Hydrol. Earth Syst. Sci. Discuss., 7, C169–C173, 2010
www.hydrol-earth-syst-sci-discuss.net/7/C169/2010/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Shallow soil moisture – ground thaw interactions and controls – Part 1: Spatiotemporal patterns and correlations over a subarctic landscape" *by* X. J. Guan et al.

Anonymous Referee #1

Received and published: 12 March 2010

General comments:

I enjoyed reading this paper on the spatiotemporal patterns of shallow soil moisture and ground thaw and the correlations between them. This paper will be of interest to other readers of HESS as well. It is especially interesting that the authors show the correlations between ground thaw and soil moisture for three different sites (peatland, wetland and soil filled valley) and compare the results from these sites. Very few soil moisture studies have been done in this landscape and I am already looking forward to a paper that describes the soil moisture patterns and the statistics of these patterns in more detail. This paper is well written and the figures are very clear as well. The

companion paper discusses the differences in the energy and water balances of the three sites and how they affect the ground thaw depths. This paper contains enough material to be a stand alone paper but unfortunately suffers from a short discussion. Other than the discussion of the results in the T3 concepts (which is very interesting), there is very little discussion, especially on the implications of the results. The authors seem to rely on the companion paper for the discussion instead. However, there is more that can be discussed than how the differences in the water balance and energy balance of the 3 sites affect the ground thaw depths. For example, the authors raise the interesting issue that the landscape is made up of different land-types and that these land-types have different ground thaw depths and soil moisture responses. However, they do not discuss the implications of these results for catchment models or for the upscaling of their results to the catchment scale, even though this scaling issue is mentioned in the introduction (P35L13-16). I think that an expanded discussion would make the paper far more valuable. It would have been nice if the results, especially the spatial patterns were described more quantitatively (and less qualitative) as well (see for example specific comments 5 and 6 but also other locations throughout the text).

Specific comments:

#1) Expand the discussion (see general comment above)

#2) P39L1: please expand the description of the TDR probes. Were the two types of probes used interchangeably or each type of probe at one site? Were the UoS probes permanently installed? How many of those probes were there? Add a reference about the UoS probes (if available). How far apart were the repeated insertions of the TDR probes? Do you have information about the repeatability of these measurements?

#3) P40L11-14: Move this section to 3.2? It is more a description than a result.

#4) P41L1: What is the significance of listing the number of outliers? These are just extreme sites (either very wet or very dry). The discussion does not mention the differences in the number of extreme sites at all or discuss their meaning/implications.

HESSD

7, C169–C173, 2010

#5) P41L14: Quantify these results. How much drier were they or how much faster did they dry?

#6) P42L22 and P43L17: Can you quantify this relation e.g. by using a logistic regression? How many of the sites that had frost depth >1 m did not have ponding (and vice versa)?

#7) P45L27-P46L1: Another paper from the same group shows that during the summer areas with the deep soils remained wetter (Advances in Water Resources 2006). Therefore in order to be able to state that "...regions without frozen ground and that posses a stable active soil column that show locations of shallow soil can be the wettest (P49L3-4)" you need to add other references that show that soil moisture in shallow soils is highest or refine this section and the statement in the conclusion.

#8) P47L26: How is connectivity defined? This connectivity could be described in more detail in the results section. The results sections could describe the spatial differences and spatial patterns in a bit more detail as well (or quantify them more – see also comments 5 and 6).

#9) Table 1: what caused the number of sites to be different for each survey? Was this due to late snow cover at some sites? Due to soil frost in the top 10 cm? Due to other reasons? Explain in the methods section.

#10) Figure 2 and text: Compared to other soil moisture studies, the variability (e.g. the difference between the 25th and 75th percentile) in soil moisture is huge. It would have been nice if this variability would have been mentioned explicitly in the text and described in more detail. It would also be good if these soil moisture values and this variability would have been compared with the results of other peat/wetland moisture studies. It would especially have been useful if it was discussed how this huge variability influenced the results. Would you have found the same relationship between soil moisture and ground thaw for the peatland and wetland if you had split the dataset for these sites in a separate dataset for hummocks and hollows? Do both show the

HESSD

7, C169–C173, 2010

same relation between soil moisture and frost depth? I assume that if you had split the dataset in a separate dataset for hummocks and hollows the variability (of more than 50% for the 25th -75th percentile) would have been significantly reduced. Is that right?

#11) Figure 2: Are sample sites with frost depth >1 m also excluded from the soil moisture figures?

#12) Figures 3-8: It would be nice if there was a scale on these figures (and a north arrow) as well

#13) Figure 9: Explain in the caption that points with a frost table >1 m were excluded from the calculation of the medians and that the medians are thus biased to the points with shallow frost tables.

#14) Figure 10b: How is this result influenced by the decision to take out the points with deep soil thaw and thus calculating the correlation between a different number of points and progressively biasing it to drier sites/shallow soil thaw sites? Or is there very little bias because as the season progressed and the thaw depth increased, the correlation between soil moisture and thaw depth became poorer for the peatland and wetland sites with deep thaw? It would have helped if there was a very short discussion about this bias in the text so that the reader is not left wondering how much bias there is in the results.

#15) Figure 12: How were the locations of the three sites on this figure calculated? Are they estimated based on the results and thus represent a rough ranking rather than a clear measure of the 'actual roles'? If so, it would be good to mention this in the caption.

Editorial suggestions:

P34L6: replace 'not be studied' by 'not been studied'

P34L16-17: rewrite this sentence because this sentence could give the wrong impression that the accompanying paper explains the observed spatial patterns at each site

HESSD

7, C169–C173, 2010

rather than mainly explain the differences between the three sites.

P35L1: replace ‘with frost’ by ‘and frost’

P35L16: insert ‘scale’ after ‘catchment’

P40L20-21: rewrite this sentence : “soil moisture decreased over time as the site became drier”. Remove “as the site became drier”?

P41L21: replace by “throughout the study, only one of the 91 survey grids was flooded. It was flooded from 12-17 May”?

P43L18-24: This should be a new section as it does not only describe the wetland site results as the section title suggests.

P46L13-15: rewrite this sentence?

P49L6: replace “equally” by “similarly”?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 33, 2010.