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Hydrology and Earth System Sciences
Discussions

Interactive comment on "On the Appropriate Definition of Soil Profile Configuration and Initial Conditions for Land Surface-Hydrology Models in Cold Regions" *by* Gonzalo Sapriza-Azuri et al.

Anonymous Referee #2

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The manuscript by Sapriza-Azuri and co-authors utilizes a well-established one-dimensional land-surface model (the Canadian Land Surface Scheme within the MESH) to establish 'how deep does the soil need to be' to appropriately model ground surface temperatures with permafrost to depth, and 'how long do we need' to initialize the climate for the simulation.

The main results from this paper are not new, although there are certainly some unique aspects to this paper. First, the fact that one needs very deep soil representation to account for permafrost is well known and unsurprisingly confirmed here. The second contribution of long time-scales of simulation is also not particularly novel, however the

authors have conducted the climate simulations in a relatively innovative manner by accounting for uncertainty and variability and providing robust estimates to this.

The paper as it stands requires revision to make an important scientific contribution. While a lot of good work has gone into this paper, it's unique contributions need to be highlighted. Furthermore, there needs to be proper accounting for the site selection and parametrization. It appears that the authors picked the data out of some publicly available archive and ran the simulation with little understanding of realistic boundary conditions. The authors need to carefully consider the surface conditions (vegetation, near surface soils) for this to be an appropriate and meaningful contribution. Norman Wells is not a grassland.

Specific Comments:

∼P3 - line 13-15. This is out of place. Unsure as to why it is here. ∼P3 - line 16-17 'there is no doubt that deeper soil....' Yes, this is well established. The question then is why is this work being completed? Additional referencing could be provided as to this. ∼P3 - line 25 'the depth considered... generally arbitrary'. Can this statement be justified? I find it hard to believe that the work going in to establishment this depth is 'generally arbitrary'. Referencing would help. ∼P3 - lines 30-34. I suggest the authors set up the paper less as a 'mystery' and with more direct language in how they are addressing the the questions in the paper. I find the set up very colloquial. ∼p4 - line 8. The environment here is NOT characterized by grass. What is the influence of this on the simulation? Perhaps it is very little, but regardless, and appropriate upper boundary needs to be established here. ∼P5, line 2 - The paragraph starts a bit awkwardly and there is no real justification as to WHY this site was chosen. There is historical data here, but there is elsewhere as well. ∼the "Back to the past" language is again colloquial. I am not sure that this type of phrasing will be adopted in the scientific community and I would suggest the authors adjust their language to be one that is more technical. ∼Figure 4 is nicely set up and I am wondering if Table 1 can be described in a more technical way or in a figure format as it is repetitive and as a reader not particularly

helpful. There is an obvious sequence here than can simply be described. ∼I am unsure as to how the parameters in Table 2 were given their upper or lower bounds. Yes, there was a Monte Carlo sampling with a uniform distribution, but LAI, minimum LAI, albedo, etc., to me seem as if they are incorrect for the environment. Please more carefully consider the rationale for this parametrization scheme and provide the reader with an understanding as to which one of these parameters is the most important for the setup and simulation. ∼P10, line 3. Please provide a reference to the end of the first sentence.

I have no real issue with the presentation of the results. As mentioned, a lot of thought and time went into the setup here and certainly a lot of computational resources were applied. I do, however, encourage the authors to highlight their scientific contribution here. The result of deeper soil configurations has been well defined for over a decade (or longer?) now. I believe that there is more value in exploring (appropriate) parameter sensitivity and the generation of relevant climate conditions. There were a lot of realizations here, but I am not sure that the authors have detailed the importance of these runs. What clear guidance can the authors provide other groups working in cold environments.

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