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Modelling of time-space patterns of energy and mass fluxes over heterogeneous land surfaces

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High resolution simulations of mass and energy fluxes in the catchment area of the Rur river (Eifel, Western Germany) are performed to quantify the budgets of energy, water and carbon dioxide in relation to inhomogeneities in soil, hydrological properties and land use. Special focus is given to the contribution of small-scale ($<$ 1km) land surface heterogeneities to the exchange of energy, momentum and mass between the surface and the atmosphere. Airborne measurements (COCA IV flight campaign, 2007) show temporal and spatial small scale variability of CO2 and H2O fluxes, which may be associated to small scale vegetation structures of varying photosynthetic activity. The investigations are performed with the non-hydrostatic mesoscale meteorological model FOOT3DK with a model resolution down to 100 m, to make the results more comparable to airborne measurements. The objective was to analyse how heterogeneous surface patterns are displayed in the atmospheric fields of specific humidity and carbon dioxide. Furthermore, a major goal was to develop a scale-adaptive coupling of land surface inhomogeneities and atmospheric dynamic turbulent transfer properties of atmospheric mass transports of CO2 and water vapour. The usage of high resolution simulations aimed at closing the gap in parameterising subscale turbulence between mesoscale models and LES models. Therefore the scale adaptive treatment of subgrid turbulence is a key challenge. Preliminary results obtained from simulations with FOOT3DK indicate that the atmospheric H2O fluxes are associated with land surface parameters like roughness length z0, cover of vegetation and particularly soil moisture. Sensitivity studies of simulations with different treatment of soil moisture are presented.