Response to reviewer comments

Based on observation data from 98 hydrological stations, the author first systematically evaluated the superiority of the hydro SMILES model in simulating high flow (100 year flood) during the large recurrence period, and then estimated the frequency and intensity changes of 100 year flood in the near, medium, and long term in the future. This is a revised manuscript, and I believe it has reached the level of HESS in terms of expression, organization, technical method description, and innovative points. This manuscript will also attract widespread attention from scholars related to hydrological simulation, climate change impacts, and flood prediction. However, the following issues need to be considered before publishing the manuscript.

AC: The authors would like to thank the reviewer for the valuable comments to further improve the quality of the manuscript. Detailed responses (author comments AC) are provided for each specific major and minor comment (RC) below.

Major comments:

Since the emphasis is on the benefits of hydro-SMILEs model for simulating high flows with extreme return periods, a comparison analysis with results from existing models is ofter required. Although the authors did not conduct a comparative analysis with other models, it is also necessary to clear the so-called more appropriate or beneficial based on the results of existing studies. The current discussion is too superficial, it is suggested to add some comparative discussions.

AC: The authors added a comparative statement to the first paragraph of the discussion. It compares our study to the results by van der Wiel et al. (2019) who used a slightly different approach for the creation of the large ensemble of climate model data to drive a global hydrological model to create a large ensemble of modelled discharge to show the benefit of a large ensemble for the estimation of extreme return levels of discharge. We further added a statement of how our approach is beneficial as it reduces uncertainties originating from different extreme value distributions as shown by Lawrence (2020). We further added a comparative reference for the opportunity to analyse dynamics of extreme high flows and their driving mechanisms (Brunner et al., 2021).

Minor comments:

There are some abbreviations of terminology in the manuscript. It is recommended to retain abbreviations of nouns used multiple times in the abstract, and implement abbreviations of nouns used only once when they first appear in the main text (such as GEV). In addition, some abbreviations (such as Line 16 and Line 66, SMILE) have already been presented in the abstract and do not need to be repeated in the main text.

AC: The authors scanned the manuscript for repetitive definitions of abbreviations and removed them within the text. If an abbreviation is defined within the text and a figure caption, we decided to maintain these definitions as we think it provides a quicker understanding of the terms mentioned within the figure for the reader.

Lines 52-53 and 57. Please first cite Brunner et al., 2021a, followed by Brunner et al., 2021b. There is no problem with the literature cited by the author, but the order in which a and b appear needs to be adjusted.

AC: The authors thank the reviewer for this comment. However, the order of appearance of these specific references is bound to the alphabetical order of the authors of the respective publications which determines their order within the reference list as well as the citation style which is a HESS requirement. Furthermore, we found that this odd appearance of references also occurs within other HESS publications (see Brunner et al., 2019 citing Brunner et al. 2019b before Brunner et al. 2019a; or Höge et al., 2022 citing Kratzert et al., 2019b before Kratzert et al., 2019a). Thus, although we agree that the order of appearance is unusual, we cannot change this order in an automated manner. However, if the reviewer insists to have this order changed, the authors will change it manually throughout the manuscript. However, it might as well be changed during copy editing.

Fig.3. Replace 'nxm' to 'n×m', 'nxHFT,m' to 'n×HFT,m'.

AC: The authors changed the multiplication character within the entire Figure 3 according to the recommendation.

Lines 23 and 293. Repeating abbreviations.

AC: The authors removed the repeating abbreviations here.

Line 169. Provide reference for the mass preserving approach.

AC: The authors added references for the mass preserving approach.

Lines 315-316. Provide the basis for dividing into three time periods.

AC: Added the basis for the division into the three mentioned future periods.

Line 334. Provide reference for the MK.

AC: The authors provided references for the Mann-Kendall test.

Line 449-451. Repetitive statements.

AC: The authors removed the last sentence of the paragraph as its statement is repeated by the first sentence of the following paragraph.

References

Brunner, M. I., Farinotti, D., Zekollari, H., Huss, M., and Zappa, M.: Future shifts in extreme flow regimes in Alpine regions, Hydrol. Earth Syst. Sci., 23, 4471–4489, doi:10.5194/hess-23-4471-2019, 2019.

Brunner, M. I., Swain, D. L., Wood, R. R., Willkofer, F., Done, J. M., Gilleland, E., and Ludwig, R.: An extremeness threshold determines the regional response of floods to changes in rainfall extremes, Commun Earth Environ, 2, doi:10.1038/s43247-021-00248-x, 2021.

Höge, M., Scheidegger, A., Baity-Jesi, M., Albert, C., and Fenicia, F.: Improving hydrologic models for predictions and process understanding using neural ODEs, Hydrol. Earth Syst. Sci., 26, 5085–5102, doi:10.5194/hess-26-5085-2022, 2022.

Lawrence, D.: Uncertainty introduced by flood frequency analysis in projections for changes in flood magnitudes under a future climate in Norway, Journal of Hydrology: Regional Studies, 28, 100675, doi:10.1016/j.ejrh.2020.100675, 2020.

van der Wiel, K., Wanders, N., Selten, F. M., and Bierkens, M. F. P.: Added Value of Large Ensemble Simulations for Assessing Extreme River Discharge in a 2 °C Warmer World, Geophys. Res. Lett., 46, 2093–2102, doi:10.1029/2019GL081967, 2019.