EMS Annual Meeting Abstracts
Vol. 15, EMS2018-258, 2018

On the influence of urban canopy forcing on urban aerosol concentrations

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The regional climate model RegCM version 4.4, including the surface model CLM4.5 with urban module was offline coupled to the chemistry transport model CAMx version 6.30 in order to investigate the impact of the urban canopy induced meteorological changes on the longterm aerosol concentrations focusing on central European cities. The urban canopy impact on temperature, humidity, wind speed and turbulence was considered. As expected, strong increases for urban temperatures, slight decreases of urban moisture, and moderate decreases of wind speed was modelled as 2001-2005 summer average. The highest impact (an increase) was modelled for the vertical eddy diffusion coefficient. These changes affected both primary and secondary aerosol concentrations as well as their gaseous precursors. It was found that the main contributor to the change of aerosol loading is the enhanced vertical turbulent mixing along with the changes in wind speed (decrease) causing up to 3 μgm^{-3} decrease and 1 μgm^{-3} increase for PM2.5, respectively. It has been further found that the temperature induced changes are relevant for secondary inorganic aerosol, mainly nitrates, however, they are negligible for primary aerosol in our simulations. The overall impact on the secondary organic aerosol is minor. We further showed, that the changes in urban humidity have only a very small impact on the aerosol concentrations. The comparison of model results with seasonal averages of PM2.5 surface concentrations with Airbase measurements showed acceptable agreement, however the improvement by including the urban meteorological effect was not evident and affected only the western part of the domain.