The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2020-338-RC2, 2021

The Cryosphere Discussions

Interactive comment on "Thermal erosion patterns of permafrost peat plateaus in northern Norway" *by* Léo C. P. Martin et al.

Anonymous Referee #2

Received and published: 22 February 2021

Apologies to the authors for this delayed review.

Martin et al. use a combination of field measurements and modelling results to investigate spatio-temporal patterns of permafrost landscape erosion. Specifically, they look at the controlling effect of snow cover and its microscale distribution in such landscape evolution. This was an interesting and in general well-written paper. In particular, the authors demonstrate a novel model structure that is capable of explicitly simulating these processes dynamically and give an indication about how this surface scheme could be considered in large scale climate studies. This work represents a useful contribution to process understanding in permafrost environments in the Arctic and I recommend publication in TC subject to some minor comments.

General points

- I think it would be useful to define thermal erosion. According to NSIDC glossary: "the erosion of ice-bearing permafrost by the combined thermal and mechanical action of moving water." I think this study is broader than that in terms of heat fluxes considered. You attribute 80% of erosion to "thermal erosion", presumably not just due to the action of water. Of course, you might not agree with the NSIDC def but perhaps state explicitly the processes considered right at the beginning of the text.

- How does the forcing compare to observations at the meteorological station? In general, why not use the station data directly? When comparing to observations it would be good to have an appreciation of any potential biases in the forcing. A plot in the annex or at least some statistics to show how the downscaling performs would be important I think.

- L.357: Why no subsidence with zero snow? I understand snow depth is important for thermal insulation and snowmelt is important for thermal erosion but wouldn't rainfall and melt due to positive air temperatures also generate subsidence, at least to some extent? Is the insulating effect of e.g. 10cm snow really so significant that it prevents significant winter cooling over the 0cm snow example? I would say this aspect of the modeling study needs to be explained in the text.

- L.219: I didn't fully understand the snow scheme I think some more details here would be useful. Specifically, how are the max snow parameters defined for each tile? By geographically matching with measurements? How do you scale the snow input in the model to generate the 4 snow height experiments? Do you apriori set a max/min snow height for each experiment somehow? And does this affect also liquid precipitation input?

- connected to the above 2 points I assume rainfall has an important contribution to erosion - was this quantified or at least put in context with other factors?

- I would recommend a reread to catch instances of poor grammar or so. Some are detailed below but likely not all.

Detailed points

L.51: result > results

L.61: I wouldn't call a threshold of 800mm "limited precipitation"

L.64: Northern Hemisphere

L.65: plateaus 'degradation > plateau degradation

L.68: "33-71%" seems like quite an uncertain result can you explain it a little bit?

L.74 "to the understanding of.."

L.81: could > can

L.109: "bleu"

L.110: cited serial number should be assigned to some authority to give it a meaning. Is it from the national met service?

L.122: Aeriel surveys were conducted...

L.199: strange indent

L.249 why ERA-Interim and not the latest gen of reanalysis ERA5?

L.259: Is wetter future foreseen in climate projections for the region? If so maybe make this link explicit that it is a future analog to some degree.

L.277: "where the edge.."

L.Fig A1 Do these boxes represent the absolut range in both x and y

L.594: you say the sim is in perfect agreement with the obs, while the sim is within the window of the obs it seems to me the variability is very much lower in the simulation. If you plotted this as a scatter plot I suppose it would look different?

Figure 8: can you locate this profile on one of the overview maps and refer to it so the

reader can understand the spatial context.

L545: "Thermal erosion of the plateau edges is the main process through which thermal erosion occurs and accounts for 80 % of the total measured subsidence" and what accounts for other 20%? Where you able to quantify that?

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2020-338, 2020.