

Investigation of microclimate
and spatio-temporal structure
of surface thermal inversions
in the winter conditions of the
Arctic

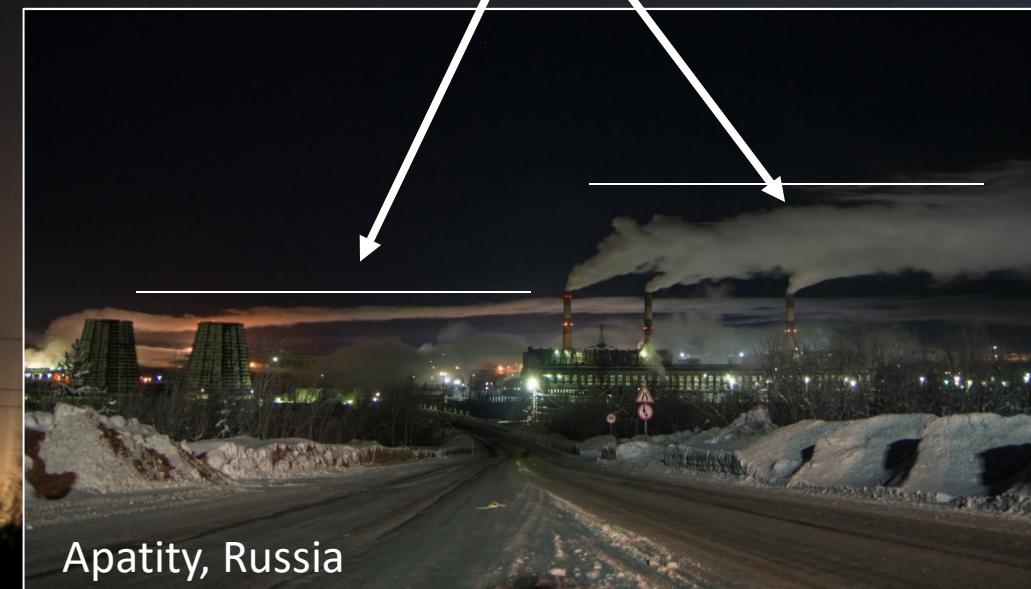
(Apatity-case study)



Konstantinov P.I., Varentsov M.I., Surkova G.V., Platonov V.S., Kolennikova M.A., Boiko A.P., Androsova E.E., Kuksova N.E., Perkhurova A.A., Krylov A.A., Varentsov A.I., Vorotilova P.G., Osipov A.M., Malytin I.V., Kospanov A.A., Melik-Bagdasarova A.S., Kozlov F.A., Bostonbaev A.S., Semenova A.A., Kostrova U.V.

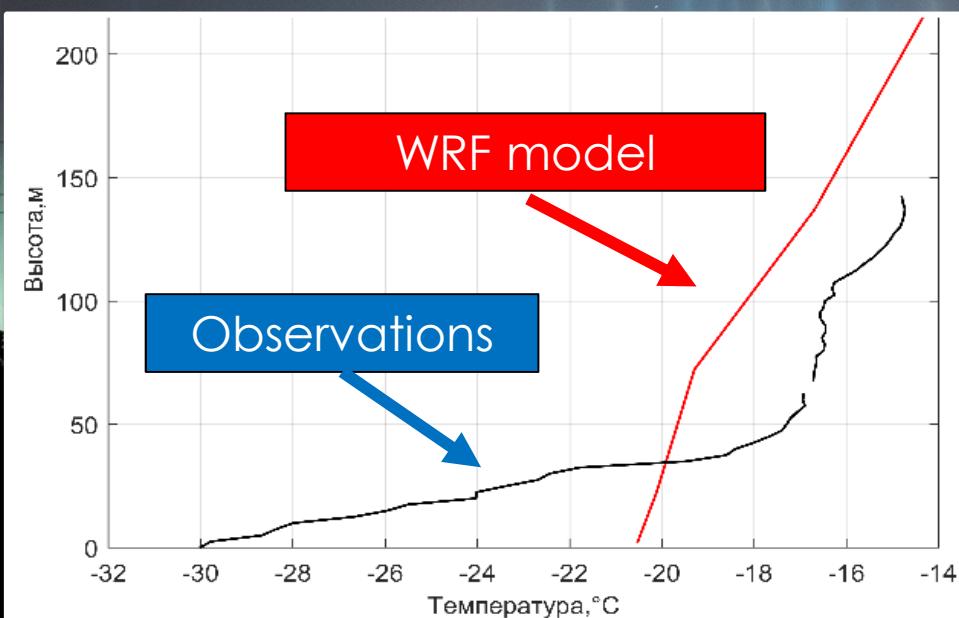
Motivation

Boundary layer inversions are closely connected with urban air quality





Field measurements



Materials and methods

Traditional AWS



Car-based sounding



*Low-cost sensors
iButton*



Dron-based sounding



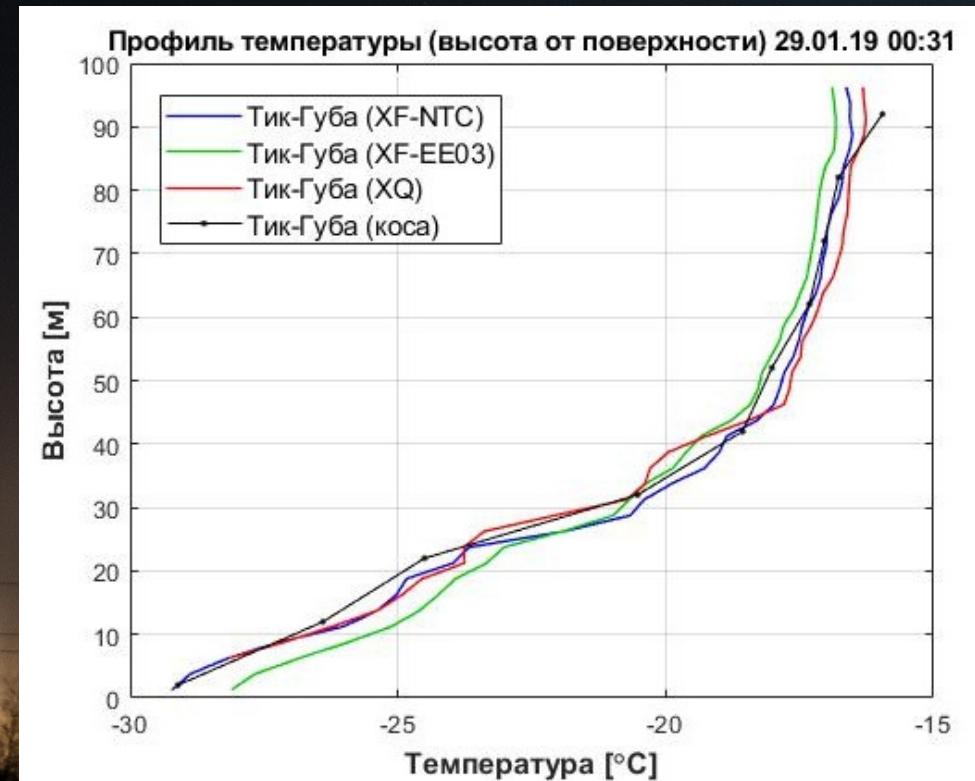
Netatmo-sensors



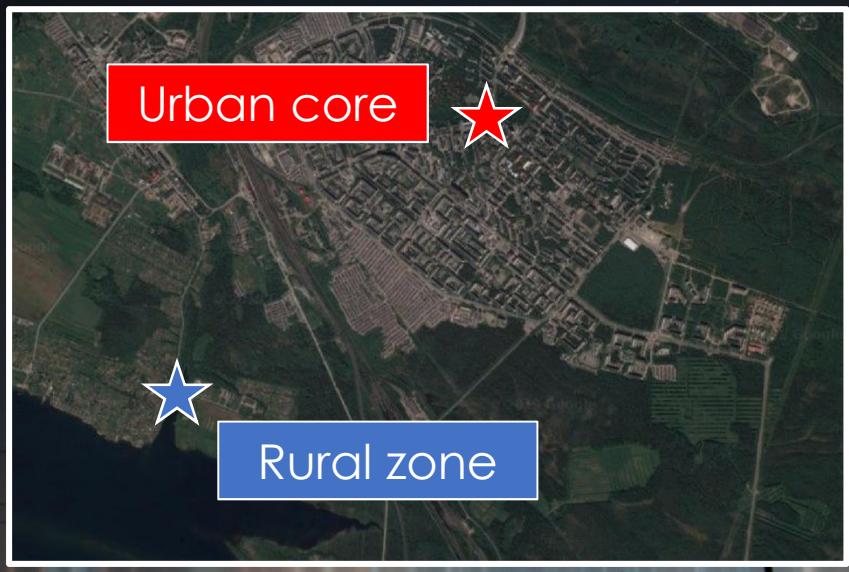
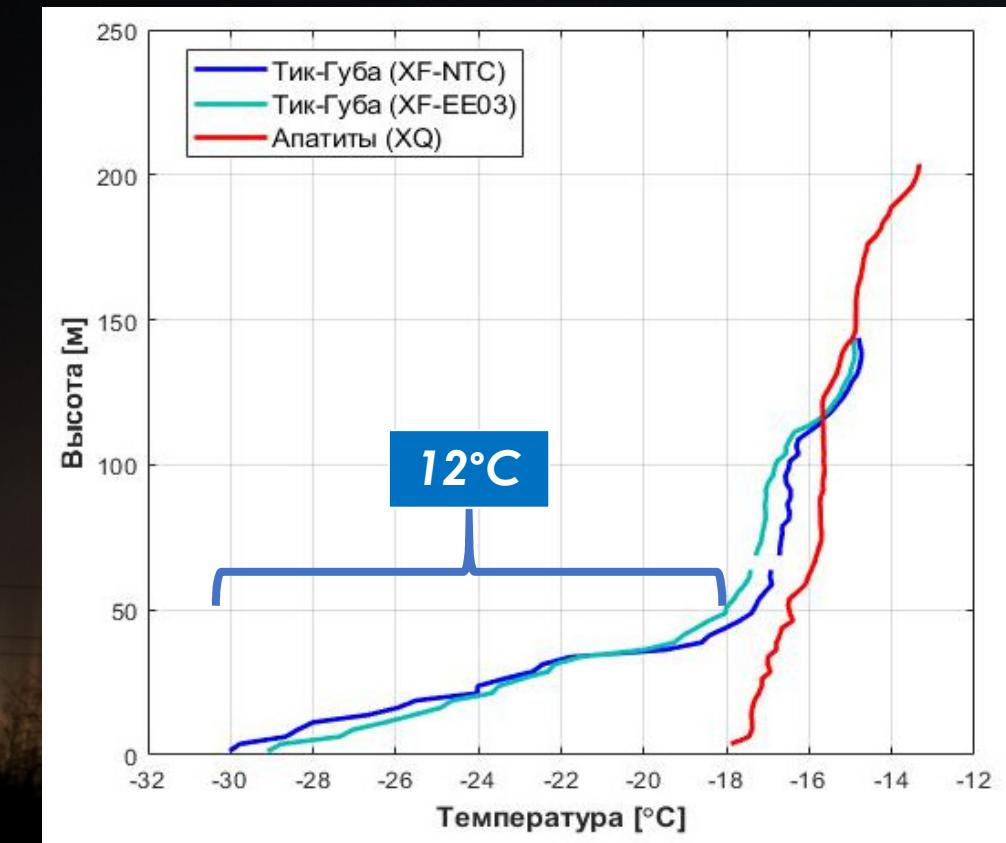
*Gradient measurements
with HOBO*



Soundings with different measuring strategies

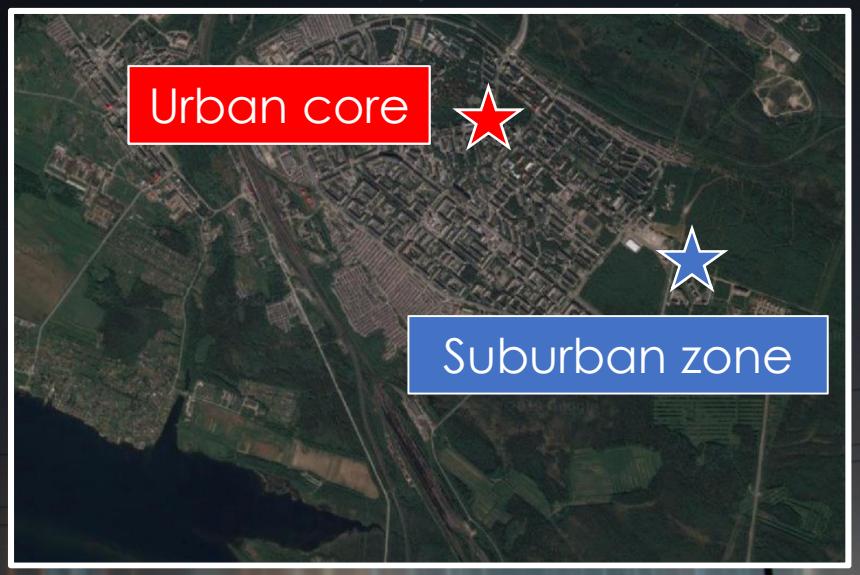
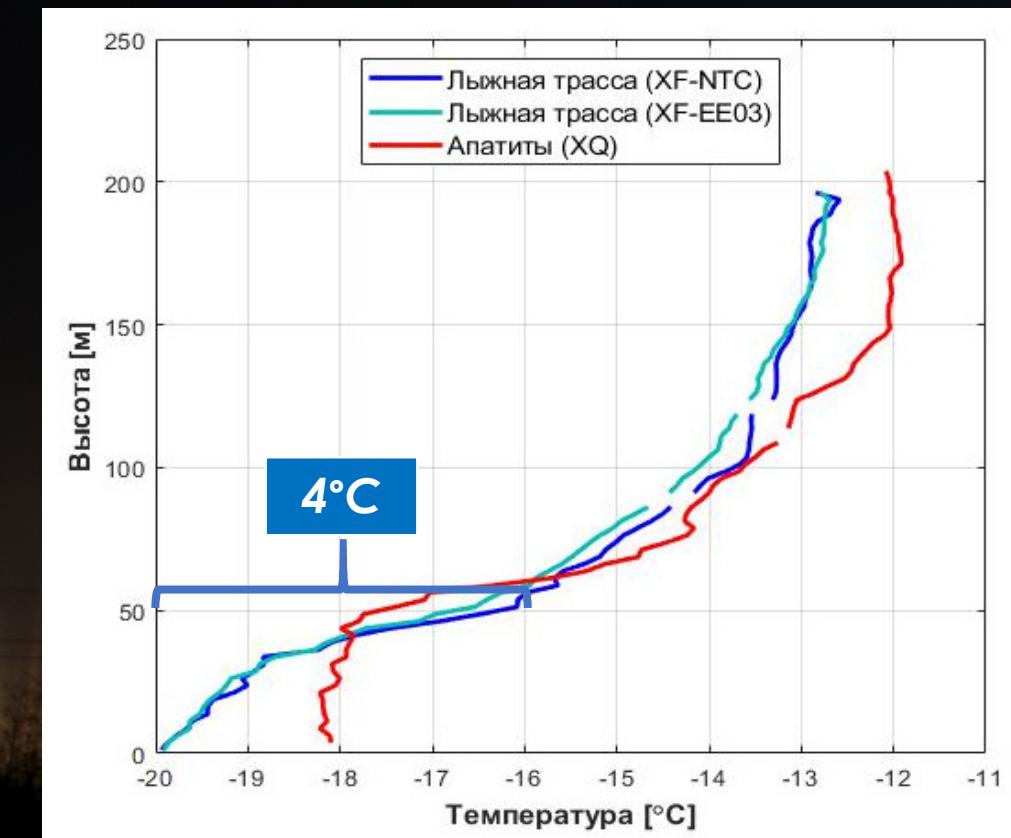


Spatial differences in thermal profiles



Night time 29/01/19

Spatial differences in thermal profiles



Night time 29/01/19

Our team



Our poster

Department of meteorology and climatology, Faculty of Geography, Lomonosov MSU

Investigation of microclimate and spatio-temporal structure of surface inversions in the winter conditions of the Arctic

Kostantinov RL, Varentsov M.I., Sunkova G.V., Platonov V.S., Kalemnikova M.A., Belia A.P., Androsova E.E., Kulikova N.E., Pechkunova A.A., Krylov A.A., Veremchuk A.L., Vasil'ev D.G., Osipov A.M., Malyutin I.V., Koszhev U.V., Melik-Bagdasarova A.S., Konkov I.Z., Bozhobayev A.S., Smetanova A.A., Kostenko U.V.

Main goal
Investigation of ground-level temperature inversions, their horizontal heterogeneity within the city and the dependence of their characteristics with the intensity of the urban heat island

Motivation
Ground level inversions poorly modeled. There is no data on surface inversions for the city of Apatity

Methods
- thermal sensors iButton
- mobile measuring complex based on a car
- weather station Metatma
- quadrocopters with temperature sensors and thermal split (a chain of thermal sensors installed 10 m)

Boundary layer inversions
Vertical sounding up to 100 meters
4 pairs of synchronous + 2 consecutive measurements
Comparison of the intensity of the surface temperature inversion in the background area (Tik-Guba) and in the center of Apatity

Microclimatic features
Study of the spatial structure of the urban heat island

Summary
1. The characteristics of surface inversions in a heterogeneous landscape differ significantly (maximum intensity - in residential areas).
2. The effect of urban heat island significantly affects the spatial and temporal structure of surface inversions, especially in the center of the city.
3. The existence of an intense urban heat island during the expedition was revealed.
4. For the first time in world practice, quantitative estimates of the spatial heterogeneity of the urban heat island for the Arctic city of a population of more than 50,000 people (Apatity) have been obtained.

Outline
For the future modeling of atmospheric processes, in particular, surface temperature within the city should determine the heat characteristics of buildings in Apatity

Acknowledgements
The members and leaders of the expedition express their sincere gratitude to the Department of Cartography and Geoinformatics of the Faculty of Geography of the Lomonosov University and the Institute of Geodesy and Cartography of the T.I. Tikhonov IAP RAS and personnel of the junior researcher Varentsov M.I. and leading researcher Repina I.A. for the provided measuring complex and also to Osipov A.M., Malyutin I.V. and Kostenko U.V. for assistance in conducting the expedition.

Building height database (Apatity)

Thanks for your attention!