

## ***Interactive comment on “Future runoff regime changes and their time of emergence for 93 catchments in Switzerland” by Regula Muelchi et al.***

### **Anonymous Referee #2**

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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

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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?

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.

1. Introduction:

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

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 these concepts originated (e.g. Giorgi and Bi, 2009). A good overview of the concept “time of emergence” is provided by Leng et al. (2016).

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## 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.

## 3. Methods

L104: partial duplicated from 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.

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).

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 state-

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ments 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.

Conclusions:

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

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.

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.

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

Other:

L 295 Replace “neglectable” with “negligible”.

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 GHG-forced precipitation change hotspots. *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.

