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to characterize the impervious water storage with an urban surface-flux parameterization TERRA-MLU: evaluation and calibration for Toulouse city

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Evaporation from the urban impervious surface could have a considerable impact on the surface energy and moisture balance on rainy days. In particular, the ever increasing urbanization could alter the interaction between evaporation from the surface and precipitation within the urban climate (change) in the future. However, uncertainty exists within the determination of water storage parameters for the impervious surface, and hydrological parameters of the soil for the natural fraction in urban environments. In order to investigate the water balance over urban areas in more detail, TERRA-MLU, a new urban surface-flux parameterization, is applied over Toulouse city centre during the CAPITOUL campaign during 2004.

The new urban parameterization covers a direct implementation of urban characteristics in TERRA_ML, Soil-Vegetation-Atmosphere Transfer model of COSMO. Besides anthropogenic heat, specific dynamic, radiative and thermal parameters including roughness length, heat capacity, conductivity, albedo and emissivity are assigned for the urban land-cover. A bluff-roughness thermal roughness length parametrization is used. New surface-layer transfer coefficients are adopted which can deal with very small thermal roughness lengths typical for urban surfaces. An new impervious water storage parameterization is introduced as well.

TERRA-MLU is evaluated 'offline' for Marseille, Toulouse, Basel and Vancouver. Sensitivity analysis at the Toulouse site demonstrates that the maximum impervious water storage needs to be equal or less than 1kg/m2 if one only considers evaporation at a potential rate from the impervious surface. Furthermore, results are improved by implementing a storage form parameter that accounts for the reduction of evaporative surface fraction in case of small water content on the impervious surface. An offline sensitivity analysis is performed to estimate the maximum water storage and the storage form parameter. At last, it is found that the rooting depth of the vegetation needs to be described carefully in urban environments with large trees in order not to underestimate the latent heat during summer.