Response to Reviewer Comments

Dear Reviewer and Editors:

We are sincerely grateful to the editor and reviewer for their valuable time for reviewing our manuscript. The comments are very helpful and valuable, and we have addressed the issues raised by the reviewer in the revised manuscript. Please find our point-by-point response (in blue text) to the comments (in black text) raised by the reviewer. We have revised the paper according to your comments (highlighted in red text of the revised manuscript).

Sincerely yours,

Dr. Yuanjian Yang, representing all co-authors

Reviewer #2:This case study work investigated the canopy UHI of Beijing City in the summers of 2016-2020. Based on data from various sources, the authors conducted a systematic analysis, aiming to get a better understanding of the synergy between heat waves and the canopy UHI, as well as the influences of local circulation and urban morphology on this synergy. It is an interesting work with the support of a dense observation network and other fine-resolution data sets.

The authors try to consider many different aspects, which in turn requires the combination of many different data sources and analysis methods. This, however, makes the paper just as complex as the climate topic. Without improvement on the structure of this paper, especially the clarity of the data and methods, and the fragmented results presentation, it is difficult to follow the flow of the paper and to grasp the key findings.

Response: Thanks very much for taking time out of your busy days to provide us with such valuable comments that significantly improve the quality of our manuscript. In

line with your comments and suggestions, we have revised our manuscript carefully and prepared a list of point-by-point responses below.

Firstly, the Introduction section is updated carefully to better highlight the central scientific question of this study. In our revised manuscript, we focus on the scientific question of how mountain-valley breeze and urban morphology drive the positive feedback effect between HW and CUHII in the Beijing megacity.

Secondly, we have revised the descriptions of the key concepts and calculation methods for CUHII, HW, mountain-valley breeze, and urban morphology in the Data and methodology section. These updates ensure that readers have a clear understanding of the approach in this manuscript.

Additionally, a summary of the key findings and the corresponding subsequent analysis are appended at the end of each subsection of the section of Results to improve the coherence of this study.

Finally, we have thoroughly revised the sections of Abstract and Conclusion to highlight our main findings. Specifically, we have emphasized the influence of wind speed and direction on the temporal and spatial distribution of the positive feedback effect between HW and CUHII, as well as the driving role of both two-dimensional and three-dimensional urban morphology in the effect.

Major comments：

1. The language needs improvement.

Response: Thank you for taking the time to review my manuscript and provide valuable feedback. I have carefully revised the text to ensure clarity, conciseness, and fluency throughout.

2. Some details in the data and method section need to be clarified, some decisions need to be justified. I think this paper needs to be better structured, some details in the data and method sections need to be clarified, and the results need to be presented more concisely.

Response: I sincerely apologize for any unclear in the previous version of the

manuscript, particularly in Data and Methodology section.

In response to your valuable suggestions, I have thoroughly enhanced the descriptions in the Data and Methodology section. This includes additional information on the introduction of LCZ data, the definition of HW, the calculation method for CUHII, the computation of the amplified CUHII during HW periods (ΔCUHII), the methodology for calculating mountain-valley breeze, and the explanation of urban morphology indicators. Taking the detailed explanation of the mountain-valley breeze calculation method as an example, the corresponding updated information is shown in lines 154-163 of the revised manuscript:

"Referencing relevant methods (Cao et al., 2015; Zheng et al., 2018), the mountain-valley breeze is extracted and the details are shown as below. Firstly, the hourly wind data from each observation station were decomposed into the components of u (east-west direction) and v (north-south direction). From June to August between 2016 and 2020, the average values of the hourly wind components were calculated, yielding hourly average values $\overline{u}$ and $\overline{v}$. Subsequently, the diurnal average values U and V were obtained by averaging all the hourly average values $\overline{u}$ and $\overline{v}$, respectively. The hourly anomalies u' and v' were then derived by subtracting the diurnal average values U and V from the hourly average values $\overline{u}$ and $\overline{v}$, respectively. The diurnal average values U and V can be interpreted as the systematic wind or background wind, while the hourly average values $\overline{u}$ and $\overline{v}$ can be considered as the actual wind. The local wind u' and v' obtained by subtracting the systematic wind from the actual wind, can be utilized in studies focused on regional local circulations, in particular for the mountain-valley breeze."

Reference:

Cao, J., Liu, X., Li, G., Zou, H.: Analysis of the phenomenon of Lake-land breeze in Poyang Lake area, Plateau Meteorol. Chin., 426–435, 10.7522/J.ISSN.1000-0534.2013.00197, 2015.

Tian, Y., Miao, J.: Overview of Mountain-Valley Breeze Studies in China. Meteorological Science and Technology, 47, 1, 11. https://doi.org/10.19517/j.1671-6345.20170777, 2019.

Zheng, Z., Ren, G., Gao, H. Analysis of the local circulation in Beijing area, Meteorological Monthly, 44, 3, 425–433, https://doi.org/10.7519/j.issn.1000-0526.2018.03.009, 2018b.

3. Please rephrase the last paragraph of the introduction section to emphasize your key research questions.

Response: I sincerely apologize for the oversight in the final paragraph of the introduction, where the key scientific questions were not adequately described. Your observation is absolutely right, and I appreciate your guidance in improving the clarity of our work.

To address this, we have expanded the introduction section to provide a more detailed overview of the existing research in this field. We have specifically highlighted that previous studies predominantly centered on the spatiotemporal variations of the ΔCUHII in the Beijing megacity, leaving a gap in knowledge regarding the driving mechanisms of local circulation and urban morphology on amplifying CUHII during HW periods.

Recognizing this gap, we have identified the exploration of this very topic as the scientific question of our study. Our research aims to investigate how mountain-valley breeze and urban morphological characteristics drive the significant feedback effect between HW and CUHI in Beijing's urban environment.

4. Please present your results more concisely while sticking to your key research questions. Try not to overwhelm readers with less important details in numbers, instead, try to summarize and convey the key results, to better connect different fragments of result presentations so that the storyline flows better.

Response: Thanks very much for your valuable comment. We have carefully considered your feedback and made several improvements to address your concerns.

Firstly, we have removed the unnecessary numerical details as you requested to simplify the text.

Secondly, we have expanded the Introduction section to more prominently outline the

key research questions.

In addition, a summary of the key findings and the corresponding subsequent analysis are appended at the end of each subsection of the section of Results to improve the coherence of this study.

Finally, we have refined the Conclusion section to ensure it clearly and concisely summarizes our main findings.

We are grateful for your attentive review and invaluable suggestions, which have significantly contributed to enhancing the quality of our manuscript.

Minor comments:

P1Line21: "insight to understand the driving mechanisms…" maybe "insight into understanding the driving mechanisms." or "insight into the driving mechanisms"

Response: We greatly appreciate the time and patience you have taken to provide your insights on our study. I deeply apologize for the small errors and oversights that you have pointed out. I have carefully addressed each of your comments and double-checked the entire manuscript for any other potential issues.

P1Line16: "On a street scale" , maybe "on the street level"

Response: Corrected.

P1Line25: "hasbecome" space in between missing

Response: Corrected.

P2Line43: "Few studies…" Do you mean "A few studies…" or do you want to say this has not been studied.

Response: Thanks very much for your valuable comment. What I intended to convey was that a limited number of scholars have conducted relevant studies on this topic. "Few studies" was revised to "a limited number of scholars".

P2Line36: "The rate of contribution of urbanization to the excessive mortality caused by high temperatures can reach more than 45% in the high-density urban areas"

-> The contribution rate of urbanization to excessive mortality caused by high temperatures can exceed 45% in high-density urban areas.

Response: Thank you for your patient guidance. The revisions have been made accordingly.

P2Line47: "Overall, the current understanding of the mechanisms through which local circulations modulated the amplified CUHII during HW periods is still in the exploratory stage."

-> Overall, the current understanding of how local circulations modulate the amplified CUHII during heatwave periods is still in the exploratory stage.

Response: Corrected.

P2Line49: "impact" not necessary

Response: Corrected.

P2Line59: "However, LCZs are a comprehensive indicator of urban morphology, and the aforementioned studies have not quantified the contribution of different urban morphological parameters to the local thermal environment, nor have they taken into account the nonlinear driving effects of 60 urban morphology on the local thermal environment (Alonso & Renard, 2020; Chen et al., 2022)."

-> However, while LCZs are a comprehensive indicator of urban morphology, the aforementioned studies have neither quantified the contributions of different urban morphological parameters to the local thermal environment nor considered the nonlinear driving effects of urban morphology on the local thermal environment.

Response: Thank you for your valuable comment. The manuscript has been revised carefully according to your comment.

P2Line63: "Currently, it is still matter of debate the roles of local circulations and urban morphology in amplifying CUHI in megacities during HW periods."

-> Currently, the roles of local circulations and urban morphology in amplifying CUHI in megacities during heatwave periods are still a matter of debate

Response: Corrected.

P2Line64: "The main objective of this study is considering as case study the megacity of Beijing, using high-density automatic weather stations (AWS) observations."

-> The main objective of this study is to use high-density automatic weather station (AWS) observations to analyze the megacity of Beijing as a case study.

Response: Corrected.

P3Line70: "The terrain of Beijing is exceptionally complex, northly bounded by Yan Mountains by Taihang Mountains in the west."

-> The terrain of Beijing is exceptionally complex, bounded to the north by the Yan Mountains and to the west by the Taihang Mountains.

Response: Thank you for your patience. The manuscript has been revised.

P4: FIG1c, not built-up -> Non-built-up

Response: Corrected.

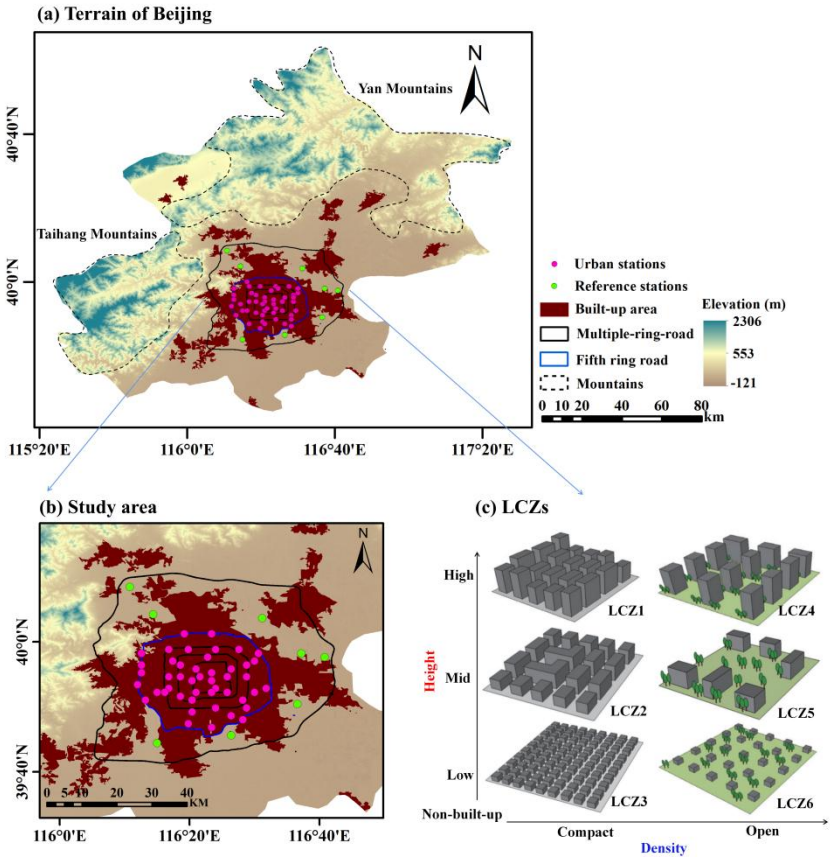

Figure 1: Overview of study area. (a) Terrain and land use of Beijing. (b) Distribution of urban stations and reference stations in the built-up area of Beijing. (c) Empirical examples of the typical LCZ types.

P5Line85: "released by Professor Yang and Professor Huang of Wuhan University"This is not necessary, you already cited the corresponding publication.

Response: I apologize for any confusion caused by the previous expression. I have made the appropriate revision in the revised manuscript as below:

"The annual China Land Cover Dataset (CLCD) is a dynamic data set accounting for land use in China released by Yang & Huang (2021)."

P5Line85: "made" maybe "produced"

Response: Corrected.

P5Line89: "The building skyline and floor data of the electronic map were extracted using Python language." Electronic map from which provider?

Response: Thanks very much for your valuable comment. The electronic map data used in our study was sourced from Gaode Maps. I have added the information in the revised manuscript.

P5Line90: "was estimated to be 3 m"

was set to be 3 m

Response: Corrected.

P5Line112: "This study identified stations that were less influenced by the urban effect" Selecting reference stations is always a challenge and the criteria are subject to the decision of different choices that might be biased. From the map on Fig1, it seems these reference stations are rather close to built-up areas.

Response: Thanks very much for your valuable comment. In our revised manuscript, the details of the method for identifying urban stations and reference stations are added in the section of Data and methodology.

In general, scholars define CUHII as the temperature difference between the urban station and the reference station (Ren et al., 2007; Shi et al., 2015). Thus, identifying the urban stations and rural reference stations is very important for investigating urban climate. In the region of our study, Beijing has undergone massive and rapid urbanization, with its urban space continually expanding into the suburbs over the past few decades. Currently, Beijing boasts a population of 20 million and a built-up area spanning 1400 km^2. Due to this expansion, a swift transportation system has become imperative for urban development, prompting Beijing to commence the construction of a Multiple-ring-road system since the 1990s (Wang et al., 2010). These rings effectively represent the radial expansion of urban zones, with varying population and building densities. Notably, the Fifth Ring Road, with a length of 98.6 km and a built-up area of approximately 300 km^2 (depicted as the blue ring in Fig. R1), encompasses the primary regions of the built-up area (Yang et al., 2013). The

distribution characteristics of average air temperature around the built-up area of Beijing are illustrated in Fig. R1, showing that the high-temperature zone in the city center aligns closely with the extent of the Fifth Ring Road. Additionally, the proportion of densely built-up areas within the Fifth Ring Road exceeds 85%, significantly higher than that outside this ring. Therefore, we have designated stations within the Fifth Ring Road as urban stations in this study.

The identification of reference stations is shown below. Firstly, the reference stations should have significantly lower temperatures than those of urban stations, based on the spatial distribution characteristics of average temperatures. Secondly, the reference stations must be located more than 50 km away from the city center, in a rural environment, predominantly situated within areas of sparse trees and shrubs (Yang et al., 2023). Thirdly, the reference stations should also be evenly distributed across different directions of the entire city. According to these criteria, eight reference stations were selected (green plot in Fig. R2), with an average altitude of 39.6 m, which is only 8.8 m lower than the average altitude of 45 urban stations (red plot in Fig. R2).

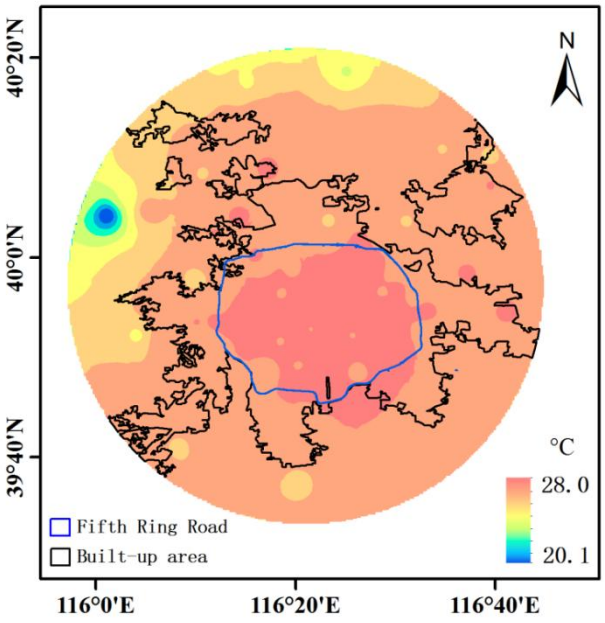

Fig. R1 The distribution characteristics of average air temperature around the built-up area of Beijing.

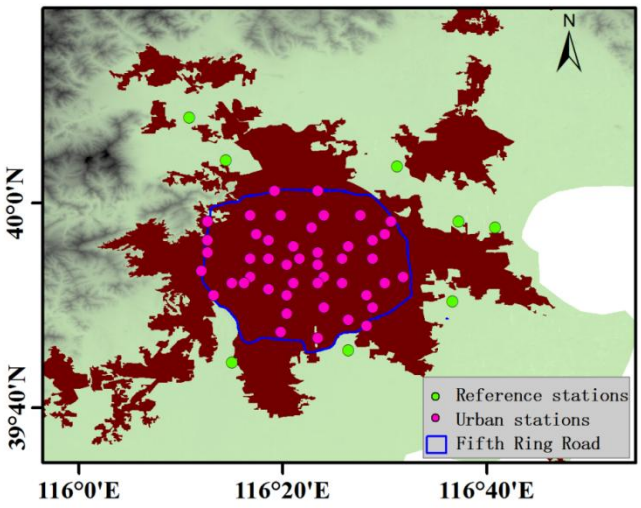

Fig. R2 Spatial distribution of urban and reference stations in Beijing.

Reference:

Yang, P., Ren, G., Liu, W.: Spatial and temporal characteristics of Beijing urban heat island intensity. Journal of Applied Meteorology and Climatology, 52, 8, 1803-1816, http://doi.org/10.1175/JAMC-D-12-0125.1, 2013.

Ren, G., Chu, Z., Chen, Z., Ren, Y.: Implications of temporal change in urban heat island intensity observed at Beijing and Wuhan stations, Geophysical Research Letters, 34, 5, https://doi.org/10.1029/2006GL027927, 2007.

Shi, T., Huang, Y., Shi, C., & Yang, Y.: Influence of Urbanization on the Thermal Environment of Meteorological Stations: Satellite-observational Evidence, Advances in Climate Change Research, 1, 7–15, https://doi.org/10.1016/j.accre.2015.07.001, 2015.

Yang, Y., Guo, M., Wang, L., Zong, L., Liu, D., Zhang, W., Wang, M., Wan, B., Guo, Y.: Unevenly spatiotemporal distribution of urban excess warming in coastal Shanghai megacity, China: Roles of geophysical environment, ventilation and sea breeze, Building and Environment, 235, https://doi.org/10.1016/j.buildenv.2023.110180, 2023.

Wang, X., Li, X., Feng, Z.: Research on Beijing urban expansion based on the principle of information entropy. China Population,Resources and Environment, S1, 88–92, https://doi.org/CNKI:SUN:ZGRZ.0.2010-S1-024, 2010.

P6Line124: "Calculation of mountain-valley breeze", I suggest adding more technical details on this in the supplementary information.

Response: Thank you for your insightful comments. I have now included additional technical details on this topic in the line 153-162 of the revised manuscript as below:

"Referencing relevant methods (Cao et al., 2015; Zheng et al., 2018), the mountain-valley breeze is extracted and the details are shown below. Firstly, the hourly wind data from each observation station were decomposed into the components of u (east-west direction) and v (north-south direction). From June to August between 2016 and 2020, the average values of the hourly wind components were calculated, yielding hourly average values $\overline{u}$ and $\overline{v}$. Subsequently, the diurnal average values U and V were obtained by averaging all the hourly average values $\overline{u}$ and $\overline{v}$, respectively. The hourly anomalies u' and v' were then derived by subtracting the diurnal average values U and V from the hourly average values $\overline{u}$ and $\overline{v}$, respectively. The diurnal average values U and V can be interpreted as the systematic wind or background wind, while the hourly average values $\overline{u}$ and $\overline{v}$ can be considered as the actual wind. The local wind u' and v' obtained by subtracting the systematic wind from the actual wind, can be utilized in studies focused on regional local circulations, in particular for the mountain-valley breeze."

Reference:

Cao, J., Liu, X., Li, G., Zou, H.: Analysis of the phenomenon of Lake-land breeze in Poyang Lake area, Plateau Meteorol. Chin., 426–435, 10.7522/J.ISSN.1000-0534.2013.00197, 2015.

Zheng, Z., Ren, G., Gao, H. Analysis of the local circulation in Beijing area, Meteorological Monthly, 44, 3, 425–433, https://doi.org/10.7519/j.issn.1000-0526.2018.03.009, 2018b.

P6: Table1, "Building cover ratio, which represents the proportion of the roof of the building to that of the entire study area." This is rather confusing, what do you mean by "the entire study area"? What do you mean by "study area", do you mean the entire Beijing urban are or only the area within the buffer zone?

Response: I apologize for any confusion caused by my previous phrasing in Table 1. To address your concerns, I have replaced all occurrences of "study area" and "entire study area" with "buffer zone" in Table 1. In addition, I have explicitly stated in the text that the buffer zone refers to a 500 m area surrounding the AWS (Oke, 2004). This clarification should help readers understand the scope and context of our analysis.

Reference:

Oke, T. R.: Initial guidance to obtain representative meteorological observations at urban sites. University of British Columbia, Vancouver, 2004.

P6Line131: "to measure the morphological characteristics around AWS", up to which distance surrounding the AWSs?

Response: Thank you for your thoughtful comments on our manuscript. We have supplemented the information in line 166 of the revised manuscript as below:

"to measure the morphological characteristics of buildings within a 500 m buffer zone surrounding the AWS"

P6: Table1,"Number of patches." What patch?

Response: Thank you for bringing this to our attention.. To clarify and improve the clarity of our manuscript, we have revised the term to "Number of building patches."

P6: "Table 1: Summary of the spatial morphological parameters." I know it is rather complicated and might require too much effort, but it would be much better to give the equations for calculating these factors, especially since you failed to describe them clearly in the text.

Response: Thank you for your patience in reviewing our manuscript. We completely agree with your assessment regarding the need for clearer descriptions of some of the indicators in Tab. 1. To address this, we have described the parameters in Table 1 in detail. In addition, we also provide a schematic diagram of key indicators (Fig. R3) to further improve clarity.

Table 1: The 2D and 3D spatial morphology indicators involved in this paper.

Indicators	Description
2D	
BCR	Building cover ratio represents the proportion of the roof of the buildings to that of the buffer zone.
NEAR	Mean distance between adjacent buildings. A lower value of this metric indicates a higher density of buildings.
NP	Number of buildings patches indicates the degree of fragmentation of buildings within a given area.
SPLIT	Splitting index represents the degree of separation of landscape segmentation. The greater the value, the more fragmented the landscape.
AI	Aggregation index, which represents the connectivity between patches of each type of landscape. The smaller the value, the more discrete the landscape.
L/W	Length-width ratio of buildings is a metric that represents the shape characteristics of buildings.
3D	
H	The height of buildings represents the average height of all buildings in the buffer zone.
H-max	Maximum height of buildings in the buffer zone.
H-std	The standard deviation of building height in the buffer zone.
FAR	Floor area ratio represents the ratio of the sum of gross floor area to total buffer zone. The higher the FAR, the greater the amount of building floor area per unit of land area.
CI	Cubic index represents the ratio of the building volume to the total study volume. It indicates a higher degree of built-up density

	or spatial occupation within the buffer zone when the value is larger.
SVF	Sky view factor represents the ratio of radiation received by a planar surface from the sky to that received from the entire hemispheric radiating environment. It ranges from 0 to 1, with 0 indicating complete obstruction and 1 indicating complete exposure.

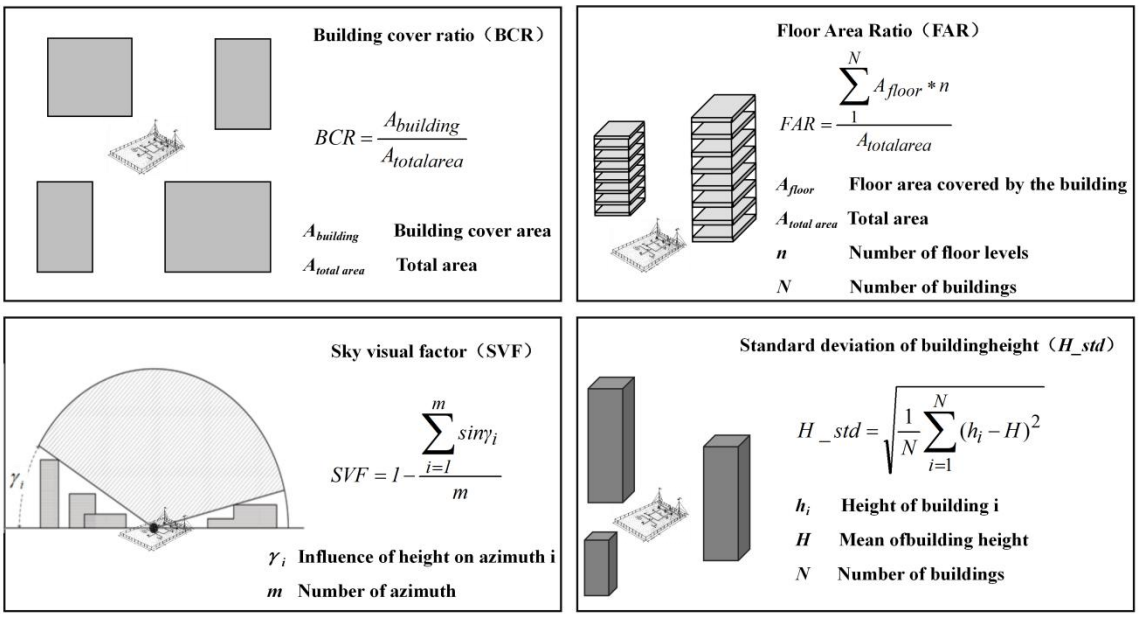

Figure: R3 The schematic diagrams and mathematical formulas of spatial morphological indicators.

P7: Table1, "in the buffer zone", you should really mention the buffer zone at the beginning of section 2.3.3, and as per my comment above, what is the size of the buffer zone? How do you define these buffer zones? This needs to be mentioned in the text.

Response: Thank you for your careful review and constructive feedback. I have taken your comments seriously and have revised the manuscript accordingly as below:

"Here, we selected six indicators of horizontal morphology and six indicators of vertical morphology to measure the morphological characteristics of buildings within a 500 m buffer zone surrounding the AWS (Oke, 2004)"

Reference:

Oke, T. R.: Initial guidance to obtain representative meteorological observations at urban sites. University of British Columbia, Vancouver, 2004.

P7Line151: "The impact of urban spatial morphology on urbanization bias" not sure what you mean by "urbanization bias"

Response: The "urbanization bias" was corrected to "the ΔCUHII".

P8Line165: "relatively weaker urban excess warming," Not sure if the HW should be the basis for defining urban excess warming. My intuition would be that CUHII is a measure of urban excess heat/warming.

Response: I would like to extend my sincere apologies for the inappropriate phrasing in my manuscript. The relevant content was revised in line 201-204 in the revised manuscript as below:

"The most prominent years for urban excess warming, specifically in terms of CUHII, were 2016 and 2019, with intensities of 1.00°C and 0.97°C respectively. In these two years, the HW numbers were 3 times and 2 times, while the HW duration were 9 days and 10 days respectively."

P8: Fig2, it seems there is no correlation between CUHI and HWs. How is the CUHII calculated? By averaging all the hourly CUHII within one month?

Response: Thank you for bringing this clarification to our attention. The method used to calculate CUHII was specifically based on comparing the air temperature differences between urban stations and reference stations during the summertime.

$$CUHII = T_{urban} - T_{reference} \quad (1)$$

CUHII is the canopy urban heat island intensity during the summertime, T_{urban} is the air temperature of the urban stations during the summertime, and $T_{reference}$ is the summer air temperature of the reference stations during the summertime. We have calculated the diurnal variation of the temperature difference between the urban station and the reference station during the summertime (i.e., the diurnal variation of

CUHII). In Fig. R4, the blue line represents the diurnal variation of summer temperature at the urban station, while the green line depicts the diurnal variation of the temperature at the reference station. By calculating the difference between these two stations, we obtained the diurnal variation of CUHII during the summertime.

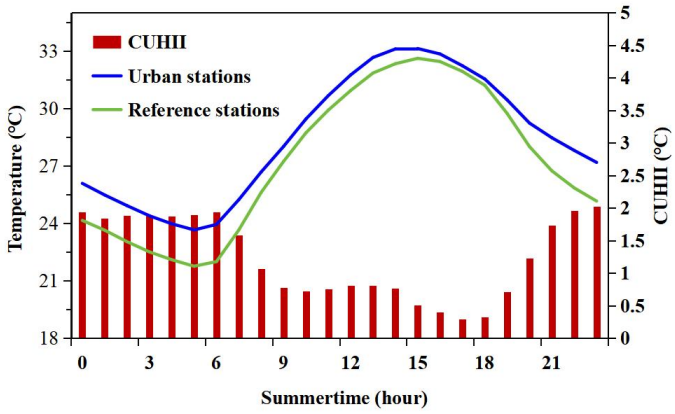

Fig. R4 The diurnal variation of CUHII in the built-up areas of Beijing during the summertime.

P12Line205: "the mountain-valley breeze strongly impacts the thermal dynamic field near-surface of Beijing megacity"

-> the mountain-valley breeze strongly impacts the near-surface thermal dynamic field of the Beijing megacity

Response: Corrected.

P14: Fig6d, the wind speed in UN is still larger than in US, what are the possible reasons and implications?

Response: Thank you for your insightful comments. Indeed, as evidenced by previous studies (Dou et al., 2014), showcasing higher wind speeds in UN compared to US during the summer valley breeze phase, as shown in Fig. R5.

We speculate that this phenomenon is intimately tied to the mechanics of the mountain-valley breeze. As illustrated in Fig. R6, during the valley breeze phase, the hillside, exposed to abundant solar radiation, experiences a significant temperature rise, acting as a relative heat source. In contrast, the air above the urban, located further from the ground, warms less, functioning as a relatively cold source. This

thermal contrast between the hillside and the city triggers a thermal circulation, with warm air rising from the hillside and flowing over to the city's upper layers, while cooler air from the city ascends the hillside to replace it.

Notably, the larger thermal gradient between UN and the hillside, compared to that between US and the hillside, could explain the observed higher wind speeds in UN during the valley breeze phase. However, this is merely a hypothesis at this stage.

To further explore the diurnal characteristics of wind fields in the built-up area of Beijing, we plan to conduct sensitivity tests using the WRF model. Specifically, we aim to investigate how the wind patterns in the UN and US would differ if the mountainous terrain were removed from the simulation.

Thank you again for your valuable feedback, which has enriched our understanding of this complex phenomenon.

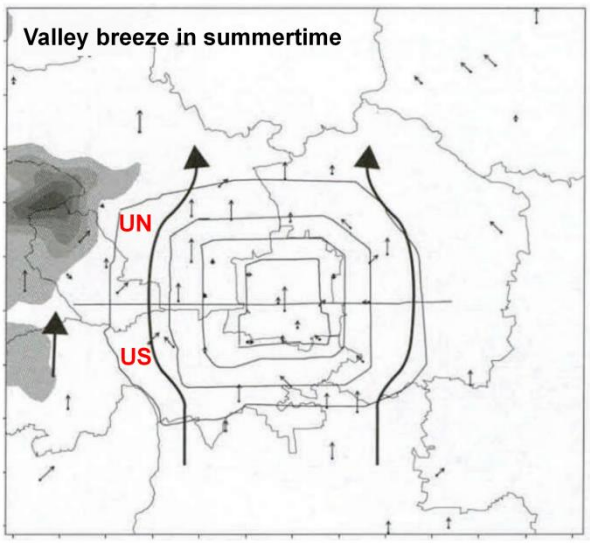

Fig. R5 Wind fields of mountain-valley breeze in summertime of the Beijing megacity (Dou et al., 2014).

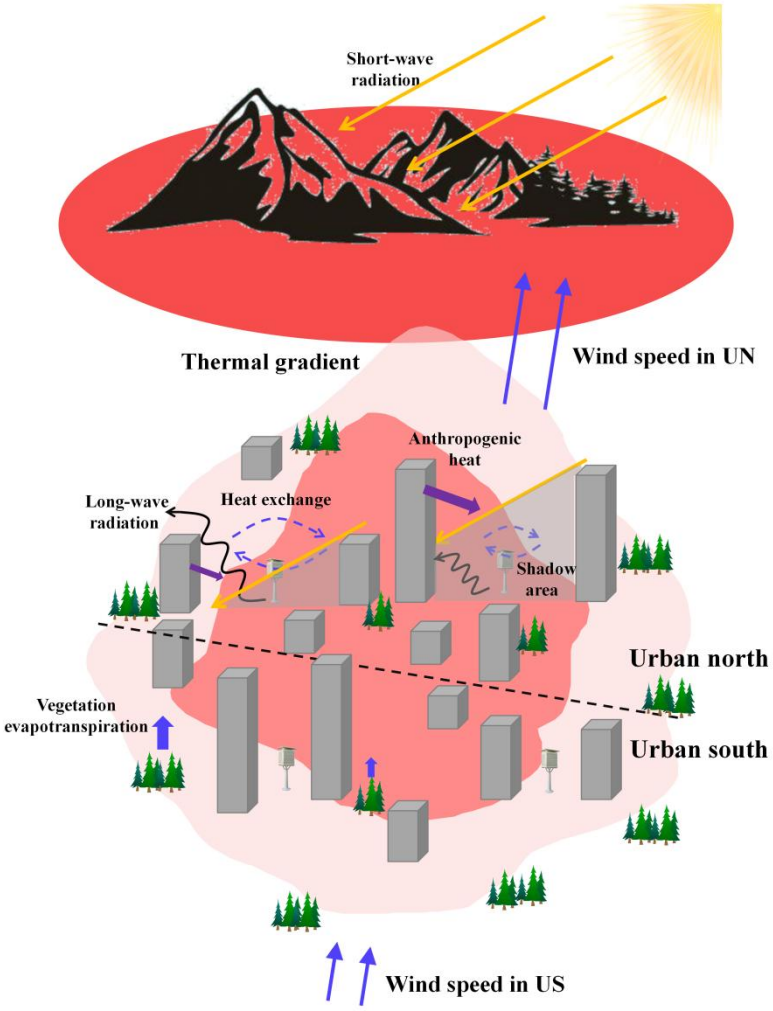

Fig. R6 Schematic diagram of the differences in wind fields between the UN and US during the valley breeze phase (self drawn).

Reference:

Cai, X., Guo, Y., Liu, H., Chen, J.: Flow Patterns of Lower Atmosphere over Beijing Area, Acta Scientiarum Naturalium Universitatis Pekinensis, 38, 5, 698–704, https://doi.org/10.3321/j.issn:0479-8023.2002.03.015, 2002.

Dong, Q., Zhao, P., Wang, Y., Miao, S., Gao, J.: Impact of Mountain-Valley Wind Circulation on Typical Cases of Air Pollution in Beijing. Environmental Science, 38, 6, 2218–2230, https://doi.org/10.13227/j.hjkx.201609231, 2017.

Dou, J., Wang, Y., Miao, S.: Fine Spatial and Temporal Characteristics of Humidity and Wind in Beijing Urban Area. Journal of Applied Meteorological Science, 25, 5, 559–569, https://doi.org/10.11898/1001-7313.20140505, 2014.

P10Line185: "It should be noted that the ΔCUHII remained positive throughout the daytime and nighttime," It is not always true, for example in 2018 in Fig3c.

Response: Thanks very much for your valuable comment. I have revised my language in the line 219-228.

"CUHII started to slowly decrease from 06:00 Beijing Time (BJT) and hit its lowest point at 16:00 BJT. Then, CUHII gradually increased and remained at a high plateau consistently from 22:00 until 05:00 the next day. The diurnal variation of the ΔCUHII was also examined in this study. Apart from 19:00 in 2016 (Fig. 3a) and 2018 (Fig. 3c), the hourly ΔCUHII values for all other years were positive. Taking the annual average as an example (Fig. 3f), the CUHII ranged between 0.18 and 2.06℃ during HW periods, which is much larger than that during NHW periods varied between 0.03 and 1.32℃. In particular, the average daily CUHII during HW periods exhibited a significant increase of 59.33% compared to that during NHW periods. The maximum ΔCUHII was 0.76℃, occurring at 00:00 BJT, while the minimum ΔCUHII was 0.05℃, observed at 19:00 BJT. It should be noted that the ΔCUHII remained positive throughout the daytime and nighttime, indicating the persistent synergies between HW and CUHI in the built-up area of Beijing."

P15Line255: "Therefore, on an urban scale, the turning mountain valley breeze caused horizontal transport of heat inner city, resulting in the north-south asymmetrical pattern of urban excess warming during HW periods." do you mean "horizontal heat transport of heat of the inner city", or just "horizontal heat transport in the city"?

Response: I apologize for the unclear in my previous phrasing. What I mean is "horizontal heat transport in the built-up area". I have revised the text in the revised manuscript.

P16: Fig7c, "Difference value (D-value) in CUHII across different urban configuration structures." It reads a bit weird.

Response: Thank you for bringing this to my attention. I apologize for the confusion

caused by the previous phrasing in Fig. 7c's caption.

I have revised the caption to provide a clearer description as below:

"Differences in CUHII between compact rise and open rise, and between high rise and low rise."

P18Line296: "The linear model has shown considerable strength" I suppose a new section should start from here. This is also why I have the impression that the results parts a rather fragmented. You need some connection between them to let the contents flow smoothly so that they form a whole and readers can better follow what you want to convey.

Response: Thank you for your insightful comments.

In response to your suggestion, we have revised the relevant section to provide a more precise and informative description of the linear model's performance. The revised text reads in line 341-343 as below:

"As depicted in Fig. 9a, the linear model yielded a coefficient of determination (R^2) of 0.44 and a root mean square error (RMSE) of 0.14°C, indicating a relatively large modeling error. Consequently, while the linear model provided a foundational framework for modeling the ΔCUHII, it might not be the most optimal choice for our study."

Furthermore, we have revised the Results section by appending a summary of the key findings at the conclusion of each subsection and appropriately introducing subsequent analysis to ensure fluency between different sections. Finally, we have refined the Conclusion section to provide a clear and concise summary of all the findings.

P20Line330: "As the previous text demonstrated"

-> As previously demonstrated

Response: Thank you for your patience and guidance throughout the review process. I have carefully rechecked the language in the manuscript once again to ensure clarity and precision.