

The authors would like to thank the editor for the valuable comments and suggestions to improve the clarity of our manuscript. We have carefully revised our manuscript based on the suggestions provided by the editor. The comments and suggestions have been taken into account in the revised manuscript, as follows (original editor's comments in bold):

Specific comments:

Line 73-74: Jones et al. (2017) and Lundin et al. (2016) have contrary findings. Are peatlands sinks or sources in the long term? Can you add a sentence to clarify the ambiguity, and further justify the need for work such as the present study?

The estimates reported in Lundin et al. (2016) were based on compiling carbon fluxes currently measured across a subarctic catchment, which does not provide information regarding carbon budget projection over peatlands. However, Lundin et al. (2016) highlighted the importance of spatial heterogeneity on high latitude carbon budget estimates. The sentence has been revised to improve its clarity (Line 71-74).

Line 116: "thaw depth (in the active layer at tundra and bog sites or in the seasonally-frozen layer at fen sites)". ALD is the maximum thaw depth above permafrost. Anything less than that is a thaw depth, as is thaw in seasonally frozen ground. You model thaw depth progression. Please go through the manuscript and make sure you verify each instance of ALD: do you really mean ALD or thaw depth in each case? Your Figure 4 presents thaw depths, and I think that is correct.

We thank the editor for bringing up the issue. We have checked and corrected our uses of ALD in the revised manuscript.

Line 134-136: Please add a few sentences more about the physiography of the study region (e.g., topography, regional geology, when deglaciated, permafrost thickness, near-surface permafrost temperatures, permafrost temperature change rates in the region?). This will give more context and relevance to the study.

Some of the requested information of the study region has been added accordingly to improve of study site description (Line 136-147).

Line 136 New paragraph

We have started a new paragraph here, as suggested by the editor (Line 148).

Line 144 Change to "however". This will highlight the difference in the direction of change.

We have changed “and” to “however”, as suggested by the editor (Line 156).

**Line 146 New paragraph and Line 151 Append to previous paragraph.
Begin sentence with " At present, the Stordalen..."**

We have adjusted the format in this section to apply the editor’s suggestions (Line 159-166).

Line 154 Begin a new paragraph here.

We have adjusted the format in this section to apply the editor’s suggestion (Line 167-178).

Line 186-188 change “period” to periods; “days 87-146” to “60 days (28 March (day 87) to 27 May (day 147))”; “and days 148-341” to “to 193 days (28 May (day 148) to 7 December (day 341))”; and rewording Line 188

We have applied the edits suggested by the editor (Line 199-202).

Line 232-233 “aboveground” to “above-ground”; insert “that are allowed to change with changing environmental conditions”; “belowground” to “below-ground”

We have applied the edits suggested by the editor (Line 246-248).

Line 236-237 “patch-scale” to “patch scale”; “landscape-scale” to “landscape scale”

We have applied the edits suggested by the editor (Line 251-252).

Line 239-240 Reviewer 2 asked for the vegetation parameters to be included in the manuscript. Please add a table to the main document or add it to the supplemental material and reference it.

We have included the vegetation parameters in our Supplemental Material Table 2, which is referenced in Line 305-307.

Line 342-347 “depth” to “depths”; “was” to “were”; “becomes greater than” to “exceeds”; “The” to “In contrast, the”; “by the end of July” to “nearly one month earlier”

We have applied the edits suggested by the editor (Line 358-363).

Line 351 You responded to Reviewer 2's question about consistent over-predictions of net CO₂ uptake for bog, but did not provide the explanation in the revised manuscript. This is needed in the discussion.

The over-predictions of net CO₂ uptake in the bog and the corresponding explanation have been included in the revised manuscript (Line 379-383).

Line 372-374 insert "that is"; insert ". This may be"; insert ":'"; insert "';"

We have applied the edits suggested by the editor (Line 391-393).

Line 382 Reviewer 2 asked for clarification regarding water table simulation and lateral water transport. You responded to the set of questions, but did not revise the manuscript to provide explanations to new readers. Please revise the manuscript or supplemental materials accordingly.

We have included an explanation of the limitations of water table simulated in our one-dimensional column simulation in the revised manuscript (Line 411-415). We have added a description of our water table simulation in our *ecosys* qualitative description in the supplemental material (Line 39-42).

Line 409 "weaker" to "comparatively lesser"

We have applied the edits suggested by the editor (Line 430).

Line 418 Reviewer 2 questioned this. I think that you should add some text to clarify the reasoning behind this choice, to head off further questions.

We have included the reason behind the choice of our seasonality calculation (Line 439-441).

Line 432 This is still a part of Results and Discussion. Please adjust numbering accordingly. EG. this will become 3.4, and the sub-section will become 3.4.1

We have applied the edits suggested by the editor (Line 454).

Line 433 Reviewer 1 wanted to know if there was a talik at any of the peatland sites. It is an important question because talik development is common in degrading peatlands, and microbial activity may continue in the unfrozen zone. See my

comment on figure 1. You don't know if a talik developed or not, but you should bring up the issue. You should add in a sentence or two that treats your lack of knowledge about talik development in the field, the ability of the model to capture talik development, and the implications on your results and discussions.

We have added a section discussing the limitations of our field measurements and the associated implications on our results in the revised manuscript (Line 456-464).

Line 449 Do you really mean thaw-depth development?

The ALD has been replaced with thaw depth in the revised manuscript (Line 480).

Line 570 Section #4 now, not #5

We have applied the edits suggested by the editor (Line 601).

Line 938 Please add a note to clarify how the %ages are calculated (the rules); what the % coverage means. Can't tell without going to the main text.

We have added a note to clarify the definition of the data coverage (Line 972-973).

Line 940 Not part of the title. make this a note below the table.

We have made the sentence "RRMSEs are relative root mean squared errors." as a note below the table (Line 976).

Line 944-945 Not part of the title. Make this a note below the table.

We have made the sentence "All gas exchanges are in units of g C m⁻²." as a note below the table (Line 980).

Figure 1 Permafrost is typically considered impermeable. The water table has to remain above the permafrost table.

We have corrected the water table position drawn in Figure 1.

Line 967 Do you actually not know the active-layer depth at the bog site? If so, say explicitly on line 159. Based on the measured field data, it looks as if there is either no permafrost, or there is a talik with permafrost much lower than 90 cm. Again, this points out the necessity to discuss taliks and related implications.

We do not know the ALD at the bog site because it is deeper than the maximum depth of

our thaw depth measurements. We have included a new section discussing taliks and related implications (Line 456-464).

Line 968 “deepens below” to “exceeds”

We have applied the edits suggested by the editor (Line 1002).

Line 978 “depth” to “depths”

We have applied the edits suggested by the editor (Line 1011).