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Cross-compartment evaluation of a fully-coupled hydrometeorological modeling system using comprehensive observation data

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Fully-coupled hydrometeorological modeling enables investigations about the complex and often non-linear exchange mechanisms among subsurface, land, and atmosphere with respect to water and energy fluxes. The consideration of lateral redistribution of surface and subsurface water in such modeling systems is a crucial enhancement, allowing for a better representation of surface spatial patterns and providing also channel discharge predictions. However, the evaluation of fully-coupled simulations is difficult since the amount of physical detail along with feedback mechanisms leads to high degrees of freedom. Therefore, comprehensive observation data is required to obtain meaningful model configurations.

We present a case study for a medium-sized river catchment in southern Germany that includes the calibration of the stand-alone and the evaluation of the fully-coupled WRF-Hydro modeling system with a horizontal resolution of 1 x 1 km^2, for the period June to August 2015. ECMWF ERA-Interim reanalysis is used for model driving. Land-surface processes are represented by the Noah-MP land surface model. Land-cover is described by the EU CORINE data set. Observations for model evaluation are obtained from the TERENO Pre-Alpine observatory (http://www.imk-ifu.kit.edu/tereno.php) and are complemented by further measurements from the ScaleX campaign (http://scalex.imk-ifu.kit.edu) such as atmospheric profiles obtained from radiometer sounding and airborne systems as well as soil moisture and -temperature networks.

We show how well water budgets and heat-fluxes are being reproduced by the stand-alone WRF, the stand-alone WRF-Hydro and the fully-coupled WRF-Hydro model.