Natural Hazards and Earth System Sciences Discussions

Nat. Hazards Earth Syst. Sci. Discuss., author comment AC3
https://doi.org/10.5194/nhess-2021-5-AC3, 2021

Reply on RC3

Marc Lemus-Canovas and Joan Albert Lopez-Bustins

Author comment on "Assessing internal changes in the future structure of dry–hot compound events: the case of the Pyrenees" by Marc Lemus-Canovas and Joan Albert Lopez-Bustins, Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-5-AC3, 2021

The authors assessed the future changes of Dry-Hot compound events in Pyrenees. Based on the definition of the duration (D) and magnitude (M) of the dry-hot event, they analyzed the climatology of the two properties. D and M from climate model simulations were corrected and then used for future projection in the study area. Overall, this study falls within the scope of this journal. It could be improved by clarifying D/M definitions and bias correction methods/results. Several comments are as follows.

"We gratefully acknowledge the reviewer's comments and the revision of our manuscript. The article has been revised in accordance with the referee's comments and suggestions, which are addressed below. Our responses appear in italic and quotation marks"

Major comments:

(1)The definition of D, M, and EM is not quite clear. For example, the definition of the 90th percentile for both the D and M needs to be clarified.

"We have rephrased L159-160 to make clearer the event definition. In addition, we have changed the 90th percentile by 95th percentile to gain sensibility when detecting extreme dry spells and heat extremes."

(2) For the bias correction, the D and M are corrected directly. Some comments or comparisons with the multivariate bias correction of climate variables (and then derive the D and M) could add merit to this study.

"The authors have made structural changes in the performance of the bias correction to guarantee more correct and transparent results in terms of the uncertainty of this type of correction in climate simulations. Below we summarize the changes made in the methodological aspect (integral restructuring of section 2.4) and to the assessment of the results of the application of the bias correction methods (section 4):"

- *"We first applied empirical quantile mapping (EQM) to the original temperature and precipitation data, rather than directly to D, M and EM. If the correction is performed*

for D, M and EM, the physical connection between the original precipitation and temperature can be omitted (i.e. the physical mechanisms are lost).”

- *“Subsequently, we incorporated a multivariate BC method, the Multivariate Bias Correction with N-dimensional probability density function transform (MBCn), proposed by Cannon (2018). This method enabled us to maintain the structural dependence between temperature and precipitation (see Fig. 7, section 4), which is relevant when working with compound events. Throughout section 4, the performance of MBCn is compared to EQM.”*
- *“To analyse the uncertainty in the estimation of dry spells in the climate models and in the subsequent correction, the D-statistic of the Kolmogorov-Smirnov test (L217-222) was used. Section 4 shows that the results are very irregular, which for the CANT region are acceptable, since the distribution simulated by the BC methods is close to the observed one; but this is not the case for the NMED region, where the distribution of the dry spells simulated and corrected by the two BC methods is clearly different according to the KS test. See Fig. 8.”*

- *“Finally, the performance of the two BC methods in modelling daily temperature has also been analysed, with emphasis on the daily extreme values above p95 of Tx for each year (spring and summer), as well as on the daily extreme values of TX for each year within a dry spell. Section 4 explains that the EQM (denoted as UBC in the text (Univariate Bias Correction)) performs quite well, but when reaching the most extreme temperature values, those occurring within a dry spell, the MBCn is more accurate (Fig. 9 and Fig. S4).”*
- *“All these results suggest the need to employ MBCn when correcting future projections. This has led to some changes in section 5.”*

(3) Presentations and discussions of patterns in several figures need to be more clear (e.g., Figure 6 and 12)

“Figure 6 was removed because section 4 was fully restructured. Please review the new version of section 4. In addition, section 5 has also been improved and now the explanations are more concise. Please review the improved version of section 5.”

Other comments

Please correct typos in many places of the manuscript (e.g., line 34).

“Done”

Lines 139-140 (and Table 1): how do you define the “90th percentile” for both D and EM? Is this threshold based on the temperature of MAM and JJA? Please clarify.

“We added the following sentence: To ensure that independent and extreme spells were obtained, for each year (spring and summer, separately) we computed 95th percentile of dry spells duration and then we selected those with a duration greater than this threshold.”

In Table 1: There are multiple days with temperatures higher than 90^{th} percentile. How do you define the EM (average or maximum)? Please make this clear.

“Table 1 is about models. We defined EM in L159-163.”

Lines 157-162: This bias correction procedure is performed on the D and M. One can also adjust the climate variables and then compute the D and M. In this case, the multivariate bias correction is of particular interest to correct the dependence between the contributing variables of compound events (Cannon, A. J., 2018, Clim. Dynam; Zscheischler J. 2019

Earth System Dynamics Discussions). Some discussion or comparison on this would enhance this study.

"Thanks for the comment. We have already addressed this issue in this review."

Figure 6: For the corrected M and EM, the bias seems to be 0 for all seasons and regions. This means that the bias correction procedure has corrected almost all the systematic biases. Is this the case in Figure 6? Please explain or clarify the almost perfect performance of the correction.

"The previous analysis did not get a clear view about uncertainties of the bias correction methods applies. We have fully restructured section 4.

Figure 12: "The drivers of the three future periods of the compound event" The analysis of the driver is interesting. However, the estimation of the driver seems to be quite vague. How do you determine the driver? Please explain it clearly.

"The drivers are drawn through the performance of CANT and NMED regions. The small sketches are intended to give an understanding of the patterns identified in the different scenarios and seasons. Most part of text has been rewritten to make these results more comprehensive."