

Reply to Reviewer #1 comments

The paper proposes a very interesting analysis on the occurrence of combined hot and dry events in China, which represent a significant natural hazard. To do so, the authors use daily maximum temperature and precipitation data obtained from the CN05.1 dataset over the period 1961 to 2014.

In addition to the identification of hotspots for the country, the authors propose an analysis of the trends with which these events occurred and a further analysis of two sub-periods (1961-1987 and 1988-2014) to highlight traces of climate change.

I find the work to be well organised, well written and of high quality. In the following, I present some general recommendations that I think would be useful to improve the manuscript. In particular, I would extend the discussion not so much with regard to the results obtained (already very good), but by improving the narrative concerning the relationship between the extreme event studied <-> natural hazard (and the main purpose of the review).

Response: We gratefully acknowledge the reviewer's comments and the time spent to review the manuscript. The helpful and constructive comments have contributed to improve the paper. We have paid particular attention to improving the discussion on the potential impacts of such extreme events. For example, the substantial increase in the frequency of LDDH events identified in our results indicates increasing climate-related risks in China. The increased spatial extent of large-scale SLDDH events suggests increased population exposure and energy demand. Given the rapid population growth and land-use change, an increasing exposure and vulnerability to these events is expected. These could cause adverse impacts on agricultural, energy production and human health. The detailed responses can be found below.

- Section 3: change the title from 'Results' to 'Results and Discussion'.

Response: Thank you, the title has been changed to 'Results and Discussion'.

- In the introduction, I suggest adding at least one sentence on technologies and methods that offer large-scale climate data with sufficient resolution to obtain

practical information. Mention, for example, satellite products and large weather station networks such as the one used by the authors.

Response: We agree that greater detail on large-scale climate data would be helpful here and have added the following interpretations in bold to the manuscript (Line 52-53):

“... An event-based identification of spatiotemporal LDDH (SLDDH) could facilitate tracking the daily spatiotemporal dynamics of SLDDH and understanding the associated physical drivers. **The detection of SLDDH needs data with sufficient resolution that provide large-scale climate information, such as satellite measurements and large weather station networks.**”

- Although it is mentioned that such combined events can be both an environmental and human problem, I would strongly suggest strengthening the discussion on their role as a natural hazard. In other words, I would enrich the (well-done) climate analysis with indications more closely related to the concept of hazard (for example, more space for potential impacts). I believe that in this way the work can be further aligned with the aims of the journal.

Response: Thank you very much for this suggestion. We have provided more discussion on the potential impacts of compound dry and hot events from a natural hazard perspective. These changes can be found in the ‘Results and Discussion’ section as follows.

“... Overall, the spatiotemporal compound long-duration dry and hot events are becoming more frequent and impacting larger areas. **The increased contiguous areas affected by SLDDH could cause dramatic losses of agricultural production and populations in highly populated and agricultural regions (He et al., 2022; Zscheischler and Fischer, 2020), such as eastern China. A potential consequence of this fast-increased frequency and spatial expansion of persistent DH events is a growing threat to food production and electricity supply (Kim et al., 2022). In addition, more frequent and widespread large-scale SLDDH events may aggravate the risk of tree mortality and wildfires (Anderegg et al., 2013;**

Zscheischler et al., 2018), leading to an increase in the occurrence of sequential fire and dust extremes (Yu and Ginoux, 2022).”

References

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- Kim, Y., Choi, Y., and Min, S. K.: Future changes in heat wave characteristics and their impacts on the electricity demand in South Korea, *Weather and Climate Extremes*, 37, 100485, <https://doi.org/10.1016/j.wace.2022.100485>, 2022.
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- Zscheischler, J., Westra, S., Van Den Hurk, B. J. J. M., Seneviratne, S. I., Ward, P. J., Pitman, A., Aghakouchak, A., Bresch, D. N., Leonard, M., Wahl, T., and Zhang, X.: Future climate risk from compound events, *Nat. Clim. Change*, 8, 469–477, <https://doi.org/10.1038/s41558-018-0156-3>, 2018.

- In my opinion, the most interesting part of the work is the fact that such extreme events are tending to increase in frequency with the passage of time. This fact of climate change should find more space in the conclusions.

Response: We have highlighted the observed increase in frequency of such compound extremes in the ‘Summary and Conclusions’ section as follows.

“Averaged across the country, the frequency of the grid-scale LDDH events in China has increased significantly in the past 54 years. Increases in LDDH frequency are found across much of the country, most notably in Northeast China, Inner Mongolia, the Sichuan Basin, and China's southeast coast.”

“There is a substantial increase in the occurrence frequency and annual maximum spatial extent of SLDDH events, with magnitudes of 0.37 times and 40,000 km² per decade, respectively. Both grid-scale and 3D analyses show a more frequent occurrence of compound long-duration dry and hot events under

past warming conditions, indicating an increased probability of long-lasting compound events.”

- Also in the conclusions, I would dedicate a few more sentences on possible limitations of the proposed approach.

Response: Thank you. More details on the potential limitations in the context of our research have been provided in the manuscript. We note some shortcomings in our analysis, mainly driven by data limitations. The gridded dataset may introduce biases due to spatial interpolation of station observations, especially over regions with sparse stations. Moreover, although we find a dominant role of rising temperatures for the increased probability of LDDH events, improved understanding of the physical drivers (e.g., atmospheric conditions and land-atmosphere feedbacks) of the identified changes is essential for risk management of such persistent compound events. To better understand impacts of such compound events, it would be valuable to link the identified changes in climate extremes to socioeconomic indicators of exposure, such as the affected population. Changes made in text include the following ones.

“... It should be noted that our results are based on gridded data, which may have uncertainties due to station density, **especially over western China with relatively few stations**. It would be interesting to compare the results with those of station observations. **Although we find a dominant role of rising temperatures for the increased probability of LDDH events, improved understanding of the physical drivers (e.g., atmospheric conditions and land-atmosphere feedbacks) of the identified changes is essential for event prediction and risk management of such persistent compound events. Further studies could extend the approach taken here to identify the characteristics of compound long-duration dry and hot events in future climates and their impacts considering regional vulnerability and exposure.**”

Again, we sincerely appreciate the opportunity to revise our work for consideration for publication in Natural Hazards and Earth System Sciences. Thank you once again

for your valuable comments and suggestions. We sincerely hope that our revision will meet with your approval.