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Intercomparison of terrestrial water budgets in EURO-CORDEX and TSMP evaluation runs

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Water is one of Earth's most important geo-ecosystem components. Here we present an evaluation of water cycle components using 12 EURO-CORDEX Regional Climate Models (RCMs) and the Terrestrial Systems Modeling Platform (TSMP) from ERA-Interim driven evaluation runs. Unlike the other RCMs, TSMP provides an integrated representation of the terrestrial water cycle by coupling the numerical weather prediction model COSMO, the land surface model CLM and the surface-subsurface hydrological model ParFlow, which simulates shallow groundwater states and fluxes. The study analyses precipitation (P), evapotranspiration (E), runoff (R), and terrestrial water storage ($TWS=P-E-R$) at a 0.11 degree spatial resolution (about 12km) on EUR-11 CORDEX grid from 1996 to 2008. As reference datasets, we use ERA5 reanalysis to represent the complete terrestrial water budget, as well as the E-OBS, GLEAM and E-Run datasets for precipitation, evapotranspiration and runoff, respectively. The terrestrial water budget is investigated for twenty catchments over Europe (Guadalquivir, Guadiana, Tagus, Douro, Ebro, Garonne, Rhone, Po, Seine, Rhine, Loire, Maas, Weser, Elbe, Oder, Vistula, Danube, Dniester, Dnieper, and Neman). Annual cycles, seasonal variations, empirical frequency distributions, spatial distributions for the water cycle components and budgets over the catchments are assessed. The analysis demonstrates the capability of the RCMs and TSMP to reproduce the overall characteristics of the water cycle over the EURO-CORDEX domain, which is a prerequisite if, e.g., climate change projections with the CORDEX RCMs or TSMP are to be used for vulnerability, impacts, and adaptation studies.