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Fully coupled catchment simulations as surrogate realities for data assimilation

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When developing data assimilation systems for coupled systems that incorporate subsurface processes one major issue is the scarcity of observations available in the subsurface, not only regarding system states but also parameters. When run at highest resolution, fully coupled simulations of the atmosphere-land-surface-subsurface system could be a way to work around this issue. The high-resolution simulations themselves can then function as a surrogate realities to draw observations to be used in the development of data assimilation systems. In order for this to work, the confidence in the simulations must be high enough such that we expect realistic behavior in all compartments, as well as in the interactions between them.
The Terrestrial Systems Modeling Platform (TerrSysMP) is used to realize a simulation for the medium sized river catchment of the Neckar, located in SW-Germany. The simulation area is roughly 51.000 km^2 and features an atmospheric resolution of 1.1km and 400m for the land- and subsurface. In total seven years of simulation are available.
Even though the simulated catchment is not aimed to reproduce the real catchment in detail, the simulation results are compared to real measurements in the region to verify that the simulated catchment produces reasonable results. For the atmosphere and land-surface, very good agreement between measurements and simulation is observed. For the subsurface, an even higher resolution with better resolved topography may be needed if the necessary small scale processes related to river discharge or soil moisture should be captured.