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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Effects of preferential flow on snowmelt partitioning and groundwater recharge in frozen soils" *by* Aaron A. Mohammed et al.

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This is a field study of infiltration in frozen soils subject to mid-winter melts. This is a highly complex process with pathways that switch on and off at different times and places, and where at times there appears to be siginficant bypass flow occuring. This field study is extremely well designed to capture the detailed aspects of these processes. This study relies on qualitative insights from field observations, particularly looking at the location and timing of responses to melt in the soils, groundwater and ponds. Very nice observations of water content rises below the frost zone are presented. I think the understanding that is laid out in this paper is consistent with a range

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Discussion paper

of previously reported insights - such as the surprising absence of runoff from snowmelt and the isotopic signatures of groundwater. The paper presents an outstanding synthesis of knowledge in this area and should be required reading for anyone trying to model this environment. The paper is generally very well written. I think it could have been about 1/3 shorter. The results section in quite a labor to read through, but I don't have recommendations to improve this - I think it is necessary to explain in extensive detail how the different instruments respond during the melt period. The introduction is well written and covers the relevant literature well. The study objective is clear. Experimental methods and instrumentation are good. Methods are good. The discussion is again slightly long winded in style, but excellent in it's coverage of the insights and literature. I think there is a solid contribution here, and the paper should be published. I note below some minor comments. The main improvement would be to more clearly explain where the soil pits are located in the depressions, and including cross-sections would help here alot.

P. 1, L. 15: "the role of shallow subsurface flow" - I'm being slightly pedantic here, but this is ambiguous language... say explicitly what "the role" is - e.g. that there is a shallow lateral subsurface transmission pathway through the frozen soil, from uplands to depressions... if that's what is meant? Maybe appropriate to use the term "interflow".

P. 1, L. 17: "before ground thaw" - do you mean total thaw, or the commencement of thaw? This could be stated more clearly and precisely.

P. 2, L. 22: It could be appropriate here to note that zero-till cropping, which is in widespread useage for the past maybe 20 years in the prairies, might also allow macropores to be preserved.

P. 4, L. 2: confusing - should "infiltrates within" be "runs off into and then infiltrates beneath"? I think the point that the pond water level rises are not corrected for the volume of infiltration below the pond during the period of runoff. It would seem reasonable to ignore this likely small error (as the authors have done).

P. 4, L. 27: It's important to say whether or not a the soil pit was installed below the depression or adjacent to the depression. This is critical to the interpretation of pond water recessions juxtaposed against the soil temperatures. This is unclear to me from the text and from Figure 1. Cross-sections in Figure 1 would be extremely helpful to interpret where the measurements are taken from, including piezometer depths.

P 6., L. 31: Your data in Figure 2 and 3 show the water content responding to the Spring melt event before the temperature responds. Why?

P. 6, L. 32: at Stauffer the increase in RR between MW3 and spring (31 and 33) seems negligible and well within likely error bounds - this point should be acknowledged. The increases are far more convincing at Triple G and Spyhill and maybe there is a reason for that?

P. 7, L. 26: This paragraph describes the data in Figure 4, but studying Figure 4 it does not appear correct in a number of places - specifically the first and third sentences.

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