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The impact of impervious water-storage parametrization on urban climate modelling

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In order to improve the representation of the water balance in urban land-surface models, we present a new impervious water-storage parametrization that assumes a distribution of water reservoirs. It has been implemented in TERRA-URB, a new urban parametrization for COSMO-CLM's standard land-surface module TERRA-ML. The water-storage capacity and the maximal wet surface fraction of the urban impervious land cover consisting of streets and buildings are estimated for Toulouse centre by matching the modelled and observed evapotranspiration (ET) rates. They amount to $1.31 \pm 0.20\,\mathrm{kg\,m^{-2}}$ and $12 \pm 4\%$, respectively. The model successfully reproduces the timespan and magnitude of increased ET for both urban observations campaigns CAPITOUL and BUBBLE. Our sensitivity study reveals that water-storage parametrization largely affects the performance of modelled ET rates. Hereby, the simulation employing the new water-storage parametrization is improved compared to arbitrary or existing water-storage parametrizations. The ET, surface sensible heat exchange and upwelling infra-red radiation are all affected until 12 day-time hours after rainfall on average. The modelled annual-mean ET during the CAPITOUL campaign from the urban land in Toulouse is an order of magnitude lower than that observed for the natural surroundings.