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Studying the modfication of precipitation in the urban region of Hamburg using an idealistic model setup

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Urban regions are considered to modify the precipitation patterns due to thermally-driven UHI circulations, uprising motions induced at the luv-side of the city and altered cloud-formation processes in urban plumes. Since the interaction between atmospheric dynamics and physics, aerosol processes and urban boundary layer processes is highly-nonlinear, it is hard to determine and quantify the impact of such processes on precipitation. Moreover, a dense and long-term observational network is often missed for analyzing urban precipitation effects.
Considering atmospheric models for the detection and attribution of important players for urban precipitation often comes along with two disadvantages: 1) full and realistc 3D-simulations often prevent an urban impact study due to small signal-to-noise ratios and 2) idealized model setups are often insufficient to capture all processes relevant for precipitation physics. With our contribution we intend to overcome the afore-mentioned limitations. We still use an idealized 2-d model setup, but force the model with a diurnal cycle and with realistic atmospheric forcing data. The forcing data are chosen from strong precipitation events in Northern Germany. Thus, we are able to derive a statistic of urban precipitation effects. Having in mind the hypothesis of an enhancement of precipitation in the leeward of the city Hamburg, we analyze the impact of the city size, the orographic features and the convective available potential energy (CAPE) on the precipitation patterns in the Hamburg region. It turns out that not only the urban region but also the Harburg hills enhance the leeward precipitation. Moreover, the simulations show a dry region inside the city, which is the result of a well-developed atmospheric and urban boundary layer that exists in particular at the second day of the simulations.