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Discussions

Interactive comment on "Optimal Design of Hydrometric Station Networks Based on Complex Network Analysis" *by* Ankit Agarwal et al.

Anonymous Referee #1

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The presented work is based on an interesting and attractive idea, namely the transposition of complex network analysis methods to evaluate and support the optimal design of hydrometric networks. A new metrics is proposed to weight and rank the relative importance of the nodes of the network: the weigthed-degree-betweenness (WDB). Two nodes of hydrometric network are considered as connected if the occurrence of heavy events is sufficiently synchronized at the two stations. If I understand correctly stations with strong similarities with other stations will have a large number of connections and hence a high WDB value and conversely. The approach is tested against a large and rich data set composed of 1229 German raingauges. Two criterions are used to compare different strategies to remove 10% of the stations of the network: the so-called network efficiency (average value of the inverse of path lengths between two nodes of

the network) and the interpolation (i.e. kriging) error. According to the results, removing the lowest ranking stations (stations with the lowest WDB values) has the lowest impact on both criterions, i.e. the proposed ranking measure helps apparently identifying the less influential stations, the station that can be removed from the networks with the most limited consequences on the measurements. This being said, the article appears to draw an extremely counter-intuitive if not absurd conclusion: the stations with the lowest correlation with the other stations of the network, station that a priori provide important additional information, should be removed first. This conclusion is highly questionable and may be explained by the selection of inadequate ranking and efficiency evaluation methods. At least, some further analyses should be conducted before the publication of the manuscript can be considered. The ranking method is selected without considering the final objective and is probably inadequate. An explanation is clearly missing at the beginning of the manuscript to explain why the network construction method and the proposed WDB are suited to rate the relative information content of the stations of the network. My feeling is that the proposed approach leads to attribute the highest ranks to the stations with the lowest relative information content which is exactly the opposite of what is meant. Moreover, the validation based on kriging necessitates a more in-depth analysis and probably further tests to be conducted. The authors consider a so-called kriging error which definition has first to be clarified. It seems to be a theoretical kriging error standard deviation provided by the ArcGIS software geostatistical extension. In fact, this standard deviation depends on the location. What is provided is certainly an average value over the whole considered area – this of course has to be clarified by the authors. This standard deviation depends on the network density, on the variance of the rainfall fields and on the characteristics of the variogram. At least the variogram and variance of fields have to be provided as a support to the analysis for the various tested networks. Removing atypical rain gauges can easily have tricky impact on the average theoretical kriging error standard deviation: the lower density of the network may be partly compensated by higher homogeneity of the measured rainfall fields (higher decorrelation distances and lower field variances).

This compensation effect could explain the modest influence or even the positive effect in table 4 for case 2. In fact, the theoretical error standard deviations are two much dependent on the network itself to enable comparisons between network structures. More classical comparison methods, based for instance on observed interpolation errors, should absolutely be selected and tested by the authors. The distance between interpolated fields obtained with the complete (reference) and reduced networks could for instance be evaluated. Interpolation errors could also be computed based on a leave-one-out sampling method providing more realistic estimates of real interpolation errors. Of course the leave-one-out test station should be selected before the network reduction methods are applied. These verification methods are computationally probably expensive but absolutely necessary. According to these doubts concerning the adequacy of the proposed method and the soundness of the conclusions, I do not recommend the publication of the manuscript and the real-world application of the suggested ranking method unless the proposed additional verifications are conducted.

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