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Modelling and visualisation of changes in radiation budget due to historic land use changes: A virtual 3D flight over SW Germany

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This study is embedded in the interdisciplinary Postgraduate Programme "Formation and Development of Present-Day Landscapes" at the University of Freiburg (DFG-GRK 692/1). We discuss the effects of historic land use changes on the local climate in areas with different terrain. For that purpose we use a model which estimates the spatial distribution of the nocturnal surface temperature from land cover, terrain form and a satellite thermal image as a reference. The modelling is applied to different patterns of land cover so that the correspondent nocturnal patterns of emission and net radiation can be derived. Starting from the data on net radiation in a next step the rates of cold air production are estimated. Our areas of investigation comprise Kaiserstuhl, Freiburg, Schauinsland, the valley of Menzenschwand and the Baar region with land use information of different time slices: For the years 2000, 1984 and 1936 we use remotely sensed data, for 1871, 1850 and 1797 we analyse historical maps, for 1000 BC we apply a population model and for 6000 BC we postulate an "only forest"-scenario. The discussion of the results is based on a sensitivity analysis for the model used. That means that changes of nocturnal surface temperature, net radiation and cold air production are explained in relation to changes in land use. The analysis shows in particular the wide ranges between the thermal characteristics of forest and grassland in complex terrain concerning the nocturnal radiation budget. In a virtual 3D flight from the Baar to the Southern Upper Rhine we demonstrate the changes in the spatial distribution of the nocturnal surface temperature based on the land use situations in 6000 BC and in 2000 AD. The comparison reveals that the anthropogenic influence by means of land use changes has led - on average - to a decrease of the nocturnal surface

temperature and thus to a smaller loss of energy in the nocturnal radiation budget.