

## ***Interactive comment on “Simulations of water, heat, and solute transport in partially frozen soils” by Mousong Wu et al.***

### **Anonymous Referee #1**

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#### General comments

Wu et al. conduct a GLUE-type sensitivity analyses using a model of coupled heat, water, and solute transport. The study has some merit and potentially fills a gap. I'll not deny that there are very few sensitivity studies of these phenomena; however, this paper is poorly presented both in terms of the technical information as a well as the overall story.

#### Major comments

1. The English in this paper is not, in my opinion, even suitable for the first submission, let alone consideration for publication. It must be rewritten by a professional English editing company. I originally began to do this for the authors, but got exhausted by about L140.

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2. Other places are grammatically correct, but incredibly vague. The authors must carefully reread through this study and make sure their sentences convey meaning. For example, ‘Laboratory and field experiments on soil freezing/thawing have received more attention’ (L54); what does this mean? More than what? Why is this needed? Similarly go to L36: “climate change in cold regions”? What about climate change? How does it relate to solute? Explain. This doesn’t fit the sentence. There are many examples of such vague statements with little to no information (e.g., L286-287). I don’t see this as an English problem, but rather as a contribution that needs to be carefully rewritten in general.

3. The introduction does not build a convincing story of why this contribution is needed. First of all it is too long (9 paragraphs). As an example of extraneous text, in Lines 37 to 95 the authors list a number of soil freeze-thaw field and modeling studies and where those studies were conducted. However, they really don’t emphasize the contribution or key input of over half of these studies. These are described in far more detail in the review paper by Kurylyk and Watanabe (2013), and listing fewer of these and referring to this synthesis would be a more effective use of space. More importantly, the main objective (e.g. ‘search for constrain’ L133), makes no sense, and thus it is very hard to get excited about the rest of the paper.

4. The title does not have ‘uncertainty’ in it. In fact, the title could probably equally apply to about 12 of the other papers cited in this study. My point is that it should be rewritten somehow to reflect the distinct aspects of this study.

5. L168, Why did the authors record TDR data at daily intervals? This seems like a low resolution given the frequency of the other data. Depending on the depth and spatiotemporal resolution, it can be very hard to calibrate or assess a model using only daily moisture data.

6. There are issues with the only two equations I looked at very closely on a term by term basis. Equation 1: The terms in this equation do not have consistent units.

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Therefore something is clearly wrong. I think the second term on the right (vapor diffusion) has incorrect units and the vapor density should be expressed as a vol/vol. Equation 2: This equation is expressed incorrectly for the divergence of convection (second term on right hand side). The temperature has to be inside the derivative. It is changing with space. Also, if you leave it outside the derivative, you have the issue that it totally depends on what temperature scale you are using (Celsius vs. Kelvin) in terms of the magnitude of that term. All other terms are independent of the temperature scale, because it is only the change in temperature that matters (i.e. the other T terms are inside derivatives). Two errors in the two equation carefully considered does not give one confidence in the rest of the paper. I strongly recommend that the authors go through the equation appendix very carefully.

7. The figures are poorly done in general. Is Figure 2 taken from the Coup manual, at least in revised form? If so, that should be stated. Figure 3 is unclear. What is energy? Is this sensible and latent heat? What do the different colors represent? Figure 4 is confusing. Why is the cross-hatching so similar? Are these cumulative? For example, for time period 2, the 0-100 section goes from 0 to -18 (I think), but the next one goes from -18 to about -38. What does this represent? Explain in the caption!

8. How does this paper differ from Wu et al. (2016) by the same authors. It is an uncertainty study using a similar sort of model it would seem. I'm not saying there are no differences, but it seems, at least superficially, to be similar. Wu, M., P.-E. Jansson, X. Tan, J. Wu, and J. Huang. 2016. Constraining parameter uncertainty in simulations of water and heat dynamics in seasonally frozen soil using limited observed data. *Water* 8(2):64, doi:10.3390/w8020064

Oddly enough this is never cited. Also, the authors have a lazy reference list. For example, Wu et al. has been published in *Cold Reg. Sci. Technol.* for over a year now, but the authors list it as accepted. The cited Wu et al. 2016 study has no journal information, so it is not easy to look up. Again, those were the only two reference items that I looked at.

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These are all very short, general comments, but a more careful, rigorous review is really difficult given the present state of the manuscript.

In summary, this is certainly not publishable in its current form, but I think it does have potential for publication in some journal some day given the content.

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