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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Delineation of homogenous regions using hydrological variables predicted by projection pursuit regression" *by* M. Durocher et al.

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1 Major

1.1 The authors support the idea of using the estimation of hydrological variables, instead of site characteristics, to delineate homogeneous regions. Yet, the estimation of hydrological variables is based on subjective selections of site characteristics and subject to model errors.

The authors want to clarify that the idea itself of using hydrological variables, called here reference variables (RV), was not proposed in the present study. The traditional CCA method has suggested already to delineate homogenous regions using flood quantiles as RV. More precisely, the idea supported in the present paper is that a larger class of RV could be considered as well as different estimation methods.

The authors agree that there is uncertainty in the RV, but it does not represent an additional uncertainty. The ROI method has implicitly these uncertainties too. If the predicted RV can be taken as the average of the ROI neighborhoods, as it is done with the index-flood model, then these predicted RVs are not predicted without error. This fact is illustrated in Figures 3b,c,d where the average LSK and LCV are not centered at the target location. It is actually an advantage of the proposed method to explicitly model that uncertainty. A mention of this advantage will be added in section 3.1 of the revised version of the manuscript, where the concept of RV is introduced (P7 L5).

1.2 **Moreover, since, homogeneity tests (e.g. Hosking and Wallis 1997) are generally based on hydrological variables (e.g., L1, LCV), these variables should not be used in delineating homogeneous regions. In other words, the same information should not be used for both delineating the homogeneous regions and testing the homogeneity of such regions.**

The authors understand the concern of the reviewer and agree that in the framework proposed by Hosking and Wallis (1997) the same hydrological variables could not have been used for delineating and testing the homogenous regions. However, the present methodology does not perform any homogeneity tests. The criteria used for selecting the size of the neighborhood is the RRMSE and is based on cross-validation, which tends to optimize the prediction corresponding to a specific return period. Consequently, the L-moments are not the variables used in the calibration of the neighborhood.

1.3 **And this clarifies the good results regarding the improvements of the homogenous properties (i.e., the results of AHM and ARE) of the resulted neighborhoods by the new method, while the improvements in the results of the regional flood estimations are insignificant (i.e., the results of RMSE and NHS)**

The authors thank the reviewer for raising this question, which gives them the opportunity to clarify this point. However, the authors do not agree that the terminology "insignificant improvements" properly describes the results of the present study. The authors have argued inside the answer AC1 of the online discussion that the results in terms of RRMSE are in fact substantial. Briefly, the improvement for the RVN-HYB method in comparison of the ROI method is of 6.1% for the RRMSE criteria and it is shown that the improvements are more important for sites that have larger discrepan-

cies.

Indeed, better performances in terms of AHM and ARE are a direct consequence of using RV, which is the main purpose of the proposed methodology. The authors believe that the important point is not if these criteria are better, but how much better they are. In the revised version of the manuscript the author will discuss in more details the magnitude of this difference:

(P12 L20) "Figures 4c,d present respectively the AHM and the ARE criteria. The AHM criterion indicates that the ROI and the CCA methods have in general lower heterogeneity than the whole dataset, but are outperformed by the RVN-LM and RVN-HYB methods especially for smaller neighborhoods. This quantifies the intuitive assumption that the regional LCV is calculated with less uncertainty when the L-moments are directly considered instead of other reference variables. In particular, the AHM of the ROI method is 72.8% with the optimal neighborhood size of 30. In comparison, the AHM of the RVN-LM method is 14.5% with the optimal neighborhood size of 28 sites, which is considerably lower. Figure 4c shows that the AHM criterion of the RVM-LM method does not reach a similar level to the ROI method until using as much as 120 sites. These results indicate that even for relatively small neighborhoods, the ROI method identifies regions that are only slightly less hydrologically heterogeneous than all sites pooled together. This suggests that, in the present case study, the ROI method has difficulties identifying sites that are similar to the target site in terms of LCV."

2 Specific

2.1 **P2 L21. "the distance between hydrological variables". The distance is between locations not variables. I guess that the authors misunderstood this comment. I am aware that the distance between two locations can be geographical distance or hydrological distance. However, the distance still should be between locations not variables, otherwise, what is the distance between the two hydrological variables L1 and LCV?**

The authors would like to thank the reviewer for pointing out this blunder. The authors agree that the formulation needs to be changed and distances remain between locations not between variables. The sentence below will be modified accordingly in the revised version of the manuscript (P2-L20):

"To identify the most similar gauged sites in terms of hydrological properties, a notion of distance is needed to evaluate the proximity, or relevance, of each gauged site to the target location and identify the most hydrologically similar gauged sites."

2.2 **P11 L23. Please, define here the Q(r) as the regional quantile. The authors defined the Q(r) on P11 L29 but it still needed to be defined immediately after the equation in P11 L23.**

The author agrees with the reviewer. The change indicated by the reviewer will be done in the revised version of the manuscript.

3 Minor

3.1 **The second part of the title of figure 3: (b), (c), and (d) Regional L-moments based on the 15 nearest gauged sites for 3 selected target locations.**

The correction will be made in the revised version of the manuscript. The authors reiterate their thanks to the reviewer.

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