



Effects of the climate change and city development on summering urban heat island and heat stress indices for Moscow megacity (Tromp Foundation Travel Award)

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The current study is focused on the analysis of temporal trends of the summertime urban heat island (UHI) intensity, their drivers and linkages with heat stress frequency for Moscow megacity. Among the considered trends, especially interesting is the intensification of summertime UHI, resulting in the urban-induced amplification of global warming during the last decades. Our analysis shows that such process is mostly driven by city growth and development and is additionally amplified by regional climate change. UHI intensification is especially pronounced for the hot weather conditions and linked with trends of the heat stress frequency.

Second part of the study is devoted to evaluation of the effects of the hypothetical scenarios of further urban development on the UHI intensity and heat stress conditions based on high-resolution (1 km grid step) simulations with a mesoscale model COSMO-CLM. The model was supplemented by urban canopy parameterization TERRA_URB [1], equipped with realistic parameters of urban surface, obtained with application of the original GIS-based technique [2] and successfully verified in comparison with observations in previous modelling studies for Moscow [3, 4].

Considered scenarios of the urban development assume the doubling of the Moscow population. Two of them propose the extensive urban expansion at the periphery of the modern city, while two others – the intensive urban growth (increasing the building height and density for existing urban areas). Simulations for such scenarios have shown that development of new urban areas or increasing the buildings height and density within existing ones affect the temperature not only locally, but also amplify the mesoscale UHI which leads to non-local effects. Partially, both extensive and intensive urban growth leads the warming in the historical city center, where no urban changes were assumed. Such non-local effects on the mean summer temperature are quite small (0.2 - 0.3K for city center), however they are strongly amplified under the heat wave conditions and becomes significant in terms of the heat stress conditions.

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