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## Building a coupled data assimilation system for the atmosphere, land-surface and subsurface on the catchment scale

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We present a data assimilation (DA) system for the atmosphere-land-surface-subsurface system on the catchment scale. The Neckar catchment in SW-Germany served as the specific case where the DA in combination with the coupled atmosphere-land surface-subsurface model TSMP was used. TSMP couples the atmospheric model COSMO, the land-surface model CLM and the hydrological model ParFlow to the DA framework PDAF. We will discuss how the ensemble system is set up in order to work properly and what issues we faced during our initial testing. For the atmosphere we found that it is important to have a good ensemble of lateral forcings as changing internal parameters for various parametrizations does not introduce sufficient variability on its own due to the rather small size of our domain. For the sub-surface the choice of parameters becomes most important and as such parameter estimation will be a valuable tool for improving DA results significantly. Finally, we are showing some first DA results with our system concerning soil moisture with two different assimilation methods with a fully coupled model setup. In the first assimilation scenario in-situ soil moisture data measured by cosmic ray probes are assimilated, while in the second assimilation scenario remotely sensed near surface soil moisture is assimilated. The first results are encouraging and we discuss additional planned simulation scenarios with the fully coupled atmosphere-land surface-subsurface modelling system as well as plans to test strongly coupled DA, where measurements are used to update states across compartments, possibly resulting in additional accuracy gain compared to traditional uncoupled DA.

