Reviewer #3
Shallow soil moisture – ground thaw interactions and controls – Part 2: Influences of water and energy fluxes.
Guan, Spence and Wedtbrook.

This paper investigates the influence of water and energy fluxes on heterogeneity in ground thaw in three different subarctic systems (peatland, soil filled valley and wetland). By contrasting these three systems, this detailed experimental study offers an examination of controls on patterns of wetness and ground thaw. The importance of this field study is further development of process-level understanding linked to spatial patterns and will contribute to better model prediction of patterns of shallow wetness and streamflow/watershed modeling in permafrost regions. Quantifying of water and energy fluxes are described in detail but, as identified by the other reviewers, there is no comment provided on uncertainties and whether or not the spatial interpolations in particular might affect the findings. This would be very useful to add. The manuscript is well written. I have provided some detailed comments below where I think clarification for the reader could help and where additional reference to the companion paper may be helpful.

Detailed Comments

- Figure 1. Elevation lines are too light to see.
- p.80, line 20-22. Is both Q_{gs} and Q_{gp} calculated for ponded conditions or does Q_{gp} replace Q_{gs} for ponding (replace, correct?)? Can this be clarified on line 22 (replace and with or?).
- Table 1. Brief mention of the methods/locations/depths of characterization for variables included in this table would be nice. Is this included the accompanying paper and if so, perhaps a reference to it would be useful here.
- P. 82, line 15. Discussion of contributions of snowmelt – could add reference to Figure 4 here (e.g. 45 mm at the valley site). This would require renumbering figures 3 and 4.
- P. 83, line 15. Bedrock runoff is not specifically shown in Figure 4; rather total surface inflow, so the wording of this line is a little deceiving. Reword and remind the reader that we get to see surface runoff (of which bedrock is a component) in Figure 4. Might also be useful to remind the reader that these specific measurements of runoff rates, although at specific sites are being applied to all bedrock outcrops, independent of site. Since so much of the surface inflow occurs during the snowmelt, I am wondering if you don't want to comment on the total amounts (mm) that occurred during this time(the 7 day stretch or so around 28-Apr to 3-4-May) instead of or in addition to the daily max bedrock runoff, as you do later on for the 24-25 June precipitation event.
- P. 84, line 9. Text indicates a large decrease in lake discharge during June 7-14 but clearly this is not large enough to clearly see in the cumulative curves in Figure 4. Perhaps this can be reworded to indicate how it is reflected in figure 4 (i.e. during the June 7-14 period, cumulate curve levels out)?
- Figure 5 shows valley site gets the least amount of surface input but Figure 4 indicates the peatland gets the least. Is there a typo here: should 'valley' read 'peatland' in Figure 4 scaling or am I reading something wrong? When I worked through the scaling, I get surface inflows for peatland (a), valley (b) and wetland (c) of ~ 290 mm, ~ 1400 mm (graph reads ~ 140mm x 10) and ~30,000 mm (graph reads ~ 300mm x 100), respectively. This doesn't line up with p.84, line 10-15 order of magnitude description or Figure 5 where valley site has least surface water inflow. I would also suggest changing wording Figure 4 to read

"…surface inflows and outflow values are 1/10th of actual for the valley site). Similar change to next sentence (replace 'at' with 'for').

- In figure 4, are surface outflow and lake inflow exactly the same or are these cumulative curves slightly different (might be useful to point out to the reader considering they lie on top of each other).
- P. 86, line 15. This line needs clarification. How was the total ground heat flux calculated for these 'lumped flooded regions'? Does this mean that at low flow Q_{gw} ~ 0 and Q_{gp} was calculated from temperature gradients? But the text indicates Q_{gw} was not necessarily zero. Some confusion here because the text implies uniform treatment of these flooded areas but a range of heat flux values are estimated. Can this be clarified? Also, was this only an issue for the wetland site (paragraph seems to indicate so)?
- In discussion of the Peclet number (methods, p. 81; and results , p87), it would be useful to explain its application for - rational for applying over uniform site area (soil covered area of each site?). This seems to get lost in the discussion immediately preceding section 4.4.2. where the advective Qgw is described as spatially variable.
- P.88, line 11-15. I would suggest the authors refer again to the companion paper here on the aspects of the spatial patterns of frost table depth. This would also be useful when discussing the heterogeneity of thaw observed in the peatland (p.89, line 7).
- p.90, line 10-12. When the authors refer to the 'energy-based paradigm', do they mean that in order to fully understand runoff generation in permafrost regions, we need to incorporate the energy-balance as it controls forst table depth, thaw, release of water, spatial variation in storage, etc…? The authors refer to Quinton and Carey (2008) on p71, line 13-20; it might be useful to use the terminology 'energy-based paradigm' here as well.