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Hydrology and Earth System Sciences Discussions

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Interactive Comment

Interactive comment on "How extreme is extreme? An assessment of daily rainfall distribution tails" *by* S. M. Papalexiou et al.

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CC: Commenter's comments
AC: Authors' comments

We thank Christian Onof for his kind comments and useful remarks.

CC1. *This is a well-written paper that makes a clear contribution to the difficult but very important question of deciding upon which distribution to use to represent precipitation extremes. One of the key strengths of the study is that it has considered a massive data base (15 029 stations) of very varied daily rainfall series. And it is interesting that the shape parameter of 0.134 is the mode of the distribution of Pareto distribution shape paramaters, since this valus has been found independently in a study by Koutsoyannis.*

AC1. Indeed the mode is 0.134, although the power-law index may not be constant in the whole world. In a new study using the same large dataset (Papalexiou and Koutsoyiannis, 2012a) (predecessor presentation of a paper under review) but investigating the classical extreme value distributions, we find that there are geographical signatures in the tail index. We must clarify that our analysis does not support a strong conclusion that a power-type distribution is the best choice for all cases. Yet, what the results indicate is that in most cases the distribution with the heavier tail performs better.

CC2. *I think the study has been well led, with efficient quality control of the data, followed by a fitting method taylor-made for the focus upon extremes. One could have included weights in the chosen objective function, to reflect the greater confidence one has in the relatively lower return periods, but I don't think this is a crucial point.*

AC2. Indeed, different objective functions can be chosen and adding weights is a good idea, yet, it has the drawback of subjectivity. The specific norm we use here results seems to perform better than common alternatives: Please see the response to Francesco Laio's review (and the figures we provide there) where we describe a Monte Carlo scheme that verifies this.

CC3. *Interestingly, the study implies that moments of order larger than 1/0.134 = 7.5 are infinite. The divergence of moments is, of course, a feature which can be predicted using multi-fractal rainfall models, and such models do imply the need to use thick-tailed distributions for extremes. Looking at the literature, it turns out that such models tend to predict that the divergence of moments will however happen for lower exponents, namely around 3 to 3.5. Given the strong empirical basis for the figure of 7.5, it would be interesting to examine how this information could be incorporated into the fitting of such a stochastic rainfall model (e.g. a multifractal model).*

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AC3. Specifically for daily rainfall, and based on previous studies (Papalexiou and Koutsoyiannis, 2012a, b) where we studied the daily rainfall distribution in more than 10000 stations, it seems that exponents around 3 to 3.5 are too low for the moments to diverge and they would generate extremely large rainfall events that would not correspond to reality.

References

Papalexiou, S. M. and Koutsoyiannis, D.: A global survey on the distribution of annual maxima of daily rainfall: Gumbel or Fréchet?, in European Geosciences Union General Assembly 2012, p. 10563. [online] Available from: http://www.itia.ntua.gr/en/docinfo/1207/ (Accessed 3 October 2012a), 2012.

Papalexiou, S. M. and Koutsoyiannis, D.: Entropy based derivation of probability distributions: A case study to daily rainfall, Advances in Water Resources, 45(0), 51–57, doi:10.1016/j.advwatres.2011.11.007, 2012b.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 5757, 2012.