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Future local and regional response of surface net radiation due to bioenergy motivated agricultural transformations

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Climate change mitigation actions involve CO_2 reduction. This may be achieved by renewable energies like bioenergy plants. Accompanying anthropogenic land use and land cover change (LULC) may interference with climate possibly impacting the surface energy balance. Despite accurate measurements exist for the energy flows at the top of the atmosphere; the energy distribution at the surface is less certain. This includes the lack to understand the response of climate to increasing greenhouse gases. New investigations on LULC due to bioenergy plants (such as irrigated and non-irrigated poplar and maize) through regional climate modelling at convection resolving scale show variations of the surface net radiation on spatial and temporal scales. Two time slices (1970-1975 based on C20 and 2070-2075 based on SRES A1B) over a temperate region in the mid-latitudes, Germany, are evaluated. The effect on regional and local scales is explored. It is suggested that LULC due to poplar/maize increases/decreases the simulated surface latent heat flux and decreases/increases the sensible heat flux compared to the reference simulation with no LULC. These changes result in a local change of the net radiation by + 5 Wm-2 in the case of irrigated poplar, by + 2.7 Wm-2 for non-irrigated poplar available for the hydrological cycle, and by – 0.7 Wm-2 for maize. Regional changes are two orders of magnitude smaller. Based on principal component analysis it is suggested that the cloud effect dominates the energy balance regionally whereas the surface albedo effect dominates locally. This study contributes to the uncertainty estimation in the quantification of the different components of the Earth's energy balance under climate change conditions.