Poster 43: The influence of latest COSMO developments regarding surface-atmospheric interactions on urban climate modelling

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During the past six years several urban land-surface schemes have been implemented in the COSMO(-CLM) model. Each of them has proven that the model system is very suitable for regional-scale urban-climate applications. Particularly, they show good performence in capturing the urban heat island (UHI) reflecting the thermal contrasts between the city and the natural surroundings, and especially its diurnal cycle and daily variability. Yet, the URban Modelling IntercomParison experiment (URBMIP) have identified some model performence issues with COSMO for urban areas, and they seem to persist in combination with each of the urban land-surface schemes. These issues include the underestimated diurnal amplitude of absolute temperatures and UHIs in summertime (Trusilova et al., 2015). As clear from previous studies, the variation of boundary-layer properties

largely influences the urban climate features initiated by the drag and heat-buffering effect of the city. Particularly, the boundary-layer temperature slope and wind speed upwind of city show clear impacts on the magnitude of the nocturnal UHI, as demonstrated by an idealized boundary-layer advection model (Wouters et al., 2013). These findings suggest that the model performance in terms of surface-atmospheric interactions directly affecting the boundary-layer properties is important for well-capturing the urban heat island.

It is investigated how urban climate modelling performance with TERRA_URB v2.1 is affected by applying the latest developments in the COSMO consortium directly related to the surface-atmospheric interactions. These developments include the implementation of vegetation shading (Helmert et al.), the improvements in the TKE-based boundary-layer turbulence scheme (Raschendorfer et al.), the conductivity that includes the soil moisture and ice, and the new resistance formulation for bare soil evaporation (Schulz and Vogel, 2016). The implications of these four developments are investigated with an urban-climate modelling setup with the test release COSMO 5.04 test coupled to TERRA_URB v2.1 over Belgium at 2.8km resolution during a mid-summer period encompassing two heat waves. An evaluation and sensitivity study is performed against absolute temperatures and UHIs observed from two-metre temperature measurements (canopy-layer UHI), tower observations (boundary-layer UHI) and satellite imagery (surface UHI).