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On the impact of urban canopy forcing on the vertical eddy transport of ozone and PM2.5

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Urban surfaces substantially differ from their rural counterparts due to the specific geometry and physical properties they have. This brings modified transport of momentum, moisture and heat from/to urban surfaces and perturbs the thermal and mechanical balance resulting in changed meteorological condition in cities. From an air quality perspective, one of the most important changes is the increased turbulence enhancing vertical mixing of pollutants above cities but increased temperatures and wind stilling play an important role too. Using the regional climate model RegCM4 coupled offline to chemistry transport model CAMx6 over central Europe we study how urban surfaces affect the vertical turbulent transport of selected pollutants trough modifications of the vertical eddy diffusion coefficient (Kv). For the period of 2007-2011 numerous experiments are performed in order to evaluate the impact of different parameterizations of Kv calculation on both surface concentrations and vertical profiles of ozone and PM2.5 over selected cities (Prague and Berlin) in central Europe. Results confirm that the turbulent transport is the most important forcing affected by the transition from rural surfaces to urbanized ones. Ozone is subsequently increased by 2-4 ppbv while PM2.5 concentrations are reduced over urban areas by 2 μg/m3. It has been shown that the representation of turbulent transport lying in the choice Kv calculation method has an important impact on the vertical profile of the selected pollutants but whether the turbulence remains the dominant factor of the urban canopy meteorological forcing on AQ depends on the choice of the Kv calculation method. Simulations are performed over three telescoping domains of 27, 9 and 3 km resolution centered over Prague, so the sensitivity of the results on the horizontal resolution is analyzed too.