



EGUsphere, referee comment RC2
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Comment on egusphere-2022-77

Anonymous Referee #2

Referee comment on "Circulation-regulated impacts of aerosol pollution on urban heat island in Beijing" by Fan Wang et al., EGU Sphere,
<https://doi.org/10.5194/egusphere-2022-77-RC2>, 2022

This manuscript examined the characteristics of UHI in Beijing with observation and model simulation focusing on the variable impacts of aerosol and regional circulation on the intensity of UHI. The authors clearly showed weakened intensity of UHI associated with aerosol pollution both in daytime and nighttime, which is opposed to what has been reported in the previous literatures. They also exhibited the differences in UHI among the different wind directions and tried to reveal the mechanisms behind them with sensitivity simulations using WRF-Chem model. I acknowledge that some of these findings are important not only to the science of UHI but also to co-controlling UHI and urban air pollution issues in the city. This paper is rightfully within the scope of ACP, however, I noticed several issues in this manuscript which cannot be passed over to be published. I suggested that the authors should consider the following comments.

Major Comment:

The manuscript was basically well organized, and each chapter (and sub chapter) summarized the information concisely. However, in many aspects. descriptions were too concise to understand properly what they mean. Most of the figure captions were insufficient, and several key points of the manuscript lacked convincing explanations and discussions but rather just cited the previous literatures. These kinds of terrible lack of information largely deteriorate the value of the manuscript. I strongly recommend the author to carefully revise the manuscript, figure and figure captions to make the paper more scientifically readable. I noticed concrete points of revision as below.

Specific Comments:

- L117: The definition of UHII is not well described. Did you take the difference between the averaged T2m over all urban stations and all rural stations?

- L120-122: You should explain why you choose the different definition of UHII for simulation from that for the observation and how large impact the difference in the definition will have. Since the rural area in calculating the UHII for simulation shown in Fig S4 and S5 is largely different from the area where the rural observation sites are located, I suppose the impact can not be negligible.

- Fig1: Insufficient caption. What is the bold curve on the figures? What is the definition of μ ? Horizontal axis should be UHII (not UHI) for a and d, UHII_max for b and e, UHII_min for c and f.

- L125: Fig.1 is unrelated to wind directions.

- L126: The definition of clean day and pollution day is not clear. Did you calculate the daily mean PM2.5 concentration averaged over all stations regardless of urban and rural and that all-station-averaged value is used for clean/polluted day judgement? Or, every

station should pass the criteria to be judged as clean/polluted day?

- L127: Unit of UHII should be [K] not [°C]

- L130-136: This part is not described well. I cannot fully understand what you want to mean here. According to the description in this part, the strengthened LW radiation in nighttime due to the absorption of sunlight by aerosol in daytime alleviate the temperature reduction in nighttime, which should lead to intensify nighttime UHII in polluted situation compared to clean condition. However, you also state that ARE reduces near surface temperature in urban areas, leading to a weakened UHII ** throughout the day**. Could you explain more about the mechanism how ARE reduce near surface temperature and weaken UHII in nighttime? I guess it's better to consider using schematic diagram to explain the complicated role of aerosol on UHII in daytime and nighttime.

- Fig2: Insufficient caption. What is the definition of box-whisker plots?

- L140: More words are necessary to explain why the reduction of aerosol in urban area in the case of northerly wind led to elevated UHII. Especially, it's quite confusing that even though the northerly wind reduces the aerosol in urban area, it is still classified as "polluted". So, you should explain why the difference in UHII between clean and polluted conditions is minimal under northerly wind. Just citing Gao et al. (2016) is not enough.

- L140-141: "Decreases" in UHII at daytime, from what?

- L142: More explanation is necessary about how the longwave radiation process can weaken the decrease of UHII in polluted condition compared to clean condition.

- L145-148: The foehn wind can be a reason for the reversal of thermal gradients under westerly, but it cannot be a reason under southerly, because there are no high mountain ranges in the south of Beijing.

- Fig3 (and FigS5): I was confused, and I could not understand why NBC-NAF is used in these figures. If you want to isolate the BC absorption effect, you should take the difference between NBC and AF. I think NBC-NAF represents the ARE by all aerosols but BC.

-L165-168: Since the lines in Fig3 are too thin and unclear to distinguish each other, I could not recognize well what you write in this part.

- L168-169: I could not recognize what you describe here about FigS3c,d: what is "slower pace"? You should describe more clearly here.

- L170: What does the "difference" mean here?

- L182: Why FigS4e here? It is for N2 not for D3.

- L184: Could you explain more precisely how the thermal difference of the atmosphere after sunset can modify downward longwave radiation in nighttime?

- Fig4: What are the blue contours in the figure? No descriptions can be found in figure caption.

- L190: I cannot understand that the weakened warm southerly wind can reduce the UHI in Beijing, since that kind of change in regional scale circulation will evenly influence both urban and rural area which cannot alter the intensity of UHI (UHI is based on the "difference" between urban and rural area). You should explain more precisely about how the mechanism that regional scale circulation change alter the UHI.

- L202: I don't think the situation in Fig4c,f,i agree with the observed least impact of aerosol on UHI under northerly wind in urban area, because the prevailing wind direction in Beijing urban area in Fig4c,f is not northerly but westerly or southwesterly.