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Hydrol. Earth Syst. Sci. Discuss., author comment AC1
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Reply on CC1

Mar J. Zander et al.

Author comment on "Future changes in flash flood frequency and magnitude over the European Alps" by Mar J. Zander et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-207-AC1, 2022

Dear dr Jie Chen,

Thank you for your time and the feedback on the manuscript.

In reply to the comments:

- The abstract will be adjusted to put more emphasis on the results and conclusions.
- The choice of using ERA-Interim as boundary conditions was made by the climate modelling partner, as the ERA5 reanalysis product was not yet available at the start of the CP-RCM simulation experiment.
- In the revised version of the manuscript more attention will be paid to the differences between the current work with convection-permitting RCMs compared to previous work using high-resolution RCMs which are not convection-permitting e.g., the EURO-CORDEX RCMs (Di Sante et al., 2021):
  - Especially in the summer and autumn seasons, when convection is a key process in rainfall generation, the 2.2 km resolution CP-RCM simulation employed in this study improves the peak hourly rainfall intensity, as well as the diurnal cycle of rainfall when compared to its courser 12km resolution RCM counterpart. The representation of intense rainfall events in the Mediterranean in autumn is thus improved (Berthou et al., 2018; Ban et al, 2021). These rainfall events are amongst the types of weather which can trigger flash floods, which alleviates caveats from previous studies that short duration intense rainfall events were not well represented in the modelling. Compared to previous hydrological modelling studies, which investigated riverine flooding, e.g., Di Sante et al., 2021, different research questions can thus be asked, delving into very local occurrence of flash flooding resulting from extreme rainfall events.
- Although this work focusses on the summer (JJA) and autumn (SON) seasons, in which snow and glacier melt dynamics play a lesser role than in (late) spring, we agree that the hydrological model description can be extended with a brief overview of the way in which we simulate snowmelt and glacier melt in wflow_sbm (using degree-day models), which is indeed not covered in the current version of the manuscript.
- In our study only one modelling parameter is studied for calibration. The parameter estimation in wflow_sbm is based on available spatial datasets providing information on soil properties, soil depth, rooting depth etc. Imhoff et al. (2021) developed a method for parameterization of the model using regionalization methods based on (pedo)transfer functions from literature and upscaling techniques to ensure

fluxmatching. Only for the Horizontal Hydraulic Conductivity ("KsatHorFrac" multiplied with a priori estimated KSatVer is used as horizontal conductivity) there is no pedo-transfer function yet, while this is a rather sensitive parameter in the model. For a sensitivity analysis, the model was run changing the KsatHorFrac parameter with homogeneous values for the Rhine basin. The model was run using the ERA5 reanalysis as meteorological forcing and the performance was evaluated against two discharge observations, one at the catchment outlet (the Rhine at Basel), one for a subcatchment (the Thur river at Andelfingen). This is included as a supplement to the paper. The text will be clarified on this point.

On behalf of the authors,

Yours sincerely,

M.J. Zander

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