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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Seasonally varied hillslope and groundwater contributions to streamflow in a glacial till and fractured sedimentary bedrock dominated Rocky Mountain watershed" *by* Sheena A. Spencer et al.

Anonymous Referee #1

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Review of the manuscript 'Seasonally varied hillslope and groundwater contributions to streamflow in a glacial till and fractured sedimentary bedrock dominated Rocky Mountain watershed' by Spencer et al.

General comment This works uses hydrochemical data to describe and infer runoff generation processes in the subcatchments of the Rocky Mountains. The topic is certainly interesting for the readership of HESS. The manuscript is generally well written. However, there are two main points that do not sound convincing to me: i) the focus on catchment resilience and disturbance, that do not appear to be logically linked to the

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investigations carried out and sounds out of context; ii) the presence of hydrochemical data only: despite the powerful nature of hydrochemistry as hydrological tracer, the combination of racer data and hydrometric data can help to unravel the complexity of hydrological processes at the catchment scales. Thus, the manuscript fails to describe in a robust, quantitative, and convincing way how water moves through this landscape in response to both rainfall and snowmelt. As a result, a clear contribution of this study to the body of knowledge is not evident. Please, find some specific and minor comments below.

Specific comments - The abstract is a bit vague. The motivation sounds weak, there are no specific objectives, the methods are partly unclear (water sources were sampled for what kind of analysis?), and the concept of hydrological resilience is not specified. I suggest revising it entirely.

- The Introduction fails to clearly stress what it is not well known about the specific topic and what is the main research gap, and the reader, at the end of the Introduction is left wondering why another study on streamflow contribution is needed. An overall objective and testable hypothesis is not reported. The two specific objectives are introduced quite abruptly, without a clear and logical connection with the paragraph above. I suggest to heavily revise the Introduction to keep these points into consideration.

- 190-208. I suggest to consider the work by Barthold (2001) and to specify the reported approaches were preferred over this method. Moreover, briefly mention how TVR and LDA work to allow the reader better understanding the methods that were used. https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2011WR010604

- I suggest merging Figs. 5 and 6 (making a multi-panel figure) and sections 5.2.1 ad 5.2.2, and Fig. 7 and 8 and sections 5.2.3 and 5.2.4 in order to present the results from the two subcatchments more organically. Similarly, I recommend merging Section 5.3.1 and 5.3.2 (Star West), and 5.3.3 and 5.3.4 (Star East) to avoid too much text and results in fragmentation.

- Since there is, at least in some cases, a strong seasonal pattern in hydrochemistry, I suggest considering making a time series plot of the different water sources in the two subcatchments in order to show, for instance, when and to which extent the stream water signature gets closer to that of hillslope groundwater and riparian water. In addition, the Authors might consider adding times series of groundwater temperatures or boxplots, as this tracer is part of the story and was shown to be able to partly explain groundwater contributions to streamflow.

- 417-418. Which evidence do the Authors have to infer the temporal dynamics of hillslope water moving to the stream? Moreover, how could the Authors describe old water mobilization without having quantified its proportion in stream water? Or this is a general statement not based on the presented dataset? Please, explain.

- 464-474. I feel this part is quite out-of-context and disconnected from the previous discussion. In general, I think that focusing on catchment resilience is not so straightforward and sound a bit contrived to me. The same comment applies to the Conclusions.

Minor comments and technical corrections 1. The title is long and complex. I suggest making it more compact and clearer.

11. I suggest to change as follows: "A lack of . . .but mechanisms governing. . .".

13. ". . .although much. . .": I cannot see the logical link in this sentence. Please revise.

13-14. "to interpret how forest disturbance may impact streamflow quantity". I would not focus on understanding runoff generation processes to this aim, but mostly on the ecohydrological role of forest on streamflow. Please, revise.

22. "but was unlike the measured sources": this sentence is not clear before reading the abstract. Please, clarify.

29: Perhaps put it more general, mentioning pathogens.

35. What do the Authors refer to by "features"? Please explain.

112. "...a priori...": Was there any evidence, field observation, previous study or knowledge of the area that allowed for this assumption?

193. TVR: please report the definition and possibly the equation to let the reader immediately understand it.

229-230. This sentence is not clear to me (without reading the cited references). Please specify.

245. leu?

269: Perhaps add "compared to bedrock groundwater".

Fig. 6b). Could the Authors perhaps colour-code samples for season (spring, summer, fall)?

322. Which are these months?

340. Why a source might be missing? Please, explain.

393-394: Are groundwater levels available? Their temporal patterns could help understand which feeds which. Perhaps some piezometers could be installed for a follow-up study.

429-430. What does "increase in stream water chemistry" mean? Moreover, how would be possible to infer connectivity through hydrochemical data only? Some speculations could be done but a combination of hydrometric and tracer data would serve this purpose better.

431. Contributions to what? Please specify.

433. It cannot be all rain water, can it? Please, revise/explain.

Possible useful readings for additional analyses and for the discussions section: Correa, A., Breuer, L., Crespo, P., Célleri, R., Feyen, J., Birkel, C., Silva, C., Windhorst, D., 2019. Spatially distributed hydro-chemical data with tempo-

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