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Earth System Dynamics Discussions

Interactive comment on "Return Levels of Temperature Extremes in Southern Pakistan" *by* Maida Zahid et al.

Anonymous Referee #1

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This study estimates the return levels and return periods of extreme temperature and wet-bulb temperature in Southern Pakistan using the peak over threshold (POT) approach. Datasets including 33-year daily maximum observations, ERA Interim data, and the bias-corrected ERA Interim data were examined to assess the severity and the likelihood of extreme temperature. This research topic is worthy of investigation, and the results are interesting. I recommend acceptance pending on Major revisions to address the following comments:

1. Both Generalized Extreme Value (GEV) and GPD distributions can be applied for assessing return levels and return periods of climate extreme events. The length of 33-year annual maximum values seems to be sufficient for deriving reasonable estimates using the GEV technique. Therefore, it is not so clear why the GEV distribution is not preferred here. Did authors examine the GEV-based return levels? Does GPD provide

a better fit and a more reliable estimation?

2. GPD approach has been widely applied for estimating the statistics of extreme rainfall and temperature (e.g. Katz et al., 2002, 2010, Cooley et al., 2005, 2007, etc.), and the techniques used in this manuscript are not nascent. In order to sufficiently support the argument that the application of GPD herein is "novel" and can provide "novel" information, highlighting any new or additional findings which can only rely upon the GPD approach is desired.

3. By comparing the distribution parameters and return levels derived from observations and ERA Interim data, it seems that they have a large agreement in the shape parameter estimations at some stations, while the bias in the mean and variance of model simulations is the primary factor that leads to the underestimation of the return levels. Does the agreement in the shape parameters indicate that the underlying physical process which produces extreme temperature is well represented by the climate model, though there is a bias in simulating the internal variability of extreme temperature? Please consider to extend the current discussions in this regard.

4. At stations such as JCB, MJD, RHI, the bias-corrected return levels underestimate the observed values. Which factor/parameter would be responsible for the consistent underestimation? For those locations, is there a way to conduct the bias correction for the shape value? Would a higher threshold correct such underestimation?

5. In section 2.1, the purpose and benefit of adding noise to the data are not clear. By adding the noise, does the convergence of parameter estimation become more efficient? Why?

6. Please consider to rearrange the order of tables and introduce them in sequence. For instance, Table 2 is introduced ahead of Table 1 in the context, so please switch their orders.

7. Please provide the Q-Q plots for the 9 stations, since the authors discussed the

“slight deviation” revealed by examining the corresponding Q-Q plots.

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