Reply on RC4

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Dear Reviewer,

We would like to thank you for your constructive comments. In the following, we will address them point by point.

1 Answers

1. In this study, the authors investigated the features of curvature, multi-scaling and flattening on the deviation of IDF curves under the stationary assumption. Particularly, the parameters of GEV are modelled as functions of duration. Do you consider the impacts of climate change on the IDF under a changing environment? There are studies who try to update the IDF curves considering the nonstationarity, such as Agilan and Umamahesh (2017) and Ganguli Coulibaly (2017), and Yan et al. (2021) provided a review about this topic. In a nonstationary model, the parameters are modelled as function of covariates, please make a discussion or outlook about this topic, which should be highlighted under the changing environment.

References

[1] Agilan, V., Umamahesh, N. V. (2017). What are the best covariates for developing non-stationary rainfall intensity-duration-frequency relationship? Advances in Water Resources, 101, 11–22.

[2] Ganguli, P., Coulibaly, P. (2017). Does nonstationarity in rainfall require nonstationary intensity-duration-frequency curves? Hydrology and Earth System Sciences, 21(12), 6461–6483.

[3] Yan L, Xiong L, Jiang C, Zhang M, Wang D, Xu C-Y. (2021) Updating intensity–duration–frequency curves for urban infrastructure design under a changing environment. WIREs Water. 2021; e1519.

Answer: Thank you for this comment and for providing usefull references. We will include non-stationarity in the discussion because we agree that this is an important concept that should be considered in IDF curves.

2. In this study, the authors just consider the GEV distribution for the deviation of IDF, I think for the study area, lognormal or Gamma distribution may also exhibit comparative or better performance. It makes sense for engineering design to try other probability distributions and compare the results.

Answer: In an engineering context for small finite samples, other distributions than the three distributions resulting from the Fisher-Tippett Theorem might approximate the measured values indeed better for the observed time period. However, the three types of the GEV (Gumbel, Fréchet, Weibull) are the only limiting distributins for block-maxima and thus this theorem gives a strong motivation to use these distributions for modelling block-maxima (e.g. Coles, 2001). Due to this solid theoretical justification, many studies use the GEV distribution to develop IDF curves (Papalexiou and Koutsoyiannis, 2013, Van de Vyver, 2018, Shrestha et al., 2017). Including other distributions is beyond the scope of this study.

3. Make a discussion about the deviation of the copula-based IDF curves.

Answer: Thank you for this remark. We will include a short discussion about copula-based IDF curves in the manuscript.

4. For Figure 3, the Quantile skill index is difficult to understand, please make a clearer legend for potential readers.

Answer: Thank you for pointing out that this figure is difficult to understand. We agree that it is a complex figure but we were not able to find an easier visualization so far. The panel inset labels ("[model] vs. [reference]") indicate which IDF model's skill is shown and which IDF model is used as reference. The indices refer to the features of the models (c=curvature, m=multiscaling, f=flattening). The skill of the individual features (columns (a)-(c)) are strongly depending on the models that are used, which is why all of these subfigures have to be shown in the manuscript.
We will extend and improve the description of this figure in lines 252 ff. to make it more clear.

References

[1] Coles, S. (2001). An introduction to statistical modeling of extreme values. London: Springer-Verlag. ISBN: 1-85233-459-2

[2] Papalexiou, S. M., Koutsoyiannis, D. (2013). Battle of extreme value distributions: A global survey on extreme daily rainfall. Water Resources Research, 49, 187–201.

[3] Van de Vyver, H. (2018). A multiscaling-based intensity–duration–frequency model for extreme precipitation. Hydrol. Process., 32, 1635–1647, https://doi.org/10.1002/hyp.11516,

[4] Shrestha, A., Babel, M. S., Weesakul, S., Vojinovic, Z. (2017). Developing Intensity–Duration–Frequency (IDF) curves under climate change uncertainty: the case of Bangkok, Thailand. Water, 9(2), 145.