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Development of a coupled groundwater-land surface-atmosphere model

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A proper understanding and representation of the interactions between the different components of the hydrosphere (atmosphere, land surface, soil zone, aquifers) is increasingly relevant to climate/meteorological prediction, environmental protection, and water management. As such, complete models of the hydrological cycle have gained recent attention in the scientific community. Here, we present a new model that consists of the regional climate and weather forecast model COSMO coupled via the Community Land Model (CLM) with the three-dimensional, variably saturated groundwater ParFlow model. A scale consistent two-way coupling is performed using the external OASIS coupler, which passes the relevant fluxes (e.g, infiltration, latent and sensible heat) and state variables (e.g. soil moisture content) between the three components using the MPI parallel communications protocol. The improvements with regards to how interactions are simulated and how different processes (or process submodels) are integrated/coupled in this new model are demonstrated by using semi-idealized simulations over the Rur catchment in Germany. The model development is carried out in the framework of the TR32 (Transregional Collaborative Research Centre, Patterns in Soil-Vegetation Atmosphere-Systems), a cross-sectional project aimed in investigating patterns and structures in soil, vegetation, and atmosphere interactions.