work the localized Ensemble Kalman Filter (LEnKF) was used to update hydraulic head, soil moisture and/or saturated hydraulic conductivity by assimilating hydraulic head or in situ soil moisture observations for a period of one year. Ensembles of soil properties, leaf area index and atmospheric forcings were generated. The ensemble of atmospheric forcings considered correlations among four variables, and spatio-temporal correlations of the atmospheric variables using a geostatistical procedure. The characterization of the water table depth and river discharge without data assimilation and for different scenarios of pressure head and soil moisture data assimilation were compared.