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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Controls on spatial and temporal variability of streamflow and hydrochemistry in a glacierized catchment" *by* Michael Engel et al.

Anonymous Referee #2

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Review for manuscript Manuscript ID: HESS-2018-135; Controls on spatial and temporal variability of streamflow in a glacierized catchment

Best authors and editors, Thank you for the possibility to review this paper, and apologies for the delay in my review. The paper studies the hydrology and hydrogeochemistry of two glaciated catchment in the Eastern Italian Alps. The work builds on a spatially and temporally distributed water sampling and monitoring campaign, supplemented with climate data. The authors are able to identify both geological and meteorological factors influencing the stream water chemistry, allowing better conceptual understanding of water sources and flow paths in the studied glaciated catchment.

I think this paper reports an impressive dataset collected in a challenging environment, and by this merit alone warrants publication. I find data analysis methods are sound, though not particularly innovative. The work has important data-based findings on the hydrology of glaciated catchments. The paper is well written with good English throughout.

general comments: I have only one major concern: with almost 3000 meters of elevation gradient and highly variable aspect and shading, only one meteorological station is used for the niveo-meteorologial variable determination. For example the snow depth (maximum depth, timing of melt) in Fig. 7 would likely be very different at different elevation ranges. The spatiotemporal variability in snowmelt at different altitudes can be a major reason for masking the tracer variability, and not creating a "coherent" tracer signal of snow and glacier melt (see discussion on L 627). Some discussion present on P20L593, but in my opinion the uncertainty caused using only one meteorological station this should be more discussed.

specific comments: P2L37: Cannot understand this sentence: what is meant with best agreement when time lengths varied?

P4L112: Why would you assume this? The hypothesis sounds somewhat trivial, and too tailored to what you found in your data.

P4L121: aim to characterize the hydrochemical signature of thawing permafrost: this does not get much attention in the rest of the manuscript, and you don't have that many water samples from permafrost thaw water either. Either reformulate the objective, or discuss the success/failure of this objective in the manuscript.

P5L141: permafrost is "sparsely located"? Can you use typical terminology for permafrost occurrence: isolated, sporadic, discontinuous.

P6L176: I'm not familiar with "rock glaciers", perhaps explain the landform when first mentioned in the text.

P8L230: do you exclude the events, where there is zero change in snow depth (no snow)? Seems so in Fig. 11.

P9L255: What do old and new water mean in this context? If I understand correctly, with Eqs 2 and 3 you are determining relative contributions from each tributary, and not any event water or other new water contribution

P9L271: I would not agree that snowmelt isotope signal is enriched from the original through the process of melting. There is an aspect of temporal variability during melting, but I would argue that the "bulk" enrichment happens through gas with water vapor exchange and sublimation in the snowpack. See e.g. Earman et al (2006) and Taylor et al (2001)

P10L284: extra parenthesis?

P11L308-321: It is not obvious when the snowmelt period is. Can you provide a hydrograph in the heat map, or describe in the text

P11L329: I don't see how the data presented shows, the relative temporal variability between the two catchment, as suggested by the authors

P12L358: discussion, not results section

P13L367: Did you measure the EC in glacier melt? Would be useful to verify the low EC water is coming from glacier melt

P14L401: wording: "clearly anticipated"?

P14L405: please indicate this event more clearly in Fig. 7, now difficult to find the data you are discussing.

P16: not sure if section 4.1 is relevant for this work. Please consider removing it, or clarify why it is important for interpreting your results.

P 17: section 4.2 is interesting speculation on the interplay between geology and hy-

drology, but geochemical processes discussed here goes beyond my expertise to critically evaluate the discussion.

P19L575: rephrase or remove "While $\triangle$SD was used in this study,"

P20L584: I think the control of T and G is specific to glaciated/permafrost catchments, where these variables remain important in sustaining water input even after snow has disappeared. I would not expect such a strong relationship in catchments without the possibility of thawing the glaciers/permafrost on warms days.

P20L586: I think the data you present if a bit far from providing evidence of any kind of tipping points: too speculative.

P20L612: interesting idea that the different travel times could be detectable for the correlation coefficient.

Rererences: Earman, S., A. R. Campbell, F. M. Phillips, and B. D. Newman (2006), Isotopic exchange between snow and atmospheric water vapor: Estimation of the snowmelt component of groundwater recharge in the southwestern United States, J. Geophys. Res., 111, D09302, doi:10.1029/2005JD006470.

Taylor, S., X. Feng, J. W. Kirchner, R. Osterhuber, B. Klaue, and C. E. Renshaw (2001), Isotopic evolution of a seasonal snowpack and its melt, Water Resour. Res., 37, 759–769, doi:10.1029/2000WR900341.

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