

Manuscript ID: egusphere-2025-4289

Title: Global escalation of more frequent and intense compound heatwave-extreme precipitation events

Response to the Editor

Dear Editor,

Thank you for your continued attention to and support for the review of this manuscript. Upon receiving the comments, the authors immediately and appropriately revised the content and structure of the paper according to your suggestions, striving to meet the revision requirements. The modifications have been marked in red font in the manuscript for review. The authors appreciate the editor for pointing out these comments and suggestions, which is beneficial for us to continuously improve and enhance this research.

Thank you again for your time and kind assistance.

Best regards,
The Authors

Public justification (visible to the public if the article is accepted and published):

Thank you for submitting the revised version of your manuscript, “Global escalation of more frequent and intense compound heatwave–extreme precipitation events.” I appreciate the considerable effort you have made in responding to the reviewers’ comments and improving the manuscript.

Overall, the revised version represents a substantial improvement over the previous submission. In particular, the manuscript now provides a clearer articulation of its scientific contribution and better situates the work within the context of compound climate extremes. The enhanced discussion of potential physical mechanisms, along with the expanded methodological descriptions and improved statistical framing, significantly strengthen the clarity and interpretability of the study. The inclusion of additional CMIP6 models and consistency checks with reanalysis data further improves the robustness of the analysis.

That said, a few issues remain that should be addressed prior to final acceptance:

1. The added comparison with reanalysis data is welcome; however, please clarify the scope of this validation and avoid overstating its implications for model fidelity in representing extreme events.

Response: Given the high accuracy of reanalysis data resulting from the fusion of observations and model simulations, we employed reanalysis data to extract the attributes of CHWEP and single extreme events during the historical period (1980-2024). As CMIP6 also provides historical data, we further extracted the attributes of CHWEP and single extreme events based on bias-corrected CMIP6 historical data. By comparing the spatial distribution differences of the CHWEP and single

extreme event attributes derived from the reanalysis and CMIP6 data during the historical period (1980-2024), on the one hand, it demonstrates that CMIP6 data possess a strong capability to reproduce the attributes of CHWEP and single extreme events; on the other hand, it indicates that similar spatial distribution characteristics of CHWEP and single extreme events can be captured even when utilizing different types of data sources. We have revised the wording in the relevant sections to ensure greater accuracy. The modifications are highlighted in red in the manuscript for your review. We thank the editor for raising this point, which has helped us improve the precision of our expression.

2. Interpretation of mechanisms

While the discussion of thermodynamic and dynamic drivers is informative, these interpretations are not directly supported by diagnostic analyses within the manuscript. Please ensure that statements referring to “physical linkage” are clearly framed as conceptual interpretations supported by prior literature, rather than direct causal attribution from this study.

Response: The authors have appropriately revised the Discussion section, clarifying that some of the causal explanations are derived from conclusions of previous studies. The authors utilize these explanations to enrich and enhance the present study, aiming to inspire scholars to further investigate the mechanisms underlying compound events. The modifications are highlighted in red in the manuscript for review. The authors thank the editor for pointing out this issue, which has helped improve the rigor of the expression in this paper.

3. Uncertainty and robustness

The analysis relies primarily on multi-model means without explicit quantification of inter-model spread. Please add a brief discussion acknowledging this limitation and its implications for the robustness of projected changes.

Response: The authors have added a discussion regarding the advantages and disadvantages of adopting multi-model averaging in the Discussion section. Multi-model averaging can effectively offset internal random errors and model-specific biases, yielding relatively more robust results and improving computational efficiency. However, it produces only a single result, making it impossible to determine the magnitude of inter-model divergence and thereby ignoring inter-model uncertainty. The modifications have been marked in red font in the manuscript for review. The authors appreciate the editor for pointing out this issue, which is beneficial for the continuous improvement and enhancement of this study and subsequent related research.

4. Sensitivity to methodological choices

The use of fixed thresholds (90th percentile) and a 7-day temporal window is reasonable, but the absence of sensitivity testing should be acknowledged more explicitly as a limitation.

Response: Although we adopted the 90th percentile threshold and the 7-day time window based on the study by You and Wang, we did not test additional thresholds and time windows, leading to a lack of sensitivity experiments. This is a major limitation of our study. We have emphasized this point in the Discussion section. The revisions have been highlighted in red in the manuscript for review. We thank the editor for pointing out this issue, which helps us enhance the logical coherence and objectivity of this research.

You, J. and Wang, S.: Higher Probability of Occurrence of Hotter and Shorter Heat Waves Followed by Heavy Rainfall, *Geophys. Res. Lett.*, 48, <https://doi.org/10.1029/2021gl094831>, 2021.

These points do not require substantial additional analysis but addressing them will improve the transparency and balance of the manuscript.

Subject to satisfactory revision along these lines, I am pleased to indicate that the manuscript is suitable for publication.

Response: Thank you very much!