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Evaluation of the daily forecasts from the coupled Terrestrial Systems Modelling Platform (TSMP) over a regional-scale domain in Central Europe

Maksim Iakunin[1,2], Niklas Wagner[1,2], Alexander Graf[1], Klaus Goergen[1,2], and Stefan Kollet[1,2]
[1]Institute of Bio- and Geosciences (IBG-3, Agrosphere), Research Centre Juelich, Juelich Germany
[2]Centre for High-Performance Scientific Computing in Terrestrial Systems (HPSC TerrSys), Geoverbund ABC/J, Juelich, Germany

Prediction of numerical weather prediction and climate models are the basis for informed decision making and increased resilience to hydrometeorological extremes in many of today's resource management challenges e.g. in the agricultural sector. Coupled multi-compartment models are capable of reproducing interactions and feedbacks in the geosystem, and have thereby demonstrated versatile tools in a variety of applications. The Terrestrial Systems Modelling Platform (TSMP, https://www.terrsysmp.org) is an integrated regional Earth system model that simulates processes from groundwater across the land surface to the top of the atmosphere on multiple spatio-temporal scales. TSMP consists of the atmospheric model COSMO (Consortium for Small-scale Modeling), the CLM (Community Land Model), and the ParFlow hydrologic model, coupled through OASIS3-MCT. This work presents an evaluation of daily deterministic 10-day forecasts of the atmospheric, surface, and groundwater states and fluxes for a heterogeneous mid mountain-ranges area in the German and Belgium Eifel-Ardennes region in Central Europe from TSMP in a monitoring setup. TSMP runs at convection-permitting resolution of 1km (atmosphere) and 0.5km (sub- and land surface) over an area of 150km x 150km, driven by ECMWF HRES forecasts through a one-way double nest. Data from the densely instrumented Eifel/Lower Rhine Valley observational network of Terrestrial Environmental Observatories (TERENO, https://www.tereno.net) is used for evaluation of the TSMP simulations. TSMP forecasts from July 2019 to July 2021 covering an agricultural and hydrological drought and the transition back to the climatological mean state are analyzed in detail. Despite the complex terrain and the free running TSMP, meteorological and hydrological station data are generally well represented while a certain overestimation of daily precipitation is observed.