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Geoscientific Model Development Discussions

Interactive comment on "Ground subsidence effects on simulating dynamic high latitude surface inundation under permafrost thaw using CLM5" *by* Altug Ekici et al.

Anonymous Referee #1

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General comments:

Ekici et al. investigated the effects of permafrost thaw induced ground subsidence on terrestrial hydrology modeled in CLM5. The proposed parameterization is not mechanistic, but it is a necessary step towards representing permafrost thaw induced changes in land surface property and hydrology in an Earth System Model (ESM). The paper is well written and it demonstrates an important yet missing element in contemporary ESMs.

Specific comments:

Pg1, L43: In addition to increased temperature, the projected increases in high latitude

precipitation could also accelerate the release of permafrost carbon (e.g., Chang et al., 2019; Grant et al., 2017).

Pg1, L46-47: Can you give a quantitative description about the release of greenhouse gases (e.g., in terms of g CO_2-eq/m2)? How about Knoblauch et al. (2018) that found strong CH_4 production under anoxic conditions?

Pg2, L1-3: There are many other "detailed processes representations" that can alter high latitude CH_4 emissions in addition to surface wetland coverage. For example, the representations of permafrost thaw stage, surface topography, vegetation and microbial community compositions (e.g., Grant et al., 2017; Malhotra & Roulet, 2015; McCalley et al., 2014; Olefeldt et al., 2013).

Pg7 Fig. 3: It might be a good idea to include the simulated soil temperature map here to (1) confirm it aligns reasonably with the simulated ground subsidence; (2) give a sense of how much warming leads to this amount of ground subsidence. Also, if the blue regions (subsidence<0.1m) are close to 0 degree C, wouldn't it suggest a potentially strong ground subsidence with the projected warming after 2010?

Pg8, Fig.4: The spatially averaged sigma-micro between the two sets of runs are very similar. Can you include the variability along with the mean values? It appears that the model is extremely sensitive to a parameter (sigma-micro) that exhibits limited temporal variability. How do the author propose to find realistic sigma-micro values for contemporary and future simulations? Once the parameterization proposed in this study is applied to ESMs, it will trigger significant changes in surface hydrology and thereby biogeochemical feedbacks resulting from sigma-micro selection along (not including the parameterization uncertainty).

Reference:

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Olefeldt, D., Turetsky, M. R., Crill, P. M., & Mcguire, A. D. (2013). Environmental and physical controls on northern terrestrial methane emissions across permafrost zones. Global Change Biology, 19(2), 589–603. https://doi.org/10.1111/gcb.12071

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