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Interactive comment on "Have precipitation extremes and annual totals been increasing in the world's dry regions over the last 60 years?" *by* Sebastian Sippel et al.

Anonymous Referee #2

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Review of Sippel et al., 'Have precipitation extremes and annual totals been increasing in the world's dry regions over the last 60 years?'

This paper (which can effectively be considered as a comment on the Donat et al (2016) paper) raises two issues with the Donat et al (2016) (hereafter D2016) paper – the way in which spatial averaging has been used and the way in which dry regions have been defined.

Both of these are legitimate concerns. However, in my view both this paper and D2016 miss what I think is the main point with respect to the definition of dry regions – namely, that most of the world's driest regions (in particular, almost all of the Sahara and the Middle East) are excluded because of a lack of data. (Similarly, many of the world's

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wetter regions in South America, equatorial Africa and southeast Asia are also excluded). Any definition, whether it is the one used in D2016 or in this paper, is likely to give an unrepresentative sample of the world's dry regions given that the data availability is largely confined to North America, Eurasia and parts of Australia. Put another way, the HadEX2 data set in its current form is not capable of providing a fully representative sample of the world's dry regions, which is particularly important given that there is no reason why we would expect tropical arid and semi-arid zones (e.g. the Sahel), subtropical deserts (e.g. southwest US) and high-latitude low-precipitation regions to have similar long-term trends. A casual reader encountering either this paper or D2016 would expect the papers to be covering a very different range of areas to that which they actually do.

(I would view both this paper's method and the D2016 method as being reasonable ways of defining dry regions – the issue is that neither is representative given the gaps in the data set).

Averaging precipitation indices is another challenge – whilst the averaging period (as mentioned in this paper) is one issue, another is whether it is appropriate to average values from a distribution which is bounded below by zero and highly non-Gaussian. If one averages absolute values, area averages are likely to be dominated by the wetter areas; if one averages normalised values, there will be much more volatility in the driest areas. (Somewhat ironically, the fact that the HadEX2 data set excludes most of the world's really dry areas averted a bigger problem here – in climates where mean annual values are, say, below 10 mm, annual totals in excess of 1000% are plausible, which would completely overwhelm less variable climates in a spatial average). In my view, it would be better not to try to do spatial averages at all, and instead report using indicators such as the % of gridpoints which show significant positive/negative trends. That said, if you are going to average precipitation indices, then this paper has identified a genuine issue with the D2016 methodology.

In summary – I think this paper accurately documents valid issues with the D2016

paper, and as such I think it is appropriate for publication, but I also think it would be improved if it engages substantially more with the issues identified above.

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