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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Opposite Effects of Aerosols on Daytime Urban Heat Island Intensity between Summer and Winter" *by* Wenchao Han et al.

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General comments: This study investigated the relationships between daytime surface urban-heat-island (SUHI) intensity and aerosol pollution in summer and winter and their seasonal difference in China by using multi-source observations. The topic is very interesting and has important climate, environment and health implications. This study has the potential to provide new insights about urban climate change and their seasonal change under heavy air pollution context. The manuscript is written clearly, and I really like the schematic diagram in figure 12. While I found some minor issues need to be addressed. My recommendation is to accept with minor revision.

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Discussion paper

We would like to thank you very much for providing so many insightful comments. Following your comments and suggestions, we have made many changes. The manuscript was also more carefully edited. The responses are highlighted in red; the changes in manuscript are highlighted in blue in this response file.

Comment 1. Introduction: UHI can be defined by satellite-based Land surface temperature (LST) (i.e., surface UHI) and also can be defined by surface air temperature (SAT) recorded by stations. There still is a bit differences in these two definitions and their drive factors, although SAT is closely related to LST. Therefore, some papers in the Introduction need to be stated clearly for which definition. In addition, suggest that surface is added in the paper Title and the MS.

Response: We agree with you that UHII mainly contains surface and atmospheric urban heat islands. We added the sentence "While the UHI mainly involves surface and atmospheric UHIs, this study focuses on surface UHI." on line 57. We also changed the title to "The Mechanisms and Seasonal Differences of the Impact of Aerosols on Daytime Surface Urban Heat Island Effect" in the manuscript and supplement.

Comment 2. Method: about meteorological station should be added in figure 1 or in the supplementary? How did you choose the urban and rural (i.e. reference) stations in each city?

Response: We added the spatial distribution of meteorological stations in Figure S1: We added the sentence "Figure S1 shows the spatial distribution of the meteorological stations." on line 138. We selected these stations city by city. Urban stations are those stations located within the urban boundaries shown in Figure 2. Rural stations are those stations located outside urban boundaries, least affected by urban areas and with the lowest altitude difference with the urban areas.

Comment 3. Sample numbers should be added in Figure 2.

Response: Figure 3 results are based on Figure S5. Samples numbers in Figure 3a

and Figure 3b are 68 and 510, respectively (see line 250).

Comment 4. Please check whether eq.3 matched with the text in lines 239-240? Also y-axis title should be MUHII (or MSUHII)?

Response: In Figures 4 and S4, we directly compared UHII under polluted conditions and UHII for all days. We deleted the previous version of the figure. The following passage has been deleted: MUHII= $(\sum\_(i = 1)^{n} n = 15) UHII\_(m\sim i)$-ãĂŰUHIIãĂŮ_(p∼i) ãĂŮ)/n, (3) where MUHII is the difference between the UHII under severe air pollution conditions and the average UHII, n is number of years from 2001 to 2015, i represents a specific year during 2001–2015, ãĂŰUHIIãĂŮ_(m∼i) is the average UHII in year i, and ãĂŰUHIIãĂŮ_(p∼i) is the UHII under severe air pollution conditions in a year i. Figure S3 shows the MUH11 at each city under polluted conditions and for all days.

Comment 5. Lines 251: aS4ll? What do you mean?

Response: Here, “sS4ll” should be “all”. We have corrected this typo.

Comment 6. Lines 272-276: excepting temperature inversion-induced stable PBL, aerosol pollutions usually accompanied with low wind speed (particularly <2m/s), which is also favorable to both heat accumulation / store and UHI enhancement.

Response: Yes, you are right. We added more explanations on lines 289 to 291: “In addition to a temperature-inversion-induced stable PBL, air pollution is usually accompanied by low wind speeds (particularly < 2m s-1), also favorable to both heat accumulation and storage.”

Comment 7. Lines 292-293: In the daytime during winter, the high aerosol concentrations in the rural areas, due to high emission induced by coal heating in rural area in the north China, while in south more industries in rural areas under stagnant atmospheric conditions? This seasonal variation in urban-rural difference may modulated by the combined effects of PM2.5 emission, transportation and diffusion (please refer to Urban-rural differences in PM2.5 concentrations in the representative cities

of China during 20152018. CHINA ENVIRONMENTAL SCIENCECE, 2019, 39(11): 4552-4560.).

Response: We agree. We added the following sentence (lines 313 to 314): "Many factors (e.g., PM2.5 emissions, transportation, and diffusion) may cause the seasonal difference in urban-rural differences (Jiang et al., 2019)." We also added the reference (line 560): "Jiang, Y. C., Yang, Y. J., Wang, H., Li, Y. B., Gao, Z. Q., and Zhao, C.: Urban-rural differences in PM2.5 concentrations in the representative cities of China during 2015–2018, China Environ. Sci., 39(11), 4552–4560, https://doi.org/10.19674/j.cnki.issn1000-6923.2019.0530, 2019." Note that we have another manuscript under review, focused on the seasonal difference in the urban-rural spatial distribution of air pollution, which also analyzes several potential factors that cause the seasonal difference.

Comment 8. Subfigures in Figure S5 and S7 are very small unclear for readership.

Response: Figures S6 and S8 have been redrawn for clarity. Increasing the zoom percentage will help with seeing more details.

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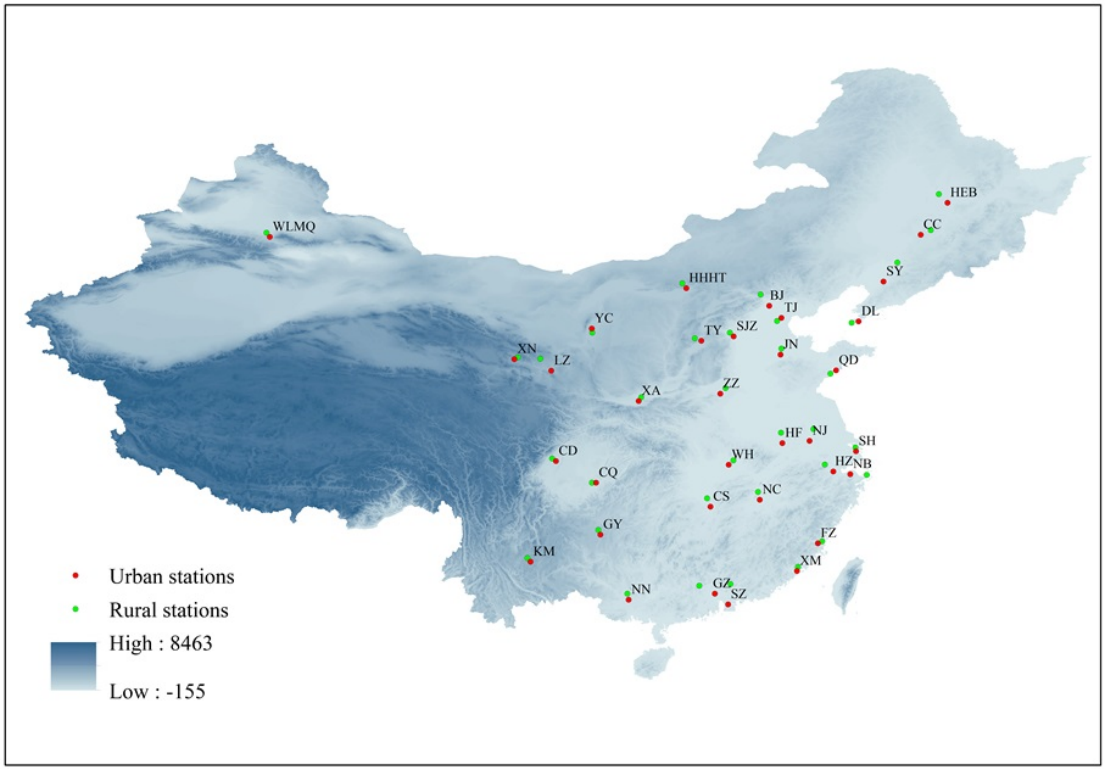

Fig. 1. Figure S1. Spatial distribution of meteorological stations located in 35 cities.

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