General comments

This manuscript builds on current understanding of the role of bryophytes and lichens in soil thermal regimes at northern high latitudes. Mosses and lichens often dominate the ground cover of northern ecosystems and play important roles in a variety of ecosystem processes including nutrient and precipitation interception, nutrient sequestration away from vascular plants, and soil cooling. The goal of this study is to integrate a process-based vegetation model that includes nonvascular plant growth into the land surface model JSBACH. The authors conduct a model experiment comparing model output between treatments with and without the addition of this bryophyte/lichen cover. While the results all support general expectations based on our current knowledge, I think this type of model coupling is an important step forward in more accurate representation of permafrost thermal regimes. My only major comment on this study is that I would recommend that the authors be more clear in the abstract and introduction about what ecosystems are being represented. Clearly, moss impacts on soil nutrient cycling and thermal regimes have been most well studied in boreal and subarctic peatlands. It is not until the very end of this paper that the reader learns that peatlands are not included in this model framework. This needs to be articulated much earlier in the paper, and defended given that many of the studies used for estimating parameters (Tables 3 and 4) include peatlands.

Specific comments

1. Page 1, line 23: But mosses are being outcompeted by shrubs in many northern systems, which can often involve an increase in productivity.

2. Page 2, lines 13-17: I certainly agree. This in part is why Bona et al. (2013) recommend that carbon cycling models parameterize feather mosses separately from Sphagnum mosses. [Bona et al. 2013. Ecosystems 16: 1071]

3. Page 3, lines 7-9. The authors describe three model scenarios here: dynamic nonvascular layer, static nonvascular layer, no nonvascular layer. Later in the manuscript, particularly in figure and table legends, it would be helpful to make sure that it is clear which scenarios are being depicted. I found it difficult to interpret in some figure legends what scenarios were being portrayed. If the authors are representing differences between two scenarios, is it always between the dynamic versus no nonvascular scenarios?

4. Page 4, line 10. While nonvascular plants lack a vascular system (though some species have poorly developed vascular tissue), they absolutely do exert controls on evaporation. This is achieved not only through individual level traits, but also community level traits. Thus, it does not seem reasonable to me that the moss evaporation rate would be similar to an interception reservoir.

5. Page 10, line 17. To be consistent with ecological studies, it would be helpful to refer to the depth of the living moss layer or the depth of the living + dead moss mat. It is notoriously difficult to separate live moss tissue from older dead

organic material in many boreal and arctic ecosystems. While this would have little implications for C uptake rates, it would influence thermal properties.

6. All empirical studies find that the thickness of the moss mat is one of the most important determinants of ground thermal regimes. Yet this study includes a static depth of 4.5 cm. I would like to see the sensitivity analyses include a greater range of variation in moss thickness. Different moss functional groups vary immensely in interactions between thickness and porosity, and this is going to govern influence thermal properties.

7. Figure 4. Which of the three model scenarios is being portrayed here? I assume this is the dynamic nonvascular scenario.

8. Page 13, line 12: There is no boreal forest biome. There are boreal forests within the boreal biome. The boreal biome includes boreal peatlands, boreal forests, etc.

9. Table 1. This table confuses me. Aren't all the rows representing differences between scenarios? Why is "difference" only listed in the last row?

10. Table 2. I think visualizing some of these results graphically might be more effective. For the parameters found to be most important (sensitive) through this approach, I think it would be particularly interesting to run additional analyses to explore interactions between parameters.

11. Table 3. This does not appear to be a comprehensive list of studies that have measured moss NPP in boreal or arctic regions. There are many studies in the literature not included here. It would be helpful to articulate why studies were or were not selected for inclusion in this table. Also, some of the studies listed in this table measured moss NPP in peatlands. I do not think these should be included, and it should be articulated why from the start of this paper.

12. Table 4. Data from New Hampshire should not be included here.

13. Figure 7. More information needs to be included in figure legends to make these "stand-alone". What are the observed data? This information is in the main text, but needs to be briefly described in the legend as well.