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Interactive comment on "Projecting Circum-Arctic Excess Ground Ice Melt with a sub-grid representation in the Community Land Model" *by* Lei Cai et al.

Anonymous Referee #2

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The authors modified the CLM 5 tiling hierarchy by duplicating vegetation land units at a subgrid scale and prescribing different excess ice distribution. They employed single grid simulations to assess the robustness of single grid-scale excess ground ice with 3 scenarios of spatial variability of excess ice low/med/high in two sites influence from maritime climate: North Slope of Alaska and Yakutsk. Then, they ran global simulations to assess subgrid representation of excess ice across the permafrost region based on CAPS with 5 different scenarios/cases. I find this manuscript helpful for the permafrost/modeling science community particularly its contribution for testing subgrid scale parameterization on excess ice on CLM. However, I considered that this manuscript should be rejected. My concern lies on the language that implies improved

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Discussion paper

accuracy when projections are not validated in this manuscript while asserting more realistic simulations. I believe the reworked manuscript does have a great potential due to its contributions of subgrid scale representations of excess ice on land models.

Major Comments:

Authors should be cautious of using the term realistic and accuracy because is misleading. L78-79 "..aims to bring modeling of excess ice ...towards a higher accuracy". The study presented does not validate simulations to field excess ice studies and/ or recent observed subsidence in these 2 sites. Similarly, the statement in L309 that the authors "demonstrated the potential applicability of sub-grid representation of excess ice, particularly in representing a more realistic excess ice melt physics than the grid-scale excess ice in the CLM" can be a bit misleading since they lack comparison to datasets or cite literature that describes field observations. The authors should clarify the rubric for "realistic" simulations when they state (L336) "we do not expect the modeled excess ice melt in this study to be highly accurate". I am certain that a validation/comparison will greatly strengthened the manuscript. I am aware that validation may be problematic since representation of excess ice in these simulations starts at 1m depth but at least make a case for single grid simulations (since global datasets are not available) including its limitations and strengthen the comparison with current literature on excess ice surveys (i.e. Jorgenson 2008) and studies that have achieved excess ice simulations and subsidence in discussion to address how is this approach more realistic. These suggestions will greatly improve the impact & message of the manuscript.

Also, manuscript should to emphasize how is this different than Lee et al 2014, Aas 2019 etc.? We know that this is a new subgrid exercise but authors need to highlight better these differences in the manuscript and show a bit more how the results compare to other studies. This will help to emphasize its uniqueness and provide a better case for the reader. Introduction & discussion can be improved in regards to the flow, message and work cited, particularly on ice, geomorphology and subsidence since

TCD is a highly interdisciplinary journal/audience.

Minor comments: I will suggest that the comparison among the different simulations/scenarios should be highlighted more. L25- a few words describing what excess ice will be helpful for the reader L27- sentence can be re-written to be more clear/straightforward in regards to the effects of permafrost thaw on geomorphology and hydrology changes. L58 Change globally for permafrost region L150- briefly describe initialization in Lee 2014 for the reader L95- a general description of the excess ice including thermodynamic and hydrological processes will be very helpful in the methods to remind the reader on the main excess ice physics from CLM-EXICE L316 repeated “more”

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