

Interactive comment on “Modeling the thermal dynamics of the active layer at two contrasting permafrost sites” by J. Weismüller et al.

Anonymous Referee #1

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The paper presents a modeling study for 2 permafrost sites in different environments. I think that this is a very interesting study. However, I have the following comments:

1) in the definition of the hydraulic conductivity, it is normally used an impedance factor to account for the blocking effect of ice (i.e. Hanson et al., 2004). If the impedance factor is not defined, the hydraulic conductivity may be overestimated. The authors should discuss this point.

2) I have some doubts if it is appropriate the assumptions that liquid water and ice are at the same pressure. In reality unfrozen water is at a negative pressure (this for example comes from the application of the generalized Clapeyron equation, see Christoffersen and Tulaczyk, JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 108, NO. B4, 2222, doi:10.1029/2002JB001935, 2003)

- 3) I think that a few more explications on the numerical method used to solve the equations are needed. It is not sufficient to cite COMSOL. Numerical methods are an important part of these kind of models, and their importance cannot be left to a citation.
- 4) Pg. 242 Line 15: the sentence “The heat capacity will only influence the values we obtain for Khsoil, but not. . .” is not clear to me. I think that the heat capacity does affect the thermal diffusivity and, therefore, the temperature profile.
- 5) In figures 7 and 8 I cannot see a blue curve, the charts should be redrawn. Probably it is better to avoid the use of colors and use differently dashed lines.
- 6) Figures from 5a to 6b are quite difficult to read. Clarity could be improved choosing a few short time intervals, and comparing the modeled and measured temperature and soil moisture in the same line chart.
- 7) Fig. 4 on the right: it is inappropriate choosing a soil freezing characteristic curve independently from total water content.
- 8) Some more quantitative indices should be given (not only the absolute error) to assess the goodness of the fit (between model results and observations).
- 9) The discussion of various disagreements between model results and observations should be helped by line charts that clearly evidence the disagreements you are talking about. Otherwise it is very difficult to follow.
- 10) The authors should discuss the importance of three-dimensional effects that are not represented with a one-dimensional simulation. In particular, lateral fluxes of liquid water may be significant.

Interactive comment on The Cryosphere Discuss., 5, 229, 2011.

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