Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., author comment AC2
https://doi.org/10.5194/hess-2022-233-AC2, 2022

Reply on RC2

Kajsa Maria Parding et al.

Author comment on "A principal component based strategy for regionalisation of precipitation intensity-duration-frequency (IDF) statistics" by Kajsa Maria Parding et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-233-AC2, 2022

- The first issue is about the stability of the relationship between the shapes of IDFs and those predictors selected. For the geographic predictors, their values are constants, however, the values of those climatic predictors closely depend on the data periods selected. Their values only based on short data period in this study would have big bias from the true values, which would significantly influence the stability of the relationship between the shapes of IDFs and climatic predictors. Especially, the authors discussed in Section 4 that the approach can be used for downscaling of climate change projections, if we cannot ensure the stable relationship between the shapes of IDFs and these predictors, how to do downscaling and ensure the reliability of the results? At least the issue should have a deep discussion including the influence or the uncertainty analysis in Figure 4 and 5.

Changes have been observed in the heavy precipitation in the Nordic-Baltic region. Dyrrdal et al. (2021) reported positive trends in daily annual precipitation maxima in a majority of stations in the regions, with strong changes in southeast Norway. This is likely to influence the estimation of IDFs. The framework that we are using in this study does not take non-stationarity into account. One issue is whether or not the statistical model that connects the climatological values and the principal components of the IDFs are stationary. This, we have not looked into. Another is whether the climatological values change so much over time that the difference in the periods of data availability from station to station has an influence on the estimated IDFs.

We have added an analysis of the trends in the climatological variables of importance in the Supplementary material. The analysis indicates that while there are few stations with significant trends in the wet-day mean in the cold or warm season, many stations display a significant warming in the summer season (Figure S24). However, as demonstrated in Figure 4, it is the changes in precipitation in the warm season that has the strongest influence on the estimated IDFs.

We also tried calculating IDF curves based on data from two different periods: 1970-1995 and 1995-2020. For this analysis, we selected 146 stations with long data records of both temperature and precipitation. At a majority of the stations, there was an increase in the estimated return values from the first period to the second. On average, the difference was small, but larger changes occured. The preliminary results of this analysis suggests that the observational period that goes into the climatological values used in the regionalization can have a strong influence on the estimated IDFs. We have added a

discussion of these findings in the manuscript.

Dyrrdal, A. et al. (2021) Observed changes in heavy daily precipitation over the Nordic-Baltic region, Journal of Hydrology: Regional Studies, 38, 100965, ISSN 2214-5818, https://doi.org/10.1016/j.ejrh.2021.100965.

- The second issue is about the presentation of the results in Figure S8. Considering that the spatial pattern from Figure S8 is an important information for understanding the spatial distribution of IDFs, it is suggested that the Figure and its related information can be added in the main document rather than in the Supplementary material.

Figure S8 has been added to the main manuscript.

- The third is about the applicability of the new approach proposed. Actually, the authors very briefly mentioned it in the last paragraph in the paper, however, it is not enough. As the study area of Norway has special climatic conditions, how about the applicability of the new approach when applying to other regions with totally different climatic conditions? It is suggested more contents be added to discuss the issue.

The general methodology could be appropriate in other regions, but the statistical model would have to be trained on a different set of IDF statistics and climatological and geographical data. The coefficients of the statistical model used in this paper are not expected to be universally applicable, and other model parameters may be more appropriate in other regions. For example, other seasonal divisions than the warm/cold seasons used in this study may be more useful to describe the annual cycle of precipitation and processes associated with heavy precipitation in other regions. Other geographical descriptors, such as the altitude or the slope orientation could prove more important than the distance to the ocean. The PCA would also pick up on different large scale patterns, being applied to a different set of IDFs. A discussion on this topic has been added to the manuscript.

- Besides, how to determine the predictor of "distance to ocean". The key issue can be explained more clearly.

The distance to the ocean is the shortest distance from a point to the coast line. The function that is used to calculate the distance to the ocean is defined in the appendix (the RMarkdown file) for those who are interested in the details. This has been clarified in the manuscript.