**Dear reviewers,**

We sincerely thank you for giving an opportunity to revise our manuscript which entitled “Spatiotemporal patterns of urban thermal environment and comfort across 180 cities in hot summer under China’s rapid urbanization". We incorporated most of the comments, concerns and suggestions from the two referees in this revised version, and all comments or concerns raised by the referees are specifically addressed in the following responses. Express my sincere thanks once again.

***Response to Reviewer 1:***

 ***General Comments:***

The authors examined the space-time features and relationship between physiological Equivalent Temperature (PET) and hydro-meteorological parameters as well as urbanization in summer across China, the meaningful conclusions are gained. Results show that variations in urban climate are inhomogeneous, and PET exhibits increasing trends at most cities in China, furthermore,GDP has a crucial role in the variability of PET. However, it seems that this manuscript is not well prepared and there are many wrong sentences and some logic questions. My overall assessment is that the paper would benefit from some additional analysis and discussion (see below) and the English writing is in need of serious editing, which is why I recommend a major revision.

[Authors’ response] Thank you very much for your brief summary of our article.We appreciate your support. We accepted your suggestion and revise our manuscript. Besides, our manuscript has been throughly polished by a native English speaking scientist colleague from USA.

**Point 1.** The authors introduce that only three years(1990,2005 and 2015) for PET, while the correlation and regression analyses are conducted between PET and urbanizaiton indices. Spatial correlation or other methods? These should be explained detailedly in the manuscript.

[Authors’ response] Thanks for your valuable advice.We have added more details about the correlation and regression analyses between PET and urbanizaiton indices. in line 213-236.

**Point 2.** Incoherent distribution of hydro-meteorological parameter has been documented over China in previous studies. I suggest that the connection between urban climate and regional climate are discussed to further reveal the variability of PET.

[Authors’ response] Thanks for your valuable advice.We have added more discussion to further reveal the spatial varaibility of PET in line 330-336.

**Point 3.** For the figure captions,how the differences are computed(XX minus XX)? This should be clearly expressed. Moreover, the differences between multiple values in different periods canot represent the variability of trends. Which need long time series of values. However, many “trends” are used in the manuscript. Please give more discussion about those.

[Authors’ response] Thanks for your valuable advice.We have changed the figure captions for the figure 5 and given more descriptions in line of 195-199. We agreed with you that the differences between multiple values in different periods canot represent the variability of trends. So we have changed “trends” into other words such as “changes”. We also given more discussion about these in line of 384-392.

**Point 4.** Existing studies pointed out that vegetation coverage has a remarkable impact on regional climate, while the authors reveal that the correlation between urban vegetation coverage and PET is not significant. Please provide the possible causes.

[Authors’ response] Thanks for your valuable advice.We have provided the possible causes about the relationship between urban vegetation coverage and PET in line 376-383.

**Point 5.** In the discussion section, please further highlight the new findings of this work in comparison with previous studies.

[Authors’ response] Thanks for your valuable advice.We have added more discussion about new finding in comparioson with previous studies.

**Point 6.** I advise the authors to find a native English speaker to proofread the manuscript because I can find many typos and grammar errors.

[Authors’ response] Thanks for your valuable advice.We have found a native English speaker from USA to proofread the manuscript.

**Point 7.** Line 262, “explain 22.0% and 13.2% of variance of PET”, please provide more detail information for readers about how the values of 22.0% and 13.2% are calculated.

[Authors’ response] Thanks for your valuable advice.We have given more detail information for readers about how the values of 22.0% and 13.2% in line 290-291.

***Specific Comments:***

**Point 1.** Line 3, delete one of “still” and “remain”

[Authors’ response] Thanks for your valuable advice.We have deleted “still” in line 3 of our revised manuscript.

**Point 2.** Line 9, had positive trend values, mostly occurring -> exhibiting positive trends mainly located; please check these elsewhere in the manuscript

[Authors’ response] Thanks for your valuable advice.We have checked these elsewhere in the manuscript.

**Point 3.** For the title, it is better to delete “hot”, since the temperature is generally highest across China, no need to emphasize with hot summer, please check these elsewhere in the manuscript.

[Authors’ response] Thanks for your valuable advice.We have deleted “hot” for the title of our manuscript.

**Point 4.** Line 57, delete “years of”, please check these elsewhere in the manuscript

[Authors’ response] Thanks for your valuable advice. We delete “years of” in our manuscript.

**Point 5.** Line 60, indicates -> indicate; for -> during

[Authors’ response] Thanks for your valuable advice.

**Point 6.** Line 61, is -> are

[Authors’ response] Thanks for your valuable advice.We have changed “is” into “are” in line 61.

**Point 7.** Line 63, of -> at, please check these elsewhere in the manuscript

[Authors’ response] Thanks for your valuable advice.We have changed “of” into “at” in line 63.

**Point 8.** Line 68, for the “GDP”, the abbreviation should show the full name in the first appearance

[Authors’ response] Thanks for your valuable advice.We have show the full name in the first appearance in line 68.

**Point 9.** Lines 69-70, the long sentence could be broken into shorter ones

[Authors’ response] Thanks for your valuable advice.We have broken the long sentence into shorter ones in line 70-72.

**Point 10.** Line 84, impact -> impacts

[Authors’ response] Thanks for your valuable advice.We have changed “impact” into “impacts” in line 84.

**Point 11.**Lines 95-96, please rephrase - this currently doesn’t make sense

[Authors’ response] Thanks for your valuable advice.We have rephrased the sentence in line 94-96.

**Point 12.** Line 112, very necessary and will be very important -> necessary and important

[Authors’ response] Thanks for your valuable advice.We have changed “very necessary and will be very important” into “necessary and important” in line 112.

**Point 13.** Line 117, external climate warming includes the anthropogenic heating, please rephrase

[Authors’ response] Thanks for your valuable advice.We have rephrased the sentences in line113-115.

**Point 14.** Line 122, “in national scale” and “at national scale” are mix used. Use “at the national scale” consistently

[Authors’ response] Thanks for your valuable advice.We have used “at the national scale” consistently in our manuscript.

**Point 15.** Lines 124-126, these meanings are repeated in comparison with aforementioned sentences

[Authors’ response] Thanks for your valuable advice.We have deleted these repeated meanings in line 119-120.

**Point 16.** Lines 128-131, the long sentence could be broken into shorter ones

[Authors’ response] Thanks for your valuable advice.We have broken the long sentence into shorter ones in line 128-131.

**Point 17.** Line 148, for the seven different subregions, please provide efficient evidences and reasons for defining these subregions, if previous studies have employed these subregions, please provide the authoritative literature

[Authors’ response] Thanks for your valuable advice.We have provided the authoritative literature about the seven different subregions in line 151.

**Point 18.** Lines 152-154, please provide efficient evidences for the “we found 1990, 2005 and 2015 were not the extreme climatic year and the climate in 1990, 2005, and 2015 could almost represent the average climatic condition of 1990s, 2000s, and 2010s.”

[Authors’ response] Thanks for your valuable advice. By analysing continuous urban climate from 1990 to 2015 in China, we found that the value of temperature(℃), humidity(%),wind speed(m/s), solar radia(W/m2) in 1990,2005 and 2015 is almost nearly close to the average value of temperature(℃),humidity(%),wind speed(m/s),solar radia(W/m2) in 1990s from 1990-2000, 2000s from 2000 to 2010, and 2010s from 2010 to 2015. We have added related data in Table 1.

**Point 19.** Line 161, please add the related references after “environment”

[Authors’ response] Thanks for your valuable advice.We have added the related references after “environment” in line 162.

**Point 20.** Line 165, Urbanizaiton -> urbanization

[Authors’ response] Thanks for your valuable advice.We have changed “Urbanizaiton” into “urbanization” in line 165.

**Point 21.** Line 166, too many citations of “National Bureau of Statistics of China” in the manuscript, please check and change them

[Authors’ response] Thanks for your valuable advice.We have checked and changed them in our manuscript.

**Point 22.** Lines 171-175, the long sentence could be broken into shorter ones

[Authors’ response] Thanks for your valuable advice.We have broken the long sentence into shorter ones in line 171-175.

**Point 23.**Line 184, Individuals or individuals?

[Authors’ response] Thanks for your valuable advice.We have changed “Individuals” into “individuals” in line 184.

**Point 24.** Line 187, meteorological parameters multiple relevant meteorological parameters-> multiple relevant meteorological parameters

[Authors’ response] Thanks for your valuable advice.We have changed “meteorological parameters multiple relevant meteorological parameters” into “multiple relevant meteorological parameters” in line 187.

**Point 25.** Line 193, radiation The -> radiation. The

[Authors’ response] Thanks for your valuable advice.

**Point 26.** Line 201, later -> following

[Authors’ response] Thanks for your valuable advice.

**Point 27.** Lines 203-205, these statements are repeated in comparison with aforementioned sentences

[Authors’ response] Thanks for your valuable advice.We have deleted the repeated statements in line 203-205.

**Point 28.** Line 206, analyze -> analyses

[Authors’ response] Thanks for your valuable advice.We have readed and added more new references and more literature review in line 63-100.

**Point 29.** Line 208, ln-transformed -> in-transformed

[Authors’ response] Thanks for your valuable advice.

**Point 30.** Line 221, Fig. 4?

[Authors’ response] Thanks for your valuable advice.We have changed “Fig 4” into “Table 2” in line 221.

**Point 31.** Line 223, please add “respectively” after 2015

[Authors’ response] Thanks for your valuable advice.We have added “respectively” after 2015 in line 229.

**Point 32.** Line 239, increase -> increase rate

[Authors’ response] Thanks for your valuable advice.We have changed “increase” into “increase rate” in line 245.

**Point 33.** Line 240, “Compared to” and “Compared with” are mix used. Use “Compared to” consistently

[Authors’ response] Thanks for your valuable advice.We have used “Compared to” consistently in our manuscript.

**Point 34.** Line 259, delete “significant”, as it is not statistically significant

[Authors’ response] Thanks for your valuable advice.We have delete “significant” in line 268.

**Point 35.** Line 262, gdp and Total -> GPD and total

[Authors’ response] Thanks for your valuable advice.We have changed “gdp and Total” into “GPD and total” in line 271.

**Point 36.** Line 263, A -> a

[Authors’ response] Thanks for your valuable advice..

**Point 37.** Line 279, for the “LULC”, he abbreviation should show the full name in the first appearance

[Authors’ response] Thanks for your valuable advice.We have showed the full name in the first appearance in line 288.

**Point 38.** Line 291, an -> a

[Authors’ response] Thanks for your valuable advice.

**Point 39.** Line 292, are -> is

[Authors’ response] Thanks for your valuable advice.

**Point 40.** Line 293, was much higher -> were much larger

[Authors’ response] Thanks for your valuable advice.We have changed “was much higher” into “were much larger” in line 302.

**Point 41.** Lines 294-295, in addition to the warming trend, urbanization had a negative impact on relative humid and wind velocity in urban area, -> urbanization had a negative impact on relative humid and wind velocity in urban area, in addition to the warming trend

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 42.** Line 299, closely -> Closely

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 43.** Line 301, during is not reasonable

[Authors’ response] Thanks for your valuable advice.We have deleted “during urbanization factors” in line 316.

**Point 44.** Lines 304-305, please rephrase - this currently doesn’t make sense

[Authors’ response] Thanks for your valuable advice.We rephrased the sentences in line 319-322.

**Point 45.** Line 311, role, which contributed to -> role to

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 46.** Line 312, that -> in

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 47.** Line 332, conditioning -> conditions

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 48.** Line 338, across -> over

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 49.** Line 343, regions s -> regions

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 50.** Line 344, comprehensively -> comprehensive

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 51.** Line 347, pet -> PET

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 52.** Line 353, variabilityat -> variability at

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

**Point 53.** Lines 375-377, the long sentence could be broken into shorter ones

[Authors’ response] Thanks for your valuable advice. We have accepted the changes.

***Response to Reviewer 2:***

***General Comments:***

The study has investigated thermal discomfort in 180 cities in China using a variety of datasets for 1990, 2005, and 2015. The topic is interesting and the findings are useful. However, the paper should be revised and the data/methods need to be clarified. There are many writing issues in the paper, and I tried to indicate some of them in the following, but please do a thorough writing check on the manuscript. Please find my comments as follows:

[Authors’ response] Thank you very much for your support. We appreciate your very thorough review and helpful comments and suggestions, all of which have been consided in our revised manuscript. The manuscript has been throughly polished by a native English speaking scientist colleague from USA.

***Specific Comments:***

**Point 1.** Line 64: “exhibit an decreasing” >> “exhibit a decreasing”

[Authors’ response] Thanks for your comments. We have replaced “an” with “a” in line 64 in our revised manusript.

**Point 2.** Line 65: “cities had positive” >> “cities that have positive”

[Authors’ response] Thanks for your advices. We have replaced “cities had positive” with “cities that have positive” in line 65 in our revised manusript.

**Point 3.** Line 68: what does “GDP” stand for? Is it the gross domestic product? If so, the sentence does not read well; “the most important contribution to increasing PET is GDP”. GDP is a monetized measure and does not cause an increase in temperature.

[Authors’ response] Thanks for your valuable advices. GDP stand for the gross domestic product in our study. Urbanization is a process marked by urban area expansion with intensive land use change, economic development, and rapid population growth. GDP was selected as an urbanization index to represent economic development. We have rewriten the sentences in our revised manuscript in line 63-121.

**Point 4.** Line 90: “become worsen” >> “become worse”

[Authors’ response] Thank you for your advice. We have replaced “become worsen” with “become worse” in line 90 in our revised manusript.

**Point 5.** Line 112: “critically very necessary” >> “critically necessary”

[Authors’ response] Thanks for your advice. We have replaced “critically very necessary” with “critically necessary” in line 112 in our revised manusript.

 **Point 6.** Line 115: “have experienced” >> “has experienced”

[Authors’ response] Thanks for your kind remind. We have replaced “have experienced” with “has experienced” in line 115 in our revised manusript.

**Point 7.** Line 125: “were still” >> “are still”

[Authors’ response] Thanks for your kind advices. We have replaced “were still” with “are still” in line 115 in our revised manusript.

**Point 8.** Lines 126-127: the sentence does not read well. Please rephrase it.

[Authors’ response] Thanks for your kind advices. We have replaced “were still” with “are still” in line 115 in our revised manusript.

**Point 9.** Line 127: “an national” >> “a national”

[Authors’ response] Thanks for your kind advices. We have replaced “an national” with “a national” in line 127 in our revised manusript.

**Point 10.** Line 160: “was used” >> “were used”

[Authors’ response] Thanks for your kind advices. We have replaced “was used” with “were used” in line 160 in our revised manusript.

**Point 11.** Line 161: “Four variables” >> “the four variables”

[Authors’ response] Thanks for your kind advices. We have replaced “Four variables” with “the four variables” in line 161 in our revised manusript.

**Point 12.** Section 2.3, Calculation of urban thermal comfort: It is not clear how the authors have calculated the Physiological Equivalent Temperature (PET). They only mention that “PET was derived from the human energy balance” (Line 188). Is there an equation to calculate it? Or did the authors use a specific software package? Please explain how PET is derived in details.

[Authors’ response] Thanks for your kind advices. We have replaced “were still” with “are still” in line 115 in our revised manusript. The PET index for every cities was calculated by RayMan software (Matzarakis et al. 2007, 2010) with air temperature, relative humidity, wind velocity and global radiation. We have added more details about how PET is derived in Section 2.3.

**Point 13.** Line 191: “monthy” >> “monthly”

[Authors’ response] Thanks for your kind advices. We have replaced “monthy” with “monthly” in line 191 in our revised manusript.

**Point 14.** Line 191: “The monthly PET index … was calculated” >> Does it mean that monthly data are used for calculating PET? Please explain the data in more details (temporal resolution that is used, period, variables). You may even consider summarizing the information in a small table.

[Authors’ response] Thanks for your kind advices. We have explained the data in more details in line 201-204 in our revised manusript.

**Point 15.** Line 221: Fig.4 is introduced before Figures 2 and 3. The order of figures should be revised.

[Authors’ response] Thanks for your kind advices. We have revised the order of figures in line 221 in our revised manusript.

**Point 16.** Fig.2 : It is better to revise “air humidity” to “relative humidity”. In addition, the legends do not read well. Please revise them and please include the legend for the green bar (2015) to all three plots.

[Authors’ response] Thanks for your kind advices. We have replaced “air humidity” with “relative humidity” in Fig.2.

**Point 17.** Figures 5 and 6: In these two figures, what does “1990-2005” indicate? Does it show PET1995-PET2005? Based on the conclusions in the text, it seems that it should be 2005-1995, since the authors mention that “95% of cities had positive trend” (Line 241). Please revise the legend in both figures accordingly.

[Authors’ response] Thanks for your kind advices. We have revised the legend in both figures5-5 accordingly in our revised manusript.

**Point 18.** Discussion: It is important to discuss about the limitations of this study and their effect on the final conclusion. For instance, it has to be mentioned that the analyses are solely for three different years and the so-called “trends” do not necessarily indicate long-term changes, but they merely show year-to-year differences. Furthermore, it seemed that monthly data was used and then averaged over the season. Therefore, the study does not capture the severity of thermal discomfort neither its peaks, and it only provides a general condition for each city in each year.

Another important discussion to include in the paper is the expected impacts of climate change on the issue. I think the authors may find the following recently published study useful for this matter:

• Sun, Q., Miao, C., Hanel, M., Borthwick, A. G., Duan, Q., Ji, D., & Li, H. (2019). Global heat stress on health, wildfires, and agricultural crops under different levels of climate warming. Environment international, 128, 125-136.

[Authors’ response] Thanks for your kind advices. We have added more discussion in line 384-396 especially about the expected impacts of climate change on urban thermal comfort in line 401-474 for our revised manusript.

**We look forward to hearing from you, thank you.**