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Modeling Soil Moisture – Atmospheric Boundary Layer Coupling: Enhanced by Cosmic-Ray Soil Moisture Sensing

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The spatial and temporal distribution of soil water is a key constituent for the coupled moisture processes between the land surface and the atmospheric boundary layer. The scales of soil moisture observations and simulations with land-surface models are typically mismatching with respect to spatial support. Cosmic-ray neutron sensing (CRNS) offers a competitive method to observe soil moisture at the spatial scales of modern LSMs as typically used in local area climate and atmospheric models. In our study, we investigate how the assimilation of CRNS observations helps to improve the spatial structures of soil moisture in these models and the local soil moisture – atmospheric boundary layer interaction.

The modeling chain consists of Noah-MP LSM, the WRF-Hydro model in both, observation driven and fully WRF coupled configuration, and the Data Assimilation Research Testbed (DART) coupled to WRF-Hydro (Hydro-DART). The data assimilation is based on Ensemble-Kalman Fitler (EnKF) with the fully coupled WRF-Hydro-Dart model system.

Extensive observations from the Terrestrial Environmental Observatories (TERENO, www.tereno.net), will be used along with data from MOSES (Helmholtz Modular Observation Solutions for Earth Science https://moses.eskp.de/), and with data from the DFG research unit Cosmic Sense.

We present the structure and a first evaluation of the model system for the Ammer river catchment in southern Germany based on observations from the TERENO preAlpine network.