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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Anthropogenic and natural drivers of a strong winter urban heat island in a typical Arctic city" *by* Mikhail Varentsov et al.

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We thank the Anonymous Referee for careful reading of our discussion paper. We have find his/her suggestions to be very useful for our study and have revised the manuscript accordingly. A number of other minor stylistic edits have been applied. All of the changes in the revised manuscript are highlighted in green. The revised manuscript is attached.

A detailed response to each of the comments is presented below and duplicated in the attached PDF file.

Comment: This is a very well-conducted analysis on an urban heat island effect in a

high-latitude urban center during winter conditions. The paper is well written and easy to follow. I have a few minor issues to be considered before accepting the paper for publication.

Response: we would like to thank the Referee for so high appreciation of our work, that inspires us for further improvements of our study and further developments of this research direction.

Comment: The authors show that roughly up to half of the observed temperature anomaly between the sites U1 and R1 can be due to orographic effects during cold winter days, not due to a real urban heat island (UHI) effect. Yet, the define UHI directly as this temperature anomaly (page 5, lines 28-29). I would very much recommend that the authors call the observed temperature differences between any two (urban vs. rural) sites as temperature anomalies, or something related to that, but not UHI.

Response: We agree with the Referee about this issue. We would like to highlight that we have been originally avoiding calling the temperature difference between the U1 and R1 sites as the UHI intensity in our study, however the related terminology was not very strict. The Referee's comment has motivated us for more accurate revision of the usage the "UHI intensity" term in our study. As he/she suggested, we have replaced the "UHI intensity" to "urban temperature anomaly" or to the mathematic designation T_R1^U1 in all cases when it was specifically related to the temperature difference between U1 and R1 sites, including the paragraph where we introduce such temperature difference (p. 6 l. 1-6).

Changes in the manuscript: multiple small changes, related to this comment, are highlighted by green in the revised manuscript, and the modified introduction of T_R1^U1 is presented below:

“We use a temperature difference T_R1^U1=T_U1-T_R1 to quantify the urban temperature anomaly. Such difference represents the deviation of the air temperature in the city center (U1 site) from the nearest WMO station (R1 site). The WMO station is used as a baseline source of weather- and climate related information in the studied area, so ∆T_R1^U1 represents the deviation of the actual temperature in the city from the regional baseline value. In many UHI studies such temperature differences are associated with UHI intensity. However, R1 and U1 sites are found at different elevations (132 and 180 m above the sea correspondingly) are situated dinfferently with respect to the local orograhy features. Besides, the WMO station is situated close to the Imandra Lake, but our analysis consider only winter conditions with a frozen lake surface, so the influence of the water area can be excluded. Below, we will examine the effects induced by the 48 m elevation difference and orograhy effects as well as by the anthropogenic UHI drivers.”

Comment: Page 5, line 28: Please mention explicitly in the text that Ti and Tj refer to temperatures at sites i and j, respectively. Furthermore, it might be worth mentioning that they are 2-m air temperatures, simply because later in the paper also land surface temperatures are being discussed.

Response: We agree with the Referee about this issue. Corresponding information has been added (see p. 5 l. 30).

Changes in the manuscript: The piece of the text, which was modified regarding to this comment, is presented below:

"Analysis in this study is based on a temperature difference ∆T_j^i=T_i-T_j, where T_i and T_j refer to measured air temperature at sites i and j, respectively."

Comment: Page 6, lines 11-12: this should rather read “...make many of the proposed

UHI scalings...”

Response & changes in the manuscript: We agree with the Referee about this issue. Corresponding edits have been applied (see p. 6 l. 12).

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-569/acp-2018-569-AC3-supplement.zip

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