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Experimental urban heat island research of Norilsk city in northern Russia in the polar night

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Growing socioeconomic activity in Arctic zone and prospective of planning and building new settlements and cities in this region requires better understanding of the urban-caused microclimatic features and their behavior in the conditions of arctic and sub-arctic climate. The most important of these features is well-known urban heat island (UHI) effect, because in high latitudes it could mitigate severe climatic conditions within urban areas and provide the economy of fuel for house heating. The UHI effect is quietly good investigated and described for the cities in low and moderate latitudes (Oke, 1987), but there is significant lack of knowledge about UHI of the cities over the Polar Circle and especially about its behavior during the polar night, while anthropogenic heat is the only source of energy to form heat island.
In this study, we consider the results of experimental research of the UHI of Norilsk – the second biggest city over the Polar Circle, which were obtained during the expedition of Russian Geographic Society in December 2013, practically around the middle of the polar night. Field measurements in Norilsk included installation of three automatic weather stations (AWS) and the net of small temperature sensors (iButton) in the city and surrounding landscape and also car-based temperature sounding of the city with AWS. The influence of the relief and stratification was filtered by using the data of MTP-5 microwave temperature profiler. Analysis of the collected data showed the existence of significant UHI with the difference between city center and surrounding landscape up to 6 ^{0}C. The dependence of UHI power and shape on the synoptic conditions were analyzed for several typical synoptic situations, which were observed during the expedition, and the negative correlation of the UHI power with air temperature was determined.

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References:
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