Climate of the Past Discussions

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Comment on cp-2021-61

Anonymous Referee #2

Referee comment on "Statistical characteristics of extreme daily precipitation during 1501 BCE–1849□CE in the Community Earth System Model" by Woon Mi Kim et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-61-RC2, 2021

Summary: The manuscript focuses on the drivers of the variability of extreme precipitation over the past three millennia in a simulation with the CESM model. The analysis aim at identifying the impact of orbital forcing, volcanic eruptions and of some important modes of natural variability on the frequency and intensity of extreme daily precipitation. The main conclusion is that the impact of external forcing is generally small compared with the influence of the internal variability modes. One exception is the signal of volcanic eruptions at short time scales

Recommendation. The climate simulation covers a period that has seldom been considered by other modelling groups. This is one reason why I found this manuscript interesting. For instance, it allows to identify the possible signal of the transient orbital forcing better than the more common simulations over the past millennium. A second reason for the interest of this manuscript is the analysis of the variability extreme daily precipitation, which has also been much less often considered than temperature.

All in all, I think this manuscript should be published, perhaps after some revisions. It is generally clearly written, the statistical analysis is, as far as I can tell, correctly conducted, and presents a novel approach including a non-stationary extreme value analysis. The conclusion seems to be properly derived from the analysis.

I have one major suggestions and a series of minor points that the authors may want to consider.

1) Main main suggestions is related to the link between temperature and extreme precipitations. Whereas the manuscript focused on the external drivers of extreme precipitation and on the impact of natural modes of climate variability, one question that probably will come to the mind of many readers is whether or not warm decadal (or miltidecadal periods) generally are accompanied by more intense daily precipitation extremes. The introduction indicates that, for the future, the Clausius-Clapeyron equation does suggest that for future warming mean and extreme precipitation should increase. Can we see that relationship already in the past in this simulation ? How large should the 'warm' or cold regions be so that the temperature impacts extreme precipitation (e.g. whole hemispheres or continents) ? If yes, would it be worth to investigate this link in climate reconstructions, as far as proxies for extreme precipitation might be found ?

Particular points

.2) 'Although, eruptions alter both the intensity and frequency of extreme precipitation,.'

Change Although to However

3) 'Extreme daily precipitation, which often causes devastating flood events, is a complex phenomenon due to its rare occurrence and short-lived nature'

I guess that this are not necessarily the reasons why extreme precipitation is a complex phenomenon. These may, however, be reasons why it is difficult to analyse extreme precipitation.

4) ' When the sample size is small and the estimated ξ is negative, there is a bias in the estimation of ξ towards a larger standard error (Blender et al., 2017)'

This sentence could be a bit confusing at first sight. I guess that here 'sample size' refers to the number of exceedances (?), but some readers would rather interpret 'sample size'

as the total number of data (above and below the threshold). In any case, this sentence is not clear to me, since in both cases the 'sample size' would be the same for all grid-cells: either 1% of the available data (threshold set at the 99% percentile) or the all the available data. So why do some grid-cells have a smaller sample size than others?