Response Letter

Dear Editor and Reviewers,
We sincerely thank the editor and the two reviewers for their valuable feedback to improve the quality of our manuscript entitled "Escalating typhoon risks in Shanghai amid shifting tracks driven by urbanization and sea surface temperature warming" (MS No: egusphere-2025-1002). According to these comments, we have revised our manuscript. Please see our responses below. For the reviewers' convenience, we have tracked changes in the manuscript and replied to all the comments below in blue. We believe that the revised manuscript has improved over the original version, and that it will be clear and informative to the journal's readers.

Reviewer 1

This study investigates the potential impacts of urbanization and rising SSTs on tropical cyclones impacting Shanghai based on convection-permitting WRF simulations of five tropical cyclones. The authors find a significant impact from increasing SSTs, including consistent increases to cyclone radius, maximum rainfall rate, and 10-m wind speed over the cyclone area that are more variable over Shanghai itself, as well as a southward shift in the cyclone track. They also find that urbanization has only a small impact on tropical cyclones, with almost no effect on large-scale cyclone characteristics but a slight increase in rainfall and decrease in wind speed over Shanghai itself. The latter half of the paper also includes an analysis of potential mechanisms, concluding that increased SSTs enhance lower tropospheric temperatures, wind speeds, and pressure anomalies, which increase cyclone size and intensity, and produce a southward shift of the cyclone tracks through enhancement of the Fujiwhara effect.
The results are clear, well-presented, and compelling. The paper is also beautifully written and was a genuine pleasure to read. The authors did a good job of evaluating potential cyclone impacts across multiple metrics, distinguishing between large-scale changes and those affecting Shanghai in particular, and proposing and demonstrating plausible mechanisms for the effects they observed. My biggest substantive comments have to do with the figures, some of which I find to be insufficiently explained and which use color schemes that are confusing and even, in some cases, deceptive. Most of my remaining comments are looking for additional clarification on certain choices that were made in the methods or analysis rather than objections to those choices. Overall, I am recommending minor revisions.

Reply: Thank you for your positive and constructive comments. We have added further clarification and explanations as detailed below, and we hope our responses address your concerns and questions.

Reviewer Comment 1.1 — Event selection – time period. On line 86, why focus on the period from 2018-2022 for selecting TCs? Why not, for example, the five most destructive TCs impacting Shanghai in the last twenty or even thirty years instead?

Reply: We did not intentionally restrict the simulated events to the period between 2018 and 2022. As one of our goals is to understand the effects of Shanghai's urbanization on typhoons, we primarily focused on typhoon events that actually made landfall in Shanghai. Since 1990, there have only been seven such typhoons (see table below). After applying additional selection criteria, such as time of occurrence, trajectory (to ensure comparable climate conditions), and economic loss in Shanghai, we selected the five events presented in the manuscript, which happen to be clustered in 2018–2022.

Table 1: Landfalling typhoons in Shanghai since 1990 considered for selection in this study.

Year	Typhoon name	Trajectory	Inclusion in study (reason)
2014	Fung-Wong	S-N	Not included (trajectory)
2018	Ampil	SE-NW	Included
2018	Jongdari	SE-NW	Included
2018	Rumbia	SE-NW	Included
2022	Muifa	SE-NW	Included
2024	Bebinca	SE-NW	Not included (post-submission)
2025	Co-may	SW-NE, then SE-NW	Not included (post-submission)

Reviewer Comment 1.2 — Event selection – trajectory. You specified that the TCs under consideration had to directly impact Shanghai (line 87), but given the southward track shift you observed under higher SSTs isn't it possible that cyclones that would otherwise have passed north of the city could shift to hit it instead? This also comes up on line 262, as it seems to me that the southward shift may spare Shanghai from some landfalls but could equally easily expose it to cyclones that would otherwise pass harmlessly north.

Reply: Indeed, our results suggest that under higher SSTs, a southward track shift could cause typhoons that would previously have passed north of Shanghai to impact the city, while some typhoons that might otherwise have made landfall in Shanghai could shift southward. In both cases, we suggest that the typhoon risk for Shanghai increases because both the size and intensity of typhoons rise, even when the track shifts away from the city. We have added more discussion in L271-275 in the revised manuscript. Following our response to Point 1.1, the event selection considered multiple criteria, allowing us to better explore how historical typhoons vary with potential city expansion and SST warming. For future work, it would be valuable to further investigate changes in general typhoon genesis and track patterns using a larger set of typhoon events.

Reviewer Comment 1.3 — WRF resolution. On line 104, you describe the vertical resolution as 45 layers going up to 50 hPa. Are those levels terrain-following, hybrid, or pressure-following? And is the layer spacing constant or does it change with height? At least a few studies (Wu et al 2019 in Acta Oceanologica Sinica; Ma et al 2012 in Asia-Pacific Journal of Amostpheric Sciences) indicate that the vertical resolution in specific parts of the atmosphere can have a noticeable effect on TC simulation with WRF.

Reply: The vertical coordinate system used is hybrid (sigma-pressure). The vertical spacing is not uniform; the model has higher resolution near the surface for a better representation of the surface-atmosphere interactions, and becomes coarser with increasing altitude. This configuration aligns with the recommendations from [Ma et al., 2012], as noted, who emphasize the importance of enhanced vertical resolution near the surface for accurately simulating typhoon intensity and structure, while noting that a large number of mid-level layers is not necessary. Configuring 35–50 vertical layers is a common practice in WRF-based typhoon simulations and has been shown to provide sufficient accuracy for reproducing typhoon tracks and associated precipitation [Wu et al., 2025, Pérez-Alarcón et al., 2024, Du et al., 2023, Hu et al., 2023]. We have revised the text in L105 to specific it.

Reviewer Comment 1.4 — Urbanization case definition. Why choose the lowest urban development scenario, SSP1, for your increased urbanization case (line 112-113)? This seems designed to under-estimate the potential impact of urbanization.

Reply: Thank you for pointing out the potential misunderstanding. To clarify, our urbanization scenario is not based on the lowest urban development pathway (SSP1). Instead, we define future urban expansion by converting grid cells within a 3 km buffer surrounding the current Shanghai city boundary to urban land. To support this design choice, we note that the resulting urban extent is consistent with the projections for the Shanghai urban area in 2040 under SSP1 or in 2030 under SSP5 based on data from [Chen et al., 2020]. We have revised the relevant sentence in L112-115 to clarify this point.

Reviewer Comment 1.5 — SST case definition. Near the end of the paper, you acknowledge a potential pattern effect of SST change which is in contrast to the uniform warming you imposed (line 280-281), so why did you go with a uniform warming case (line 118)? Particularly when you already have the pattern effect, at least in a climatological sense, in Figure S1.

Reply: Our primary motivation for using uniform SST warming was to isolate and interpret the typhoons' response to increased SST in a simplified and controlled framework. This approach is commonly adopted in WRF-based typhoon studies (e.g., [Choi et al., 2019, Yin et al., 2021]) as it provides a clear baseline for assessing the effects of sea surface warming without the added complexity introduced by spatial SST variability. However, as indicated in Figure S1, future SST warming in the East China Sea is projected to be greater than that in the South China Sea, highlighting the importance of SST heterogeneity. We fully agree with the reviewer that the pattern effect (i.e., non-uniform SST changes) can produce more realistic and complex responses (see [Sun et al., 2013]), and we acknowledge that incorporating spatially varying SST should be considered in future work. We have added further discussion of this point in L298-301.

Reviewer Comment 1.6 — Significance or Confidence Intervals on TC metrics. Figures 5 and 6 look a lot at changes in key TC metrics from the CTR case, and line 151-152 discusses deviations from the control track in km. Is there any way to establish statistical significance of these changes, using either the bias from observations or some spread in these metrics from an ensemble of TC simulations? For example, some of the magnitudes discussed are quite small (line 186-187 discusses a "consistent" change in maximum rainfall and maximum wind speed in Figure 6, but those changes are on the order of 1-4 mm/h and 1-2 m/s, which seems very small to attribute to a significant impact of urbanization). I realize this could be challenging to quantify, but if there is any way to do so I think it would make it much easier to interpret Figures 5 and 6.

Reply: We agree with the reviewer that quantifying the significance of the changes observed in our simulations would be valuable. Unfortunately, the limited number of simulated tropical cyclones (five in total) precludes a robust statistical analysis to assess significance levels or confidence intervals. Performing statistical tests with such a small sample size may lead to misleading conclusions due to data limitations (see [Morin, 2011]).

Reviewer Comment 1.7 — Domain for calculating I_{max} and W_{max}. In Figure 6, the maximum rainfall and wind speed are calculated just over the Shanghai domain, but in Figures 5 and 7 it is not clear to me the domain that was used to find these maxima. Is it within the radius R during the timesteps that Shanghai was also in that radius, similar to Figure 2c?

Reply: In Figures 5 and 7, at each time step, I_{max} and W_{max}^{10m} are calculated as the maximum rainfall intensity and 10-m wind speed within the typhoon radius R, following the typhoon's center. As illustrated in Figure 2c, we extract the maxima within the specified radius (whether solid or dashed circles) at every hourly time step, regardless of whether Shanghai is located within the radius at that particular time. In contrast, Figure 6 focuses exclusively on the Shanghai city domain, and the maxima are calculated only within the city boundary. We have highlighted this in the captions of Figures 5-7.

Reviewer Comment 1.8 — Color scale for Figures 5 and 6. I don't understand the color mapping used in these figures, and on fairly close inspection actually find them quite deceptive. As far as I can tell, each panel (single heat map) uses a shared colorbar, which has a diverging colormap where the lowest values are red and the highest are blue. But the intention of the figure seems to be to compare changes from the control simulation, so in my view there should really be a separate color scale for each row (otherwise the highest-intensity values will always be on the most and least intense TCs, so you don't really see changes even when they do exist across the middle of the pack), such that the CTR simulation is grey for each TC, any increase from that is red, and any decrease is blue, with the two sides symmetric so that the intensity of the color indicates either the absolute or relative (which may be better, since the text mostly discusses changes as a percent of the control case) change from the control case. As is, there are some very confusing cases where the text describes, for example, a three-fold increase in the radius of Jongdari in the SST3 scenario (line 160), but the corresponding box in Figure 5a is the palest shade in the Jongdari row, which would imply the opposite. Either way, the color scaling should be explained in the caption, particularly since it is not provided as a colorbar on the figure.

Reply: Thank you for this valuable suggestion. We have revised Figures 5 and 6 by using a neutral color (grey) for the control values, and marking positive and negative changes in each simulated scenario in blue and red, respectively, with darker shades indicating stronger signals.

Reviewer Comment 1.9 — Diverging colormap for uniformly increasing values. A minor point, but S1 uses a diverging red-blue colormap even though the underlying values are uniformly positive and represent a change in temperature over time. I found this unnecessarily confusing, and it took me a while to realize that the blue areas are still an increase in SST, just a smaller one.

Reply: Thank you, we have revised the colormap of Figure S1.

Reviewer Comment 1.10 — Definition of Delta in Figure 7. It was not clear to me what the Delta in rainfall and wind represents. In "after landfall", for example, is the change calculated as a change over the Shanghai domain from the moment of landfall to one time step (1 hour) after landfall? 6 hours after landfall? In that case, line 196 is confusing to me, as it states that an enhancement of rainfall both before after landfall indicates that Jongdari decays slowly after reaching land; if rainfall increases after landfall, it's not decaying at all yet, right? And if the change is actually between the CTR case and a SST/U3km case, I'm still not sure what time(s) "before" and "after" refers to. This is another case where I think a more detailed explanation in the figure caption of what the Delta I_{max} and Delta W_{max}^{10m} actually represent is needed.

Reply: Thank you for highlighting the need for clarification. In Figure 7, Delta (Δ) in rainfall and wind refers to the difference between the CTR and the other sensitivity experiments. The landfall time is defined as the first time step when the typhoon radius reaches Shanghai. "Before landfall" refers to all simulation time steps prior to landfall, while "after landfall" refers to all time steps following it. We have revised the figure caption to provide a more detailed explanation.

Reviewer Comment 1.11 — Fujiwhara effect seen in all cases. The finding that the Fujiwhara effect played a role in the response of all 5 TCs to increased SSTs was particularly interesting to me (line 221-222). Was there no secondary pressure low in the CTR case, and one developed in all 5 cases under increased SSTs? Or did the secondary low already exist but just got stronger/closer to the primary TC? Is there any explanation for why this change in the effect strength happens under increasing SST? Explaining why the Fujiwhara effect gets stronger would help to support the claim made in line 296-297, particularly since about 61% of current TCs occur as doubles (line 228), which is a large number but wouldn't necessarily produce any change in the other 39% of TCs unless the increase in SSTs actually makes double-TC events more frequent rather than just changing the range/strength of interaction.

Reply: In all five cases, a secondary low-pressure system is already present in the control (CTR) simulations, and it further intensifies under the warming scenarios. Our findings do not suggest an increase in the frequency of double-TCs but rather indicate stronger interaction when such systems are already present, leading to a more pronounced Fujiwhara effect. The physical explanation is that higher SSTs provide more heat energy (increased T^{850} [°C]) and stronger wind velocity (increased W^{850} [m s^{-1}]), which promote the intensification of both primary TC and the second low (as indicated by decreased $MSLP$ [hPa]). Intensification of the two low-pressure systems leads to larger outer wind fields and increased water vapor convergence, thereby resulting in stronger interactions between them. According to [Lee et al., 2023], Fujiwhara interactions become stronger when the participating TCs are more intense or larger, which is consistent with our findings under SST warming. We agree with the reviewer that our mechanism applies only to cases where double TCs already exist. We do not observe any evidence that increased SST leads to a higher frequency of double-TC events. We have clarified this and expanded the explanation in L219-222, and L233-235 in the revised manuscript.

Reviewer Comment 1.12 — Influence of El Nino. In line 266, you state "anomalously warmer SST, so-called El Nino, significantly influences typhoons on a large scale." However, the support for this point that follows seems to be based on a single El Nino year (2023) and subsequent TC season. I think you either need more references to support the claim that El Ninos in general can influence typhoons on a large scale or to soften that claim to a possibility rather than a surety.

Reply: Thank you for pointing this out. We agree that the original statement may not have been sufficiently supported. We have added some sentences in L279-289 to clarify that numerous studies have demonstrated that El Niño can exert large-scale influences on typhoons in the western North Pacific.

Reviewer Comment 1.13 — Line 44: "there are not many evidences" → "there is not much evidence"

Reply: Thank you. We have revised the sentence as suggested.

Reviewer Comment 1.14 — Line 92: "followed the TC central location" → "following the TC central location"? I'm not sure I understand this sentence structure, though

Reply: Thank you. We have revised the sentence.

Reviewer Comment 1.15 — Line 105 and in Table 2: "Yonsei University scheme (YSU) scheme" → "Yonsei University (YSU) scheme"

Reply: Corrected as suggested.

Reviewer Comment 1.16 — Figure 7 caption: "landfall from Shanghai" → "landfall in Shanghai"

Reply: Corrected as suggested.

Reviewer Comment 1.17 — Line 203: "T" → "T^{850}"

Reply: Corrected as suggested.

Reviewer Comment 1.18 — Line 225: "The typhoon" → "Typhoons" and "has been found normally moving" → "have been found to move" or similar

Reply: Corrected as suggested.

Reviewer Comment 1.19 — Line 238: "amount of water vapor context" get rid of "context"

Reply: Corrected as suggested.

Reviewer Comment 1.20 — Line 242: "enhances the upward" → "enhances upward"

Reply: Corrected as suggested.

Reviewer Comment 1.21 — Line 243: the citation should be in-text, no parentheses

Reply: Corrected as suggested.

Reviewer Comment 1.22 — Line 249-250: "marking a record-breaking four-time landfall" not sure what this refers to; did the TC make landfall four times? Or was the record broken by a factor of four?

Reply: Thank you for pointing it out. We meant that this typhoon made landfall in China four separate times, which is a new record for the most landfalls by a single typhoon. We have revised the sentence to clarify this in the manuscript.

Reviewer Comment 1.23 — Line 273: "tropical regions" New York and Tokyo (2 of the 3 listed cities) are mid-latitude, not tropical

Reply: We have removed the "tropical regions" and revised the sentence to: "While we focused on the specific changes and impacts of TCs in Shanghai, it is important to recognize that similar analyses are needed for other large coastal cities that are vulnerable to TC activities (such as New York, United States; Tokyo, Japan; and Visakhapatnam, India; Peduzzi et al., 2012)." Thank you.

Reviewer 2

This study examines the effects of sea surface temperature (SST) warming and urbanisation on typhoon hazards and risks in Shanghai, a city often prone to their effects. This is done by comparing WRF experiments with uniform SST warming and land use change for five recent damaging typhoons. The results show that typhoons increase in size with warming SSTs, making their associated wind and rainfall more hazardous. However, increases in urbanisation has little effect on the synoptic evolution of the typhoon, instead increasing the local rainfall due to increased surface roughness and moisture convergence. Overall, this manuscript is very well written, succinct, and easy to follow. The methodology, results, and discussions are all sound, and there is clear impact and relevance to disaster management. There is also a good discussion of the limitations and avenues for future research. I recommend this paper for publication after minor revisions addressing the following comments.

Reply: Thank you for reviewing our manuscript and for your constructive comments. We have addressed the specific points you raised, as detailed below. We hope that our responses and revisions satisfactorily address your concerns.

Reviewer Comment 2.1 — The authors suggest that a southward shift of tracks due to the Fujiwhara effect may reduce cyclone impacts in Shanghai. However, the case studies selected were only ones that impacted Shanghai to begin with. Is it possible that typhoons that would normally make landfall north of Shanghai will now directly hit Shanghai, resulting in greater effects? Some further discussion of this, particularly around lines 262-263, may be beneficial.

Reply: Our results indicate that a southward shift in typhoon tracks under higher SSTs could increase the risk to Shanghai in two distinct ways. First, typhoons that would previously have passed north of Shanghai may now make direct landfall on the city, increasing wind and rainfall hazards. Second, even if typhoons that would have directly impacted Shanghai now shift southward, the increased size and intensity of these typhoons may still subject Shanghai to severe impacts, such as flooding and storm surges. We have extended the discussion in L271-275 to clarify these two scenarios and highlight that the overall risk to Shanghai may rise due to both potential changes in typhoon track and intensity.

Reviewer Comment 2.2 — Figure 9 presents differences between CTR and U3km for In-fa, however this seems to be largely a null result (i.e. no significant changes). Meanwhile, Figure S5 presents results that show substantial differences between the simulations, and these are discussed in the text. Because of this, I would suggest moving Fig S5 into the main body of the text, and Fig 9 into supplementary material. Some of the colour maps used in figures could be improved. Notably, a blue-red diverging colour map is frequently used where a sequential colour map would be more suitable. This applies to Figs 3, 5, 6, 8, 9, S1, S2 and S4.

Reply: Thank you for your suggestion. After careful consideration, we have chosen to retain Figure 9 in the main body as it provides a more consistent comparison with Figure 8, which is essential for explaining the differential impacts of urbanization and SST on typhoon dynamics. Regarding the color maps, we have revised Figures 5, 6, 7 to use a neutral color (grey) for control values, with positive and negative changes in blue and red, respectively. Darker shades indicate stronger signals, enhancing clarity. Figure S1 has been revised using sequential colors as suggested. For Figures 3, 8, 9, S2, and S4, we have opted to retain the blue-red color maps, as they do not introduce ambiguity in these contexts. After evaluating the color maps, we believe the current scheme is both visually appealing and effectively conveys the data.

Reviewer Comment 2.3 — A study by Yin et al. (2021) has previously the effects of SST warming on typhoon hazards in Shanghai and could be included in the discussions. Yin, K., Xu, S., Zhao, Q., Zhang, N. and Li, M., 2021. Effects of sea surface warming and sea-level rise on tropical cyclone and inundation modeling at Shanghai coast. Natural hazards, 109(1), pp.755-784.

Reply: We appreciate you bringing this paper to our attention. We have incorporated the reference in the revised manuscript and added the following discussion to the manuscript: "The combined effects of sea surface warming and sea level rise have been shown to exacerbate typhoon-induced hazards, resulting in significantly greater inundation risks for coastal regions (Yin et al., 2021)".

Reviewer Comment 2.4 — L11-12: "...and their dynamic systems" is unclear. What specifically does this refer to?

Reply: Thank you for pointing this out. We have changed "TC sizes and its dynamic systems" to "TC sizes and intensity".

Reviewer Comment 2.5 — L44: change to "there is not much evidence that supports..."

Reply: Revised. Thank you.

Reviewer Comment 2.6 — L92-93: given that all TCs analysed here are from 2018 onward, you could just say the temporal resolution is 3 hrs.

Reply: Corrected as suggested.

Reviewer Comment 2.7 — L98: MODIS should be defined.

Reply: Corrected as suggested.

Reviewer Comment 2.8 — L104-105: WSM and MM5 should be defined.

Reply: Corrected as suggested.

Reviewer Comment 2.9 — Fig S1 caption: "temporary" should be "temporal".

Reply: Corrected as suggested.

Reviewer Comment 2.10 — L128: "radius" or "distance" is perhaps more suitable than "buffer".

Reply: We have changed it to "distance". Thank you.

Reviewer Comment 2.11 — L142: I'm not sure that a percentage bias is appropriate for MSLP here, given it tends to only vary between approx. 950-1050 hPa.

Reply: Thank you for your comment. The bias here is calculated as the relative difference between the simulated SLP_{min} (CTL) and the observed SLP_{min}. Although the range of SLP_{min} is relatively small, we believe that the percentage bias still provides a useful quantitative measure.

Reviewer Comment 2.12 — L143: I don't think "climate dynamics" is suitable here since this isn't a climate study. Consider replacing this part with something like "the tracks and intensities are well simulated, including an increase in SLP_{min} as the TCs move over land".

Reply: Thank you for your suggestions. We have revised this sentence.

Reviewer Comment 2.13 — Fig 3: the red contour showing Shanghai is a little difficult to see. Consider changing this to a different colour or otherwise making it clearer. Also relevant for Figs 8 and 9, where the red line overlies red shading.

Reply: Thank you for your suggestion. We have revised Figures 3, 8, and 9 to make the Shanghai more visible.

Reviewer Comment 2.14 — L159: it may be convenient to redefine the variables for the reader.

Reply: Revised it as suggested. Thank you.

Reviewer Comment 2.15 — L163: "exposure" could be changed to "exposure time" etc. to specify this paragraph is referring to the time of the cyclone.

Reply: Revised.

Reviewer Comment 2.16 — L168-169: The first sentence here feels like it should belong in the previous paragraph, otherwise it could be removed.

Reply: We have removed it, as suggested.

Reviewer Comment 2.17 — L178: Are the quantities shown in Fig 6 averaged over the Shanghai domain, or are these values at a single grid point?

Reply: In Figure 6, the values correspond to the maximum rainfall intensity and maximum 10-m wind speed averaged over all time steps, with the maxima identified within the Shanghai domain at each time step. We have clarified this better in the figure's caption.

Reviewer Comment 2.18 — L187-188: I recommend changing the words "positive/negative effect" to remove any connotations. Something simple like "can increase/decrease" may work. Also see L198.

Reply: We have revised the text accordingly. Thank you.

Reviewer Comment 2.19 — L210-211: "equivalent in intensity" is only really true for SST2 and SST3 experiments.

Reply: Thank you for pointing this out. We have clarified in the revised manuscript that "equivalent in intensity" applies specifically to the SST2 and SST3 experiments at 2021-07-26 0600 UTC. Moreover, in the CTR and SST1 experiments, the two typhoons reach comparable intensities at later times. For instance, in the CTR case, the two TCs exhibit similar intensity at 2021-07-27 0600 UTC.

Reviewer Comment 2.20 — L213-214: does In-fa actually move southward/southwestward, or is it just that its northward propagation is slowed?

Reply: We confirm that Typhoon In-fa moved in a southward/southwestward direction, which is clearly illustrated in Figure 4b.

Reviewer Comment 2.21 — L225: change to "Typhoons in the Northern Hemisphere have been found to normally move northward..."

Reply: We have revised it as suggested.

Reviewer Comment 2.22 — L225-231: It also appears that raising SSTs allows the model to spin up TCs more frequently and rapidly, potentially leading to more double (or more) TC activity events and hence more common Fujiwhara effects. Has this been observed in recent decades? Some further discussion could be beneficial.

Reply: Thank you for raising this important point. We have clarified in L233-235 that the mechanism discussed in our manuscript applies specifically to cases in which binary TCs are already present. Warming SST primarily intensifies the existing two typhoons and their interactions. We did not find evidence in our simulations or in recent literature that increased SST necessarily leads to a higher frequency of binary TC events. However, in light of the large number of two-typhoon cases in the WNP region (60.6%), we anticipate an increase in the southward movement of typhoon trajectories in this region in the future.

Reviewer Comment 2.23 — L238: should this be "water vapour content"?

Reply: Revised.

Reviewer Comment 2.24 — L243: the authors for the references here should be outside the brackets.

Reply: Thank you for noticing this.

Reviewer Comment 2.25 — L266: should this "warmer SST" related to El Nino be specific to the central/east Pacific?

Reply: Thank you for pointing this out. We have specified the sentence to the western North Pacific (WNP) region.

Again, we would like to thank the Editor and the anonymous reviewer for their comments and suggestions. We look forward to hearing from you regarding our submission. We would be glad to respond to any further questions and comments that you may have.

References

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[Wu et al., 2025] Wu, J., Xu, H., Song, Y., Liu, Y., and Lang, X. (2025). Urbanization intensified predecessor rainfall redistribution associated with typhoon khanun (2017) in the lower yangtze river region. *Atmospheric Research*, page 108384.

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