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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.

Anonymous Referee #1

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General comments: This study showed that that aerosols have very different effects on daytime UHII in different seasons: reducing the UHII in summer, but increasing the UHII in winter. It also found that he seasonal contrast in the spatial distribution of aerosols between the urban centers and the suburbs lead to a spatial discrepancy in aerosol radiative effect. Different mechanisms are analyzed for different seasons. The manuscript has well-presented some interesting findings. However, there are still some major concerns that need to be addressed.

Some concerns: 1.I suggest the authors combine the first paragraph with the second paragraph. And remove the sentence in the second paragraph, "It is well established

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that cities are the largest sources of anthropogenic heat emissions as by-products from industrial and human activities. Human activities can also generate large amounts of aerosols that can reduce air quality, change the physical and chemical properties of the atmosphere, and endanger human health (Sanap and Pandithurai 2015, Cohen et al. 2017, Wei et al. 2019a, b)." to the beginning of the third paragraph. 2.The sentence "The effect of urbanization on clouds and precipitation has been the focus of many studies (Changnon et al. 1977, Ackerman et al. 1978, Changnon et al. 1991, Shepherd et al. 2002, Shepherd and Burian 2003)" looks very abrupt here. 3.Overall, illustrations with more logics are needed for introduction Section. 4.Section 2 is suggested to be "Data and methods". The data, method of Extracting urban impervious surfaces and urban contours, model description should be included separately by three parts. I suggest the authors combine the "research windows" into "method of Extracting urban impervious surfaces and urban contours". And combine the "Aerosol parameters" to the part of "data" together with some data in the present part "Study areas and data". "Study areas" can be removed to the beginning of result analysis. Additionally, the method of calculating USII should be mentioned. 5.Figure 1 need some modifications, for example, the city name "Changchun" has been divided into 2 rows. 6.Figure 2 should mark the result of confidence test. The impact factors are more than aerosol. The atmospheric humidity should be included. Here, the relation between USII and visibility may be one-sided. Moreover, the result of urban heat island does not just include the changes in aerosol. In Figure 3, the details of "severe air pollution condition" should be shown, including the data used here, definition of severe air pollution and period of severe air pollution event. It is not clear whether the ðİŚĹðİŘżðİŘijðİŘijðİŚİ∼ðİŚŰ is calculated based on several severe air pollution event or not. The details should be addressed and added. 7.Figure 5, "red curves" should be changed to "red curve", "black curves" to "black curve". How did the PM2.5 concentration bins get? And was the urban-rural PM2.5 difference corresponded to the PM2.5 concentration bins? Some descriptions should be added. Same information for AOD is also needed. 8.A better quality of combination figure is needed for Fig. 8. The meaning of arrows in Fig. 9

should be given. 9.Page 19, Line 368, “In summer (Figure 11 a), aerosols reduce UHII throughout all day; but in winter (Figure 11 b), aerosols enhance UHII in the afternoon. These results are consistent with the observational results shown in Figure 3”. Figure 3 cannot provide the consistent result. Figure 3 shows the result at annual scale. However, Figure 11 is the simulation for an event for three days.

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