

## ***Interactive comment on “Effects of bryophyte and lichen cover on permafrost soil temperature at large scale” by P. Porada et al.***

### **Anonymous Referee #1**

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#### General comments:

Bryophytes (mosses) and lichens are known to have an insulating function, thereby protecting the permafrost in the Arctic region, but this is not or poorly taken into account in earth system models. In this study a dynamic bryophyte and lichen layer has been added to the global land surface model JSBACH. Both the coverage and thermal properties of this new layer are dynamic as the water content is taken into account. As such this paper is a novel contribution within the scope of The Cryosphere. The authors have addressed the effect of the insulating bryophyte and lichen layer by comparing with model simulations without such a layer or a constant (non-dynamic) bryophyte and lichen layer. Outcome is a significant impact of the bryophyte and lichen layer on soil temperature and associated permafrost thawing depth in summer in tundra and boreal forest areas. In general, the study is well conducted and the manuscript

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is well written, although some editing still needs to be done. Figures and tables are well designed. My main comment is that the manuscript is rather long for a modelling study with a limited scope. Perhaps move Model sensitivity and Model evaluation to Appendices (with summaries in the main text)?

Specific comments:

P.2, L.16-17: Therefore, ... please be more specific about what is expected for the insulating effect in the different seasons.

P.4, L.20: Suggestion: mortality instead of turnover.

P.5, L.4: Isn't G (net growth) per unit of time? What is the time step of the calculations?

P.5, L.7: The disturbance takes place once a year?

P.8, L.28: How large are the grid cells in the model?

P.10, L.3-6: It would be helpful to give these three configurations a name, e.g. Dynamic, Constant, and Without (bryophyte and lichen layer).

P.10, L.8: Suggestion: start a new section here, e.g. 2.3 Sensitivity analysis.

P.14, Fig. 5c: Suggestion: use a similar range of the x-axis scale, e.g. -30 to 0, for a proper comparison with panel d.

P.15, Fig. 6 legend: Is the difference Dynamic minus Without or Dynamic minus Constant bryophyte and lichen layer?

P.16, L.12-15: I do not understand how an increased NPP can lead to a reduced coverage and what porosity has to do with this. Equation 1 shows how coverage depends positively on net growth. And net growth is positively related to NPP.

P.16, L.16-20: Not necessary to discuss this, as effect is only small

P.17, L. 14-15: Is this because the chosen grid cell is a relatively warm grid cell?

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P.18, Table 2 legend first line: Suggestion: temperature difference due to the addition of a dynamic bryophyte and lichen layer

Table 2:  $\Delta T/\Delta P$  is not explained in the legend and not used in the text

P.19 This section Model evaluation comes as a surprise: it was not announced in the Methods

Text comments:

Results are usually written in past tense. Please pay attention to this, particularly in the Discussion when you describe your study (which is done).

P.19, L.5: insert north in-between region and of

P.19, L.23: to a similar extent as

P.25, L.5: reducing effect of ... ground cover on ...

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