

**Review of “Estimating changes of temperatures and precipitation extremes in India using the Generalized Extreme Value (GEV) distribution” by Pangaluru et al.**

Pangaluru et al. analyze the spatial distribution of extreme precipitation/temperature return levels over India. To estimate the return levels, they use a GEV distribution. The paper is well written and the content fits HESS. My main concern is that the authors are using a non-stationary GEV model, but they do not even mention non-stationarity. Research has not yet agreed if all parameters of GEV model should be considered non-stationary (Lee et al. 2017). The authors (without convincing the reader) just use non-stationary GEV model and consider that all parameters are non-stationary. Therefore, I recommend publishing the article once the authors address the followings:

**Major concerns:**

**Non-stationarity:** It seems that the authors are using a non-stationary GEV distribution while they do not even mention non-stationarity. This is not acceptable. If you are using a non-stationary model, you have to convince the reader that this is the best option. Why are you using a non-stationary model? There is no literature review about Non-stationarity! Why did you consider all three parameters to be non-stationary? Studies have concluded that it is very hard to estimate a non-stationary shape parameter in GEV distribution (see Lee et al., 2017 and references cited there). It's not clear how the authors have dealt with this problem.

**Literature review:** The literature review does not seem to be covering the entire content. More literature review on precipitation extremes is needed. Also, a significant portion of the introduction covers extremes in China while the study area is India. I suggest adding literature review of other regions such as U.S. as well. A recent paper on the extremes of the U.S. is Zarekarizi et al., (2018).

**Model parameters:** If the parameters are non-stationary, the readers need to see the variations in the parameters. I would like to see the parameters (all of them) in all datasets! (Historical, CRU, and all RCPs). Did you estimate the parameters for every dataset (Historical, CRU, and every RCPs)? Did you estimate the parameters once in the historical period and used it for the future? Please explain and show the estimate parameter maps in the revisions.

**Model choice:** Authors need to prove that non-stationary GEV is the best-fit model. I am not convinced why the authors have used non-stationary GEV.

It's not clear why the authors chose GEV for extreme precipitation. You can add literature review if other studies have use GEV for extreme precipitation as well.

Authors are only using plots to show the goodness-of-fit. This is not enough. Please use 1-2 quantitative measure too (such as AIC, BIC, DIC, RMSE, NSE, etc.)

**Downscaling:** (Line 112) Did you do any downscaling? If yes, explain. if not, explain the reason in the discussion section! Also, say exactly how many cells you have? For figures, have you used smoothing? If yes, what method?

**Introduction:** The introduction needs more literature review on precipitation extremes. Explain in more detail what are the goals of the study?

### **Minor concerns:**

It's not clear what program the authors have used to estimate the parameters.

Cite papers that have used GEV to model extreme precipitation.

In case, a reader is interested to reproduce you research, where can they get the data? Please provide links. Also, I always encourage open source research. Please indicate if you are planning to share data and code? If yes, where can a reader find the data?

Explain how you extracted cold extremes from the dataset.

Figure captions are generally too short and need to address more details.

Line 32-34: Revise, grammatical issue.

Line 39: Use the term "return period"

Line 46: What is CRU? Spell out or just say observation.

Line 56: Grammatical issue.

Line 67: What was their conclusion?

Line 81: Spell out GCM.

Line 90: This is confusing. Please separate data and method. There is no transition from data to method.

Line 94: Is the length of CRU data up to 2005 or you chose this period?

Line 97: It is not clear if the authors have done “quality checking procedures” themselves or it’s available through data sources?

Line 106-107: Explain in more detail.

Line 114-116: Not clear. Revise please.

Line 117: Add a section or subsection here.

Line 129: Please look at Lee et al., (2017) in GRL, too.

Line 151: What do you mean by “regression”?

Line 151: Explain “delta” method.

Line 152: As you know, in GEV model, the realizations should be i.i.d. How can you convince the reader that a month is enough to make sure that data are not dependent? You can cite previous papers that have used monthly maximum temperature and precipitation.

Figure 1: Please indicate how many points you have and if you are ignoring any outliers?

Line 156: Please add all the fitting information.

Figure 1: What data are you using for these plots? Historical or CRU? Explain in the caption. It would be good to see this for other datasets too (if possible).

Line 161: Please use the term “return period”

Line 165: Please explain this in the caption, too.

Line 168: “(Figure not shown)”. I think it’s important to show this figure (if not limited in the number of figures. In that case, you can add it in the responses to this review)

Line 209: Revise the title of sub-section. This section is more of analyzing the spatial distribution, not changes.

Line 247: standard deviation of what? Estimated return levels?

Line 271: I could not find lee et al. (2014) in the list of references. Please make sure all the cited papers are included in the references.

Line 283: You did not analyze trend. Please revise this term.

Line 313: Issue with citing style.

## **Tables:**

Table 1: Please highlight the rows to indicate the models that you have used in the study. Also, make it clear in the caption too.

Table 1: The quality (of both tables) is low. Explain in the caption what “stem” is.

## **Figures:**

I suggest separating the map in figure 1 from the rest of figure. They are representing different ideas.

What are the gray dots in the map in figure 1?

Figure 1, lower right panel: add legend.

Expand the figure 1 caption and add more detail especially about the dataset.

Figure 2: Explain in the caption that what the numbers above each panel is? This applies to all figures.

It is not clear from the caption that what the figure represents (this should be applied to all captions)

I suggest adding 6 more panels below these and represent CRU data.

Figure 3: Revise the title of the colorbar to make sure the reader understands that this is difference and not absolute values.

Is this difference between return periods? Or absolute values. Make it clear in the figure.

Figure 4: You could change the colorbar so that the spatial distribution of the data is clearer.

## **References:**

Lee, B.S., Haran, M, Keller, K., 2017. Multidecadal Scale Detection Time for Potentially Increasing Atlantic Storm Surges in a Warming Climate. *Geophys. Res. Lett.* <https://doi.org/10.1002/2017GL074606>

Zarekarizi, M., Rana, A., Moradkhani, H., 2018. Precipitation extremes and their relation to climatic indices in the Pacific Northwest USA. *Clim. Dyn.* <https://doi.org/10.1007/s00382-017-3888-2>