REVIEW OF PANGALURU ET AL., 2018, HESS: ESTIMATING CHANGES OF TEMPERATURES AND PRECIPITATION EXTREMES IN INDIA USING THE GENERALIZED EXTREME VALUE (GEV) DISTRIBUTION

GENERAL COMMENTS

Pangaluru and co-authors quantify extreme temperature (maxima and minima) and precipitation over India using climate models with historical forcing and CRU data. They show biases between the two datasets spatially over India. I may not have a lot of comments, but overall I find that the analysis is shallow and I fail to grasp what the significant contribution of this paper is. There is already a lot of literature comparing historical and future temperature using climate models. For example, the IPCC report, but also many other papers, often on a global scale. Therefore, I strongly doubt whether the manuscript in its current (or even updated) form meets the standards of HESS. Here I provide some key points that need to be addressed:

- None of the figures actually provides information on future **changes** in the extremes over India. All that can be seen is that there are biases between the climate models and CRU. This should be analyzed because that is the analysis that was suggested in the title of the paper and even what is concluded on, for example, L316 and L356-359. It would probably also require carrying out bias-correction for the climate models.
- The CRU data is monthly. Most literature for extremes is on daily or subdaily scale. I am not sure if it is very useful to do extreme value analysis on monthly data. Essentially you probably have 2 or 3 months each year that can have the highest temperature or precipitation. You could also take the month which generally has to highest temperature and do a trend analysis. I would like to see some analysis by the authors that showed that the assumption of a GEV-distribution is useful or use references to explain that this is a useful approach.
- Regional averaging: is this done before or after the application of the GEV model? Explain why.
- Extreme value theory is normally used to estimate extremes with return period beyond the window of training data. With 100+ year of data, you could just get the 10, 20 and 50 year return levels directly from your data, without fitting any GEV model, so what is the point in doing that?
- I did not comment on the captions, because the author have made it too difficult for a reviewer to assess them as the captions and the figures are given separately. Please fix this in a revised manuscript.
- The precipitation analysis is carried out much less rigorously compared to the temperature analysis. I think this should be extended.

SPECIFIC AND TECHNICAL COMMENTS

Are the temperatures monthly average temperatures (day+night), or are they monthly averages of daily maxima/minima or something else?

L31-32: “The GEV statistical distribution is a time-dependent distribution”

The GEV distribution in itself is not time-dependent. Only if you make the parameter non-stationary (e.g. Wilcox et al., 2018). Later on in the methods the authors (falsely) suggest a time-dependency of the parameters (L136), but I actually think that they applied GEV non-stationary for different time periods, which is different from applying a time-dependent (i.e. non-stationary) method.

L31-34: “The GEV statistical distribution is a time-dependent distribution with different time scales of variability bounded by a precipitation, maximum (T_{max}), and minimum (T_{min}) temperature extremes and also assessed their possibility changes are evaluated and quantified over India is presented.”

There is something wrong in this sentence.

L37-40: “The regional means of historical warm extreme temperatures are 34.89, 36.42, and 38.14 ◦C for three different (10, 20, and 50-year) periods, respectively; whereas the cold extreme mean temperatures are 7.75, 4.19, and -1.57 ◦C.”

Since there has not been given a definition of a regional mean extreme temperature this information is not very helpful in the abstract. The word period is somewhat misleading here. I suggest to use always (throughout the manuscript) include the word ‘return’ when talking about return periods. Period could just refer to a certain length of time.

L46-47: “The CRU precipitation extremes are larger than the historical extreme precipitation in all three (10, 20, and 50-year) return-periods.”

What does this mean? CRU is historical precipitation right?

L56-57: “India is the third most influenced nation by weather related by disasters, which can largely be attributed to both higher occurrences of extreme temperatures and precipitation”

Does this statement include or exclude the effect of risen CO_2-levels in the atmosphere, or is it because of the fact that people simply live very close (perhaps too close) to rivers for example.

L58-60: Trenberth (2005) showed that climate change due to increased greenhouse gas emissions leads to changes in extreme event behavior in terms of precipitation and temperature all over the world.

Really? The title of the paper suggest that it looks at uncertainties in hurricanes. Perhaps other references are more appropriate.

L64: “Jaruskova and Rencova (2008)”

Not sure why this reference is singled out. There are probably hundreds of papers using GEV. A reference that should probably not be missed is Papalexiou and Koutsoyiannis (2013), since that does global analysis and thus includes India as well.

L124: “Generally, the value of ξ is greater than zero for precipitation data”

Can you provide a reference?

L161: “return time periods”

I think this should be return period or return time and not return time period

L215-217: “Moderately warm regional mean temperature changes are observed in RCP2.6 and RCP8.5 scenarios at about 1.15, 1.28, and 1.28 °C for the three (10, 20 and 50 year) periods, respectively.”

Where can I see these numbers back?

L228: “warming of more than 2 °C over the western Himalayan region in the 50 year period”

The word 'Warming' suggests a trend in time of 2 degrees Celsius over 50 years, but I think the authors are just discussing the biases between CRU and CMIP5 for the 50-year return period or something like that. Please provide more details of what you actually did and better explain what you mean exactly.

L322: "Extreme warm values in Historical Tmax in India appear to be rather moderate"

I could be me just being from a much colder country, but a regional average monthly value of temperature of 38 degrees Celsius is not something I would classify as moderate.

Table 2: clearly provide the considered time period in the caption.

Figure 1: axes lack units…

Figure 2: The word historical is misleading. CRU is historical data, and climate models can simulate the climate of the past, but that does not make them actual history.

TECHNICAL CORRECTIONS

Notation of italic and non-italic symbols is a mess and not up to the standards as outlined in the HESS manuscript preparation guidelines.

*L60: **'The'** Generalized Extreme … (this same error occurs at other places as well)*

Table 2: 30 year should probably be 50 year

L331: shown → showed

REFERENCES

Papalexiou, S. M. and Koutsoyiannis, D.: Battle of extreme value distributions : A global survey on extreme daily rainfall, Water Resour. Res., 49(1), 187–201, doi:10.1029/2012WR012557, 2013.

Wilcox, C., Vischel, T., Panthou, G., Bodian, A., Blanchet, J., Descroix, L., Quantin, G., Cassé, C., Tanimoun, B. and Kone, S.: Trends in hydrological extremes in the Senegal and Niger Rivers, J. Hydrol., 566(September), 531–545, doi:10.1016/j.jhydrol.2018.07.063, 2018.