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Modeling energy fluxes in heterogeneous landscapes employing a mosaic approach

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Recent studies show that uncertainties in regional and global climate and weather simulations are partly due to inadequate descriptions of the energy flux exchanges between the land surface and the atmosphere. One major shortcoming is the limitation of the grid-cell resolution, which is recommended to be about at least 3x3 km^2 in most models due to limitations in the model physics. To represent each individual grid cell most models select one dominant soil type and one dominant land use type. This resolution, however, is often too coarse in regions where the spatial diversity of soil and land use types are high, e.g. in Central Europe. An elegant method to avoid the shortcoming of grid cell resolution is the so called mosaic approach. This approach is part of the recently developed ecosystem model framework Expert-N 5.0.

The aim of this study was to analyze the impact of the characteristics of two managed fields, planted with winter wheat and potato, on the near surface soil moistures and on the near surface energy flux exchanges of the soil-plant-atmosphere interface. The simulated energy fluxes were compared with eddy flux tower measurements between the respective fields at the research farm Scheyern, North-West of Munich, Germany.

To perform these simulations, we coupled the ecosystem model Expert-N 5.0 to an analytical footprint model. The coupled model system has the ability to calculate the mixing ratio of the surface energy fluxes at a given point within one grid cell (in this case at the flux tower between the two fields).

This approach accounts for the differences of the two soil types, of land use managements, and of canopy properties due to footprint size dynamics.

Our preliminary simulation results show that a mosaic approach can improve modeling and analyzing energy fluxes when the land surface is heterogeneous. In this case our applied method is a promising approach to extend weather and climate models on the regional and on the global scale.