



EGUsphere, referee comment RC1
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Comment on egusphere-2022-1006

Anonymous Referee #1

Referee comment on "Peatlands and their carbon dynamics in northern high latitudes from 1990 to 2300: a process-based biogeochemistry model analysis" by Bailu Zhao and Qianlai Zhuang, EGU sphere, <https://doi.org/10.5194/egusphere-2022-1006-RC1>, 2022

General Comments:

I found the manuscript to be very interesting and comprehensive. The paper makes some very useful conclusions based on PTEM model projections for a range of important climate change scenarios. I think a revised version could be considered for publication with attention the specific comments provided below.

General Comments:

What is the time-step of the PTEM model? If it is hourly to daily, I think the water table depth extrapolations are probably meaningful. However, PTEM is run at an annual time step. The extrapolation of mean water table depth to constant states throughout an annual cycle is inappropriate. The dynamics of winter snowfall accumulation and melt, precipitation variation and temperature, and seasonal changes in evapotranspiration drive a dynamic water table depth in peatlands that needs to be captured in models. With decomposition, methanogenesis and methanotrophy being dependent on oxygenation associate with dynamic water table position.

Due to the extensive use of abbreviations, I found the manuscript hard to read and follow. Please limit their use.

While certain science disciplines may be well acquainted with the IPCC forcing and climate projections, I believe the paper would be more approachable by the average reader if Table S2 and a similar Table for forcing details were included in the published paper.

Arctic regions in the posted polar maps seem to extend into Boreal regions. What land cover is the basis the global calculations of change impact? Perhaps a supporting table defining the lands for the model spatial extrapolations would be helpful. How much peatland/wetland area? How much upland area? How much permafrost vs. discontinuous permafrost vs. temperate area?

I don't understand the authors' use of the phrase "run-on". Is this suggestive of a transitional fen state between raised bogs and open aquatic systems?

Does PTEM include depth layers? Are the bins mentioned on Line 254 peat layers?

Specific Suggestions:

Line 7: Adjust text to: "have been a large C sink...."

Line 10: Adjust text to: "Peatland area expansion, shrinkage and C accumulation and decomposition are modeled."

Line 14: I don't understand "the peatland being C sources".

Line 24: Adjust text to "plant litter from being fully decomposed"

Line 31: A possible additional phenology reference:

Richardson AD, Hufkens K, Milliman T, Aubrecht DM, Furze ME, Seyednasrollah B, Krassovski MB, Latimer JM, Nettles WR, Heiderman RR, Warren JM, **Hanson PJ** (2018) Ecosystem warming extends vegetation activity but heightens cold temperature vulnerability. *Nature* 560:368-371, doi:10.1038/s41586-018-0399-1.

Line 32: You might change "will" to would.

Line 35: Change to: "To date, multiple modeling studies" to distinguish this work from observational or experimental data.

Line 41: Change "considering" to including.

Line 54: Change "However, the" to ", but future".

Lines 93 & 100: What is CRU?

Line 205: Please add the specifics of the CO₂ concentrations simulated to the treatment tables mentioned above.

Lines 243 to 246: Some explanation for the inclusion of and need for pH specificity would help the reader.

Line 290: Expand "the threshold temperature" to "the threshold temperature needed to transition the peatland from a C sink to a C source". If you state it this way, lines 291 and 292. Might not be needed.

Page 12: I would like to see the quantitative specifics provided in Supplement Tables S3 and S4 brought into the main manuscript.

Page 14: A very nice paragraph to describe conditions before 2100.

Table 1. It is a bit odd to suggest that a transition from one frozen state to another can have large impacts. This interpretive oddity results from the use of mean annual values. Is there another variable that could also be included? For example, days above freezing that could perhaps better explain the results.

Line 414: Change "no" to not.

Section 4.2 Recent experimental results showing the relationship between warming and nutrient availability could be cited here:

Iversen CM, Latimer J, Brice DJ, Childs J, Vander Stel HM, Defrenne CE, Graham J, Griffiths NA, Malhotra A, Norby RJ, Oleheiser KC, Phillips JR, Salmon VG, Sebestyen SD, Yang X, **Hanson PJ** (2022) Whole-ecosystem warming increases plant-available nitrogen and phosphorus in an ombrotrophic bog. *Ecosystems*
<https://doi.org/10.1007/s10021-022-00744-x>

Line 463: The units for Hanson et al. 2020. Data are wrong they should be $\text{gC m}^{-2} \text{y}^{-1} \text{ } ^\circ\text{C}^{-1}$. The implication is that the Hanson et al. results are proportionate to the amount of warming.