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Validation of soil moisture and surface fluxes in EURO-CORDEX simulations as part of a land-atmosphere coupling analysis

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Land-atmosphere coupling is highly important to understand e.g. many of the processes involved in regional climate change and its impacts. A main science question is in which way the land surface influences the atmosphere and how the strength of this coupling may be quantified. Such complex land-atmosphere interactions are e.g. sensitive to small scale surface heterogeneities that are better captured by higher resolution regional climate model runs that are supposed to provide an added value when it comes to the reproduction of extremes and associated impacts.

As part of a land-atmosphere coupling analysis, where we investigate the coupling strength and its spatial and temporal variability based on ERA-Interim re-analysis driven multiscale EURO-CORDEX (Coordinated Regional Climate Downscaling Experiment) validation runs, the present study shows, how well the spatial patterns and temporal evolutions of surface moisture and surface energy fluxes are reproduced in these simulations.

The analysis is done on a subset of eight WRF RCM simulations that are part of the EURO-CORDEX ensemble. We evaluate daily model results from 1990 to 2008 at spatial resolutions of about 48 km (EUR-44) and 12 km (EUR-11) for the complete European model domain. The model simulations are compared to the Essential Climate Variables (ECV) Soil Moisture satellite data product of the ESA Climate Change Initiative regridded with a nearest neighbor resampling to the EUR-44 and the EUR-11 grid, respectively. Due to data coverage, the data intercomparison is done on a grid-cell-basis for all individual days with a matching satellite observation for annual and seasonal time spans. Related to the soil moisture-temperature feedback this quantity is highly important for flux partitioning. In order to evaluate those fluxes and thereby the reproduction of boundary layer processes by the models, latent and sensible heat fluxes are compared for individual locations against flux tower measurements of the FLUXNET dataset. An important prerequisite for a valid intercomparison is e.g. a match of the dominant land use as used by the land surface schemes in the RCMs with the station site. As most RCMs in the intercomparison use the NOAH LSM with MODIS land use and USGS GTOPO topographic data, our intercomparison does not necessarily give an information on the quality of the LSM but is rather intended to investigate the overall effects of the complex interplay of several processes.