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# Modelling soil-plant-atmosphere interactions by coupling the regional weather model WRF to mechanistic plant models

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Climate change causes altering distributions of meteorological factors influencing plant growth and its interactions between the land surface and the atmosphere. Recent studies show, that uncertainties in regional and global climate simulations are also caused by lacking descriptions of the soil-plant-atmosphere system. Therefore, we couple a mechanistic soil-plant model to a regional climate and forecast model. The detailed simulation of the water and energy exchanges, especially the transpiration of grassland and forests stands, are the key features of the modelling framework.

The Weather Research and Forecasting model (WRF) (Skamarock 2008) is an open source mesoscale numerical weather prediction model. The WRF model was modified in a way, to either choose its native, static land surface model NOAH or the mechanistic eco-system model Expert-N 5.0 individually for every single grid point within the simulation domain.

The Expert-N 5.0 modelling framework provides a highly modular structure, enabling the development and use of a large variety of different plant and soil models, including heat transfer, nitrogen uptake/turnover/transport as well as water uptake/transport and crop management. To represent the key landuse types grassland and forest, we selected two mechanistic plant models: The Hurley Pasture model (Thornley 1998) and a modified TREEDYN3 forest simulation model (Bossel 1996). The models simulate plant growth, water, nitrogen and carbon flows for grassland and forest stands. A mosaic approach enables Expert-N to use high resolution land use data e.g. CORINE Land Cover data (CLC, 2006) for the simulation, making it possible to simulate different land use distributions within a single grid cell.

The coupling results are analyzed for plausibility and compared with the results of the default land surface model NOAH (Fei Chen and Jimy Dudhia 2010). We show differences between the mechanistic and the static model coupling, with focus on the feedback effects of evapotranspiration, heat flow and radiation of thermodynamic values.

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