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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Spatially-distributed tracer-aided runoff modelling and dynamics of storage and water ages in a permafrost-influenced catchment" *by* Thea I. Piovano et al.

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Response Referee 1

This study contributes to improving the understanding of runoff generation in an alpine discontinuous permafrost setting. It makes use of a conceptual model to simulate the seasonally changing stable isotope signature in the water of a small catchment. The STARR model used has been described in published literature, but the present paper applies the model in a spatially distributed fashion to study the "age dynamics" of water storage and generated flow. The simulations show the displacement of old water from soil storage to the stream during snowmelt and the role of organic soils is explained.

Figures 6 and 7 provide convenient summaries of the spatial distribution of soil storage and water age in the course of two years.
Response: Thank you for this positive evaluation of our study.

The Introduction section may be considered by some to be too lengthy but since many readers may not be familiar with the hydrological environment of the subarctic, such an extensive presentation can be helpful. I note that in Figure 4e, the range of the best 100 runs of stream water age has a considerably wider spread of values above than below the median. Is there an explanation for this asymmetry?
Response: The distribution of stream water ages is asymmetrical as only a few of the best simulation show higher ages. Such asymmetry in the spread of modelled ranges has been already shown in some of the previous model applications (e.g. Ala-aho et al., 2017b; Piovano et al., 2018). In the latter it was noted this asymmetry was controlled by the parameter ranges used in the multi-criteria calibration. Here, a key factor for the increase in the uncertainty during winter periods is the lack of constraints in that specific period (i.e. during winter both data of discharge and isotope stream signature were not available). In the revised version we have plotted the stream water ages in a semi-log scale to help visualizing the trend when uncertainties were smaller.

The paper reads well, but some minor editorial changes are needed.
Response: Thanks for spotting these errors and inaccuracies.

p. 8, line 15: two open brackets in a sentence - in front of the word "approximately" may be a comma?
Response: Done.

p. 10, line 22-23: I do not understand the phrase "as overland flow and only occasionally simulated during melt".
Response: Corrected.

p. 13, line 30: I do not understand "their high porosity allow several hundred mm of total water storage when saturated and large amounts at field capacity".

Response: Corrected.

p. 13, lines 34-35: “infiltrating meltwater supplies latent heat to bring soils to freezing”. I thought the addition of latent heat would raise the soil temperature and not bring it down to freezing.
Response: You are correct. We changed the text.

p 14, line 4: “which are inked to conditions (of) the previous fall” – the word “of” is missing.
Response: Added.

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