EMS Annual Meeting Abstracts
Vol. 16, EMS2019-794, 2019
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Boundary layer inversions and human thermal comfort in Arctic cities (based on UHIARC measurements) (Tromp Foundation Travel Award)

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Regional and global climate change amplification in Arctic latitudes affects not only natural landscapes but also cities and its infrastructure (permafrost melting, growing of urban heat island magnitude etc). First assumption about microclimate of polar cities in Eastern Arctic was based on the UHIARC (Urban Heat Island Arctic Research Campaign) seasonal-scale experimental meteorological observations in the five cities: Apatity in Kola peninsula, Vorkuta in the north-east of the European Russia (Komi republic) and Nadym, Novy Urengoy and Salekhard in located in the north of Western Siberia. All of them have quite similar population (from 50 to 115 thousands inhabitants) and building features. In this study we focused on investigation of differences between the Arctic cities, caused by both geographic
location and various types of urban development. To do this, we estimated the differences in long-term trends in air temperature and in urban thermal comfort between different cities. In addition, deep regionalization was carried out using the WUDAPT-technology of the urban environment in the studied points to show quantitative differences in the types of building structure. An attempt was also made to estimate how the trends in cities differ from the trends in the rural area.
The already existing UHIARC network was expanded in the cities of Apatity (Kola Peninsula) and Nadym (Western Siberia) by the low-cost recorders of temperature inversions in the surface layer at heights of 1.5 and 3 meters, respectively. With the help of these complexes, it is supposed to obtain a reliable climatology of surface inversions in city core area and outside the city for the winter period, when episodes of high concentrations of atmospheric pollutants are most frequent. Such low-level inversions are a persistent feature of the Arctic climate, in particular, its Russian part. Exactly in this region, during the winter period, the most favorable conditions for temperature inversion's formation are observed. Results showed that in Nadym frequency and magnitude of surrface inversions is at least two times higher in city center
than in surroundings.
Analysis of thermal comfort trends (PET-index) showed that only near White Sea coast (Arhangelsk region) in cities of Eastern Arctic number of days with expreme thermal stress durng last 50 years has significantly augmented.

This study was supported by Russian Foundation for Basic Research (RFBR) project №18-05-60146 and 18-05-60126. Work of Pavel Konstantinov (human thermal comfort trends analysis) was supported by RSF project № 17-77-20070.