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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Heterogeneity measures in hydrological studies: review and new developments" *by* A. I. Requena et al.

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Authors' reply to Anonymous Referee #3

The manuscript titled 'Heterogeneity measures in hydrological studies: review and new developments' presents a summary of the state current state of Regional Hydrologic Frequency Analysis (RHFA). Generally, I found the manuscript to be a very interesting and information dense product that I enjoyed reading. However, I think that there are missing components that limited my understanding of the implications of this study. This manuscript has a lot of ground to cover to get to it's results, and I encourage the authors to include key information and reorganize some of the sections as per my general comments below.

Reply: The authors thank the reviewer for the thorough revision of the manuscript as

well as for the constructive comments provided. The authors tried to address all the comments raised by the reviewer. Please, see the reply to general comments below.

1. I was not able to find the data source in which the study was applied. It seems as though the data might be synthetic and generated as a hypothetical, but that is not clear. Please include at lease a small section specifically about how the data was used (if measured from real data) or synthesized (if it was generated by the authors). Please include this data, or summary of data, either in the manuscript itself or as supplemental material.

Reply: The present study is based on synthetic data, as it is briefly described in the second paragraph of Sect. 2 "Assessment of a heterogeneity measure". In this regard, the authors agree with the reviewer about the need of including a specific section, e.g. Sect. 2.1 "Synthetic regions", to better underline this. Also, for clarity reasons, "simulation-based" will be added to an existing sentence in the Conclusions: "In the present paper, a simulation-based general framework is presented. . ." The authors understand the suggestion of the reviewer about including the synthetic data used or a summary of them. In this regard, a better description of the general way in which the regions are generated will be included in the aforementioned new Sect. 2.1. Nevertheless, the amount of data used in this study is very large and their characteristics change depending on the step of the methodology applied for their assessment. The authors believe that the current description of the specific values considered for generating the regions of study in each step of the methodology may be considered as enough for understanding the data used. The authors would like to note that many simulation studies present their results in a similar way (e.g. Viglione et al. 2007; Wright et al. 2015).

2. The Gini Index is a very popular index to determine economic equality as the authors mention, but there should be additional descriptions about why the Gini Index was applied in the way that it was. Many of the other methods have been used in the past and are presented as benchmarks. However, the Gini Index is fairly new in hydrologic studies, and extra explanation of implementation should be added.

Reply: The authors agree with the reviewer. The Gini Index has not been directly applied to hydrology. However, as mentioned in Sect. 3.3, it is connected with the well-known L-moments which do. Indeed, the Gini Index corrected for short samples corresponds to the sample L-CV. Then, the Gini Index applied on the at-site L-CV in a region provides a value of the dispersion of the at-site L-CV in such a region, and hence it can be seen as a measure of its heterogeneity. Sect. 3.3 will be rewritten for extending the description of the Gini Index and clarifying this point.

3. I would consider changing the title to the manuscript to something more reflective of the end goals of the paper. While a review of past heterogeneity measures is vital to introducing new methods, I am confused as to why " in hydrologic studies" is used. The connotation seems to be that you are applying new methods to the results of past studies, which is not the case. Consider "New developments of heterogeneity measures for synthetic distributions of extreme hydrologic events."

Reply: The authors thank the reviewer for pointing this out and agree that the use of “in hydrologic studies” may be confusing. They also thank the reviewer for the new title suggestion. In this regard, the authors prefer not to use “synthetic distributions” in the title to avoid misunderstandings. Note that in this study the heterogeneity measures are assessed by using simulated data, but they will be applied on real data in practice. The synthetic data simulate real hydrologic conditions and in no way restrict the scope of the analysis. The title of the paper will be changed from “Heterogeneity measures in hydrological studies: review and new developments” to “Heterogeneity measures in hydrological frequency analysis: review and new developments”, based on the reviewer suggestion. The authors wish again to thank the reviewer for his important input concerning the title of the paper.

4. Specific comments: Line 8 Page 1 - I found the first sentence "Regional frequency analysis is needed to..." to be misleading. While this statement is certainly true, I did not find this to be a major part of this study. This statement should be in the introduction as background instead.

Reply: The authors agree with the reviewer. This sentence will be removed from the abstract and adapted to the Introduction.

References:

Viglione, A., Laio, F. and Claps, P.: A comparison of homogeneity tests for regional frequency analysis, Water Resour. Res., 43, 2007.

Wright, M.J., Houck, M.H. and Ferreira, C.M.: Discriminatory Power of Heterogeneity Statistics with Respect to Error of Precipitation Quantile Estimation, J. Hydrol. Eng., 04015011, 2015.

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