Weather Clim. Dynam. Discuss., author comment AC2
https://doi.org/10.5194/wcd-2022-15-AC2, 2022

Reply on RC2

Colin Manning et al.

Author comment on "Large spread in the representation of compound long-duration dry and hot spells over Europe in CMIP5" by Colin Manning et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2022-15-AC2, 2022

This manuscript investigates the representation of compound dry and hot spells in Europe in the CMIP5 data set. The model data is compared to EOBS. The results show that CMIP5 models struggle to capture the duration and intensity of these compound events. The manuscript is well written, the figures are clear and the results are relevant. I recommend to publish the manuscript after major revisions as detailed below.

We thank the reviewer for taking the valuable time to review this manuscript, it is much appreciated.

Major points:

The choice of a constant MSLP threshold needs to be further motivated and discussed. There are several issues with this choice. I) heat lows can from over the Iberian peninsula (https://rmets.onlinelibrary.wiley.com/doi/abs/10.1256/qj.01.189) during hot conditions breaking the link between MSLP and high temperatures, while the overall tropospheric circulation is still anticyclonic. Ii) in locations with high orography the correction of the surface pressure to MSLP might introduce biases. Iii) the climatologically lower pressure at higher latitudes leads to longer exceedances over the 1012hPa threshold compared to lower latitudes.

We accept that the way we have treated anticyclonic conditions is flawed and so we have updated the analysis and applied an algorithm from Sousa et al. (2021) that detects anticyclonic features, namely sub-tropical ridges and atmospheric blocking using geopotential heights at 500 hPa. We combine these features under the same definition, anticyclonic systems, as both will have the same local effect on precipitation and temperature and both can also occur within the same life cycle of an anticyclone. The updated analysis assesses the frequency of anticyclonic systems in Europe according to the chosen algorithm, their local influence on the persistence of dry spells and the link between model biases in the frequency of anticyclonic systems in models and biases in both dry spell persistence and the magnitude of temperatures during dry spells in models.

A direct comparison of absolute temperatures between EOBS and CMIP5 (Figure 5) will be strongly affected by the representation of the orography and coast lines within CMIP5. A comparison relative to a percentile might be more meaningful.

We agree that the representation of the coastline and orography may play a role in the temperature biases. However, we do not understand the rational behind why a percentile-based approach would remove these effects as they will be seen across the temperature distribution. However, we have added text (L293-295) to note the influence of coastal effects on the interpretation of the biases in those locations.

Please control for multiple testing in all analyses using the FDR (see Wilks 2916, https://journals.ametsoc.org/view/journals/bams/97/12/bams-d-15-00267.1.xml)

The cited paper refers to parametric tests which require statistical assumptions. Our approach uses non-parametric bootstrapping which does not require such assumptions. In the approach, we randomly shuffle seasons to break the seasonal dependence between the precipitation and temperature series and calculate the metric. This is repeated 1000 times and provides an indication of whether the result can be achieved by random chance. As the approach is non-parametric, FDR does not apply here, and we interpret the presence of stippling as there being a < 5% chance of the result occurring by random chance.

How relevant is the representation of summer convection in the models for the duration of the dry spells?

This is an interesting question though one which we cannot answer here. It would likely require a detailed analysis of the models with specific types on convection parameterisation schemes and/or a comparison with a high-resolution convection permitting climate simulations.

Minor points

Abstract: long-duration ï□ sub-seasonal (Long duration is per se not very clear, it could also refer to spells that last for several years)

Thank you for the suggestion, this has been added to the abstract.

38 Zscheischler 2020/2021 is missing in the list of references

We apologise for this omission; we have updated the reference list.

Add Ridder et al. 2022 to the list of references
https://www.nature.com/articles/s41612-021-00224-4

Thank you for highlighting this paper, we have now cited this in the introduction.

96 Is the mean taken across all spells? The definition is not yet fully clear.

Yes, we calculate the maximum temperature within each dry spell lasting longer than 5 days. is then the average maximum temperature from all those dry spells.

182 IPPC ï□ IPCC

Thank you for noticing this mistake, it has been corrected.

410ff Include the results of Zscheischler and Seneviratne

(https://www.science.org/doi/full/10.1126/sciadv.17002639) in the discussion.

This has been included in the discussion (Line 537).

Figure 1a I recommend to use a colormap with only one color, two colors suggest a change in sign.

Thank you for this suggestion, and we agree that it might appear as a change in sign though as the paper does not assess changes in the hazards, we feel this is not a large issue. The colormap has been chosen to remain consistent with a previous paper (Manning et al., 2019), and we chose this colormap as it highlights the large difference between dry spell lengths in Northern and Southern Europe. As such, we prefer to keep the current colormap.

Panels c,d,e in Figure 3 do not fit the description and look the same as panels c,d,e in Figure 7, there may have been a mix-up.

Thank you for pointing this out and we apologies for this mix up. This mistake has been corrected.