Referee #2:

Thank you very much for your thorough review. We very much appreciate your valuable suggestions.

Muelchi et al. describe the modelled effect of climate change on river regimes. For that they analyse runoff changes, regime changes and time of emergence of changes for three different climate scenarios. The motivation and novelty of the study are the use of newly released climate scenarios and hydrological model simulations that take changing aspects of climate change (for example glaciated area) into account. They supply detailed results on what changes in runoff are to be expected for Switzerland under the different scenarios. This is a great contribution and will be especially useful for water resources planning. For that the split of the analysis for the different seasons will be useful as well. Additionally, Muelchi et al calculate the time of emergence, which indicates that high elevation catchments will show climate change impact earlier than lowland catchments. The article is very well and thoroughly written. The presented results and not only their explanation will be useful for a broader community. Although there are several changes the authors should consider, most of them are minor. One main caveat of the presented results, is that they heavily rely on model results described in a manuscript currently under review. With no pre-print or open review process, the reviewers for this article have no way of judging the validity of the model. Is there a possibility that the model used and therefore the results presented in this article might change depending on the review comments on the data manuscript? How sensitive is the model to parameter choices and data uncertainty?

Reply: *The description of the data set is currently in the final stage of the reviewing process in Geoscience Data Journal. A reviewed version of the manuscript was resubmitted last week. The reviewers did not ask for new simulations. Therefore, the data set and thus the analysis in this paper won't change anymore. A short comparison of modelling results between modelling efforts of three Swiss research institutions (hydrological models: HBV-light and two versions of PREVAH) using the same climatic data set (CH2018) showed that results agree well on the sign of change This study is available in the PhD thesis of Regula Muelchi that was finished just this week. This emphasizes the robustness of our results. We send a copy of the revised data paper and a temporary link to the PhD thesis to the editor for the reviewers and the editor.*

Further comments:

Abstract

Please make clear that the second paragraph starts describing results. The change is too abrupt and leaves the reader guessing if the sentences still belong to the methods section or results. It would be good to include a descriptive sentence defining the concept of time of emergence already in the abstract. This could be taken from the introduction ("The time of emergence reflects the time when the climate signal emerges significantly from natural variability"). I agree with a previous reviewer that the detailed listing of percentage numbers is too extensive for the abstract and should be reduced.

Reply: *The beginning of the second paragraph will be changed to "Results project changes in seasonal patterns with increasing winter runoff and decreasing summer and autumn runoff." The sentence referring to the numbers will be deleted and the concept of time of emergence will be briefly defined.*

1. Introduction:

L33: “became more precise and more reliable” Source?

Reply: *Appropriate references will be added.*

L54: Please include the reference after each specific finding listed in lines 55+56 Neither the time of emergence nor “framing of the results as a function of global mean temperature change” are new concepts. Please include appropriate references that indicate to the reader where theses concepts originated (e.g. Giorgi and Bi, 2009). A good overview of the concept “time of emergence” is provided by Leng et al. (2016).

Reply: *References will be given after each finding. The concepts of time of emergence and analysis as a function of global mean temperature change will be referenced.*

2. Data

Although it is one of the declared novelties in the use of this study, it is unclear what “transient properties of climate change” are included in the model simulations besides regularly updating glaciated area. Especially since the study describing the model data is not available.

Reply: *Thank you for this comment. We will make this point clearer. Most previous studies on climate change impacts on runoff regimes in Switzerland were driven by climate simulations for 30-year periods which were downscaled with a delta change approach. This approach does not capture changes in the variability. In contrast, our study uses runoff simulations driven by transient climate simulations (119 years from 1981-2099). Therefore, potential changes in the variability are incorporated in these simulations.*

3. Methods

L104: partial duplicated from line 79.

Reply: *We will remove the sentence in line 79.*

3.1 Study area: For those not familiar with Swiss geography a map of the different regions or a change to East/West/South/North would help with the descriptions. Listing the catchment characteristics as a table (S1) is difficult to read. Additional map overviews would help similar to Figure 1. They should present catchments glaciated area and fraction of precipitation falling as snow. This can be included in the supplement.

Reply: *Thank you for your suggestions. The description of the study area will be extended by a description of geographical features in Switzerland (such as mountain chains). Maps showing glaciated area and fraction of precipitation falling as snow for the reference period will be added in the supplement and referenced in the text.*

3.4. Time of emergence of seasonal changes: Others have used this method before. Please cite to make clear where previously used methods were applied compared to method decisions made by

the authors. Additionally, please justify why this specific method was chosen and what uncertainties this choice might entail (Gaetani et al. 2020).

Reply: *We will add citations according to your suggestions and discuss the uncertainties regarding the time of emergence in more detail.*

Discussion:

It is unclear what the "not shown" brackets indicate. Are these results that you found but do not present? Are these results of the climate simulations that are included in CH2018, 2018? Since they carry the interpretation of the results, please set the findings in context with previous studies regarding snowmelt, precipitation and evaporation development under climate change conditions in Switzerland. The current focus of the discussion is on high elevation/glaciated catchments. Please include interpretation of changes in lowland catchments as well. Especially since statements like "Lower lying catchments show generally a later time of emergence" (L340, Discussion) and "the pluvial catchments in the lowlands will face decreasing spring runoff" (L365, Conclusion) remain unexplained.

Reply: *We apologize for the confusion. "not shown" refers to results from either CH2018 simulations (precipitation) or results from the hydrological model (evapotranspiration and snow melt) which are not explicitly presented in the paper. However, they reflect the processes leading to our results (water balance). We will compare this with previous studies according to your suggestion.*

Furthermore, runoff changes in lower lying catchments will be discussed in more detail. Generally, lower lying catchments are less affected by climate change and runoff in these catchments is mainly governed by evaporation and precipitation. Snow related processes play a minor role in these catchments. However, the changes in lower lying catchments are not negligible in terms of impacts because water is needed for irrigation or for cooling infrastructure.

Conclusions:

Instead of referring to "sophisticated methods" please briefly mention them. Especially since they are highly relevant for the novelty of this study.

Reply: *We will change "sophisticated methods" to "quantile mapping".*

Figures:

Fig. 2/3 To keep in line with the rest of the article it would be good to describe first the RCP2.6 scenario and then RCP8.5.

Reply: *We will change the order of the results according to your suggestion. Thank you for the suggestion.*

Fig. 5: People with red-green vision deficiency will struggle interpreting these graphs. Please choose a different colour scheme for this figure and figure S5.

Reply: *Thank you for this comment. The color scheme will be changed.*

Fig. 8: Please include column headings directly in the figure.

Reply: *We will include column headings (+1.5°C,+2°C,+3°C) in figure 8 as suggested.*

Other:

L 295 Replace “neglectable” with “negligible”.

Reply: *Will be replaced.*

Gaetani, M., Janicot, S., Vrac, M., Famien, A.M. and Sultan, B., 2020. Robust assessment of the time of emergence of precipitation change in West Africa. Scientific reports, 10(1), pp.1-10.

Giorgi, F. and Bi, X., 2009. Time of emergence (TOE) of GHGâˇARˇ forced precipitation change hotâˇARˇ spots. Geophysical Research Letters, 36(6).

Leng, G., Huang, M., Voisin, N., Zhang, X., Asrar, G.R. and Leung, L.R., 2016. Emergence of new hydrologic regimes of surface water resources in the conterminous United States under future warming. Environmental Research Letters, 11(11), p.114003.