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A virtual reality catchment for data assimilation experiments

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Current data assimilation (DA) systems often lack the possibility to assimilate measurements across compartments to accurately estimate states and fluxes in subsurface-land surface-atmosphere systems (SLAS). In order to develop a new DA framework that is able to realize this cross-compartmental assimilation a comprehensive testing environment is needed.

Therefore a virtual reality (VR) catchment is constructed with the Terrestrial System Modeling Platform (TerrSysMP). This catchment mimics the Neckar catchment in Germany. TerrSysMP employs the atmospheric model COSMO, the land surface model CLM and the hydrological model ParFlow coupled with the external coupler OASIS. We will show statistical tests to prove the plausibility of the VR.

The VR is running in a fully-coupled mode (subsurface - land surface - atmosphere) which includes the interactions of subsurface dynamics with the atmosphere, such as the effects of soil moisture, which can influence near-surface temperatures, convection patterns or the surface heat fluxes. A reference high resolution run serves as the “truth” from which virtual observations are extracted with observation operators like virtual rain gauges, synoptic stations and satellite observations (amongst others). This effectively solves the otherwise often encountered data scarcity issues with respect to DA.

Furthermore an ensemble of model runs at a reduced resolution is performed. This ensemble serves also for open loop runs to be compared with data assimilation experiments. The model runs with this ensemble served to identify sets of parameters that are especially sensitive to changes and have the largest impact on the system. These parameters were the focus of subsequent ensemble simulations and DA experiments. We will show to what extend the VR states can be re-constructed using data assimilation methods with only a limited number of virtual observations available.