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Local Reanalysis on the Convective Scale with a Fully-Coupled Model (TerrSysMP)

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Reanalyses provide temporally and spatially consistent fields of weather and climate parameters by combining model physics and observational data. The generated fields can be used to quantify water and energy budgets and intercompartmental fluxes within the earth system. Reanalyses are usually performed for several decades on a global scale, therefore using a relatively coarse horizontal grid to delimitate the computational effort. Due to the coarse spatial resolution, local and small scale processes, e.g. within meso scale river catchments, are not well represented, as well as the resulting water and energy budgets.

The latter is one of the main research topics of the Transregional Collaborative Research Centre 32 (TR32). Within TR32, a new Terrestrial Systems Modeling Platform (TerrSysMP) was developed, which is able to reproduce processes within the atmosphere, surface and groundwater. TerrSysMP is a scale consistent fully coupled modeling system, which is composed of the atmospheric model COSMO (version 5.1), the surface model CLM3.5 (Community Land Model) and the 3-dimensional hydrological model ParFlow. The different models are connected via an external coupler (OASIS3) for the exchange of relevant state vectors. Earlier studies showed that TerrSysMP provides a realistic hydrological balance in the coupled system and well reproduces the energy and water fluxes between the atmosphere and ground on small scales.

This study extents the COSMO reanalysis system developed within the Hans-Ertel-Centre for Weather Research by the fully coupled model TerrSysMP. The reanalysis setup uses a spatial resolution of 1 km in the atmosphere and a finer resolution in the ground ($\sim$500 m), within an area of approx. 150x150 km in central Europe (Rur-catchment and surrounding). This area includes various measurement sites of TR32 and therefore a range of different observations from atmosphere to ground are available for comparison with the modeled parameters. Hence, results of the regional reanalysis will be validated with comprehensive measurements of the terrestrial system, expecting an improved estimation of the water and energy budgets of the Rur-catchment. We report about the first tests of the reanalysis setup after implementing TerrSysMP into the Kilometre-Scale Ensemble Data assimilation Tool (KENDA) of Deutscher Wetterdienst. The setup will include the assimilation of radar data with the Efficient Modular VOlume RADar Operator (EMVORADO).