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

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The paper presents estimations of temperature return levels over Southern Pakistan using the Peak Over Threshold approach based on both observation time series and reanalysis time series of the nearest grid points to the observations stations. Such a study is not new research, but as the authors mention, it had not been made for this region, so this justifies publication.

General comments This analysis presents different problems and misunderstandings, therefore I suggest publication after major revisions.

Major comments

1. Line 28 p3, it is stated "If the ERA Interim dataset characterizes well the extremes. . ."

This is very unlikely, since re-analysis has a too low spatial resolution to represent adequately local extremes, this is not the aim of reanalysis

2. Lines 31 to 35 p4: it is true that stationarity is a requirement to perform POT, but stationarity means that the distribution is invariant by translation in time, not the autocorrelation is weak. Autocorrelation is rather linked to independence, and must be handled too. Maybe here stationarity refers to the iid (independent and identically distributed) condition, then this section deals with independence, but not with identical distribution. However, identical distribution needs to be checked as well, just because of seasonality. Has seasonality been checked? Is the occurrence of the highest values restricted to the summer season or identically distributed throughout the year? If a season appears as favoring high temperature values, then the analysis should be restricted to this season, otherwise the occurrences are not distributed according to a homogenous Poisson process and the frequency of occurrence is biased. Not only seasonality can disturb the identical distribution, trends can too. There is no discussion about possible trends. Maybe it is possible to neglect the trends over the relatively short 1980-2013 period, but this could be checked.

3. When computing TWmax, are we sure that Tmax and RHmax occur in the same time?

4. Some considerations on independence are given again between lines 15 and 22 p6, but no indications are given on how this is used and applied in the study.

5. In section 3.2 concerning the GPD fits, one can read "if the higher quantiles are neglected, then the stations like . . . show that the exceedances fit very well". But in an extreme value analysis, the higher quantiles are the targeted ones!

6. In the conclusion, it is stated that: "This paper contains novel and beneficial information . . ., which would help the local administration to prioritize the regions in terms of adaptation". What does adaptation mean here? The estimated levels are based on observations, thus these are rare levels which could occur even if there were no

additional warming. It is not clear in the paper if this distinction is made. The notion of return level is defined for stationary time series, that is without any cycles nor trends, and is devoted to the estimation of very rare levels which could happen (once every N years in average), but may not yet have been observed. Climate warming brings other difficulties in their estimation: the definition of a return level has to be changed because a past and a future period are not prone to experience the same temperature levels, and the estimation is complicated. Different papers are devoted to this problem, for example:

Cheng, L., AghaKouchak, A., Gilleland, E., & Katz, R. W. (2014). Non-stationary extreme value analysis in a changing climate. Climatic change, 127(2), 353-369 Du, T., Xiong, L., Xu, C. Y., Gippel, C. J., Guo, S., & Liu, P. (2015). Return period and risk analysis of nonstationary low-flow series under climate change. Journal of Hydrology, 527, 234-250 Obeysekera, J., & Salas, J. D. (2016). Frequency of Recurrent Extremes under Nonstationarity. Journal of Hydrologic Engineering, 21(5), 04016005 Parey, S., Malek, F., Laurent, C., Dacunha-Castelle, D. (2007). Trends and climate evolutions: statistical approach for very high temperatures in France. Clim.Change, 81, 331–352. Parey, S., Hoang, R.T.H., Dacunha-Castelle, D. (2010). Different ways to compute temperature return levels in the climate change context. Environmetrics, 21, 698–718.

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