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Urban heat island and its impact

Tomas Halenka, Peter Huszar, Michal Belda, and Jan Karlicky
Charles University, Fac. of Mathematics and Physics, Prague, Czech Republic (tomas.halenka@mff.cuni.cz)

To assess the impact of cities and urban surfaces on climate, the modeling approach is often used with inclusion of urban parameterization in land-surface interactions. This is especially important when going to higher resolution, which is common trend both in operational weather prediction and regional climate modelling. Model descriptions of urban canopy related meteorological effects can, however, differ largely given the odds in the driving models, the underlying surface models and the urban canopy parameterizations, representing a certain uncertainty. To assess this uncertainity is important for adaptation and mitigation measures often applied in the big cities, especially in connection to climate change.

In this study we contribute to the estimation of this uncertainty by performing numerous experiments to assess the urban canopy meteorological forcing over central Europe on climate for the decade 2001-2010, using two driving models (RegCM4 and WRF) in 10 km resolution driven by ERA-Interim reanalyses, three surface schemes (BATS and CLM4.5 for RegCM4 and Noah for WRF) and five urban canopy parameterizations available: one bulk urban scheme, three single layer and a multilayer urban scheme.

Effects of cities on urban and rural areas were evaluated. There are some differences in sensitivity of individual canopy model implementations to the UHI effects, depending on season and size of the city as well. Effect of reducing diurnal temperature range in cities (around 2 °C in summer) is noticeable in all simulation, independent to urban parameterization type and model. Also well-known warmer summer city nights appear in all simulations. For the adaptation and mitigation purposes, rather than the average temperature increase the distribution of it is more important providing the information on extreme UHI effects, e.g. during heat waves. We demonstrate that for big central European cities this effect can approach 10°C, even for not so big ones these extreme effects can go above 5°C.