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Reinventing urban open spaces by different biomass strategies – Analysis of the microclimatic effects by measurements and modelling

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In the framework of the joint research project 'KuLaRuhr' different concepts of sustainable urban land management are studied in the urban agglomeration 'Ruhr district' in western Germany. The present subproject focusses on the microclimatic potential of urban open spaces in the City of Bottrop, especially of those open spaces that are unsealed and vegetated. The project tries to establish scenarios reinventing this spots by multifunctional land use and different biomass strategies, e.g. vegetation density, vegetation type, geometry and water surfaces. Results of measurements and microclimate simulations should allow for the development of transferable concepts and recommendations for other urban areas.

Over a period of twelve months measurements of the surface energy balance components, air temperature and relative humidity were conducted at six sites within the urban area and a rural reference spot. All seven measurement sites had different characteristics related to the degree of impervious surface, vegetation fraction, building geometry and composition. Hence, different types of urban open spaces could be investigated. Additionally, three of the six measurement sites were subjected to simulations with the urban microclimate model ENVI-met. In a first step the measurements were used to validate the model. Three green space scenarios were implemented to analyze the microclimate modifications that occurred due to a change in land use and biomass strategy. A warm summer day in July was simulated as a case study.

First results indicate that open spaces with limited fractions of impervious surface experience stronger nocturnal cooling (maximal nocturnal cooling of 17.1 K above a green space with 46 % impervious surface in contrast to 14.7 K with 93 % impervious surface) and limited warming at noon time. However, nocturnal cooling intensity did not scale with impervious surface fraction which is believed to be coupled to the surrounding building structure. A scenario with a high percentage of herbaceous biomass is characterized by less near-surface noon air temperatures (0.8 K in contrast to green space with grass). Different microclimatic effects of different biomass scenarios will be presented and discussed.