Author response to RC2:

We highly appreciate the relevant feedback and the positive assessment of our manuscript by Reviewer #2. In the following we address the specific comments raised:

1. *Data: The authors should explain the reason of using Thornthwhaite method (one of the simplest methods) for daily evaporation estimation since the choice of the method affects the results.*

   Response: Due to data restrictions it was not possible to use a potential evaporation method beyond a temperature approach. For deciding on the calculation methods, Thornthwhaite and Hargreaves method (Hargreaves and Samani, 1982) were compared to values from the Hydrological Atlas Austria and the PhD thesis of Kling (2006). Whereas the Hargreaves method overestimated potential evaporation in the Austrian Alps, the Thornthwhaite method was more in line with literature values and was therefore chosen. In the revised manuscript we will add in line 88 "using the Thornthwhaite method. The Thornthwhaite method compared well with published estimates of potential evaporation in the Austrian Alps (Hydrological Atlas Austria, and Kling 2006), while the Hargreaves method, another temperature-based method, overestimated potential evaporation."

2. *Data: Authors could give at least a basic description of both applied scenarios RCP4.5 and RCP8.5 (e.g. moderately optimistic scenario RCP4.5, worst-case climate change scenarios RCP8.5).*

   Response: In the revised manuscript, we will add a brief description of the scenarios, e.g. at line 104: "RCP 4.5 is an intermediate pathway where emissions are curtailed, yielding 4.5 W/m² radiative forcing by the year 2100. RCP 8.5 represents a pathway with increasing greenhouse gas emissions and no mitigation measures."

3. *Methods: Please, elaborate the decision for the selection of the period 2071-2100 and not the period 2041-2070 for the investigation of the influence of climate change on future runoff extremes. The uncertainty of the results for such a distant future (2071-2100) is much greater and therefore confidence in the results is much lower.*

   Response: Although uncertainties in distant future are larger, the effects of climate change are more pronounced and can thus be more easily detected. To cope with uncertainties, an ensemble of projections is used and uncertainty ranges are given in the results.

   In the revision, we will add a sentence in line 158: "Although uncertainties are larger at the end of the century than midcentury, the climate change signal is stronger which enhances detection of potential changes due to climate change."

4. *Results, Figure 5 caption: It could be useful for readers to add colours to the explanation in the brackets: "Red and grey lines represent the mean flow regime….. "*

   Response: Agreed. We will add this.

5. *Results: Section 3.3.2: I would suggest to change the order of the words in the title (timing and magnitude) to follow the structure of the section. The same goes to some other sections (i.e. 3.3.3, 4.3, 4.4)*

   Response: Agreed. We will change the title of Section 3.3.2 and 4.3 to "Annual maxima (timing and magnitude)" and of Section 3.3.3 and 4.4 to "Annual minima (timing and magnitude)"

6. *Discussion, lines 339-340: The statement that the increase in projected future precipitation compared to the past is in contrast to other climate projections for Austria is not elaborated enough. What are the possible reasons? Did other authors (e.g. Stanzel and Nachtnebel, 2010) use the same scenarios for the same catchments/regions?*

   Response: This is indeed a very interesting point. Stanzel and Nachtnebel (2010) used A1B, A2 and B1 scenarios with the REMO-UBA RCM for entire Austria. These are different scenarios and models than the ones used in this study. This can be a possible reason. Another reason might be that previous studies focused on other catchments. Unfortunately, all studies that reported mean changes in precipitation in Austria where not run with the EURO-CORDEX ensemble. However, Smiatek et al. (2016) performed a climate analysis of the EURO-CORDEX ensemble for the Alpine region and found that the majority of simulations indicate summer and winter season precipitation increase, which would be in line with the projections used in our studies. They also highlight the uncertainty that remains regarding precipitation projections in the Alpine region. Therefore, the reason for the differences is likely the differences in GCM/RCM combinations used for the studies. To clarify this, we suggest to extend our statement to:
   "The increase in projected future precipitation in Austria is in contrast to results of previous studies that are not based on the EURO-CORDEX ensembles which suggested no change or a decrease in precipitation (Stanzel and Nachtnebel, 2010; Goler et al., 2016). However, it is consistent with the results of an analysis of the EURO-CORDEX ensemble for the Alpine region as reported by Smiatek et al. (2016)."

7. *Discussion: In my opinion the section 4.5 is redundant. The societal impacts were not evaluated in the research; therefore, the discussion about the topic is not relevant.*

   Response: The aim of this section was to give a brief overview of the possible societal relevance related to the results of this study. However, we agree that the societal impacts were not explicitly evaluated. We would nevertheless find it important to provide perspectives on the potential relevance of the findings. We therefore suggest to remove this section, but to briefly discuss the implications of the changes in the individual indicators in the associated sections 4.1-4.4, e.g.:

   Line 354: "The increase in annual runoff in future, may have a positive impact on hydro-power generation. Nevertheless, seasonal changes can lead to decreased energy production in summer and autumn and increased energy production in winter and spring. Management schemes of hydro-power production may need to be adapted to such changing seasonal water availabilities, which could potentially be realized by storing seasonal melt water in artificial basins (Farinotti et al., 2019). Adaptation measures are likely to be higher for RCP 8.5."

   Line 385: "The changes in monthly runoff could lead to a mismatch between water supply and water demand as mountain regions of the Alps are classified as supportive for the lowlands (Viviroli et al., 2007). However, the Alps are identified as basins where present water demands can also be met in 2060 (Mankin et al., 2017). Therefore, water scarcity due to changes in runoff dynamics in the Alps seems unlikely (Immerzeel et al., 2020)."

   Line 455: "The increase of magnitudes of maximum flows may locally entail the need to carefully review flood risk assessments and safety of hydraulic structures designed for lower flood estimates."

Line 413: "This leads to less predictability in the timing of future flood events."

8. *Discussion: Section 4.6 (Climate model uncertainty) should be a part of the next section Uncertainty & limitations, where all other uncertainties are discussed.*

   Response: We agree that Section 4.6 also deals with uncertainties. We separated the two sections as the uncertainty in climate modelling chains was evaluated by analysis, whereas the uncertainties and limitations in Section 4.7 where not explicitly assessed. We suggest to keep the two sections separate. However, to avoid confusion about the content of each section, we will rename Section 4.7 “Caveats & limitations”.

9. *Discussion, line 495: “….in the largest increases in magnitudes”. Of what? Annual minimum and maximum flows?*

   Response: Yes, we will add “in the largest increases in magnitudes of annual minimum and maximum flows” for clarification.

10. *Discussion, line 500: It would be useful for readers to define the model 10 more precisely.*

    Response: We will add “model 10 (HadGEM2-ES r1i1p1 CCLM4-8-17)” for clarification

The technical corrections will be addressed.

Hargreaves, G. H., & Samani, Z. A. (1982). Estimation of potential evapotranspiration, Journal of Irrigation and Drainage Division. Proceedings of the American Society of Civil Engineers, 108, 223–230

Kling, H. (2006). *Spatio-temporal Modelling of the Water Balance of Austria*.

Smiatek, G., Kunstmann, H., and Senatore, A. (2016), EURO-CORDEX regional climate model analysis for the Greater Alpine Region: Performance and expected future change, *J. Geophys. Res. Atmos.*, 121, 7710– 7728, https://doi.org/10.1002/2015JD024727