

Dear Vivek,

We are sincerely grateful for the time you devoted to annotating our manuscript. In response, we have revised every section where you requested clarification or additional context; your comments have been invaluable in raising the manuscript's quality.

First, every language issue you raised—grammar, terminology, word choice, and unclear phrasing—has been corrected in the revised manuscript. Below, we elaborate on several key points; your handwritten comments appear in black, and our responses are shown in blue.

1) Abstract: Is this a generalized statement or based on the simulations presented here?

Thank you for your comment. The statement is based on the simulations presented in this study. We have revised the sentence as follows: “Based on the simulations presented, permafrost carbon feedback is unlikely to initiate a self-perpetuating global tipping process under both stabilization and overshoot scenarios.”

2) Line 200: Is it possible to report there in time scale years?

Yes. We have converted the passive carbon pool transformation rate from s^{-1} to its corresponding mean residence time in years and clarified its temperature dependence:

“The passive carbon pool transformation rate was estimated from the ^{14}C age of the passive carbon pool in midlatitude soils (Trumbore, 2000). Its MRT at 5 °C is 300 to 5000 years, yielding a passive carbon pool transformation rate of 0.25×10^{-10} to $4 \times 10^{-10} s^{-1}$ after adjustment to 25 °C. The MRT of the passive carbon pool was assumed to follow a uniform distribution (MacDougall and Knutti, 2016).”

3) In Figure 3, panel c) = permafrost C loss is this frozen C? panel d) = permafrost region C loss is this all (frozen + unfrozen) C? If yes, please change the wording in figure caption to make this clear.

Panel (c) shows the loss of permafrost carbon only; usual soil carbon can also be frozen, but its loss is excluded here. Panel (d) shows the total soil carbon loss from the permafrost region, encompassing both permafrost carbon and usual soil carbon. To clarify this distinction, we have revised the manuscript's terminology, replacing “permafrost region soil carbon” with “total permafrost region soil carbon” and have updated the figure caption accordingly.

4) Line 297: Are you comparing Figures 5a and 5b?

Yes, we are comparing Figures 5a and 5b in this context. To clarify this point, we have revised the sentence to: “Our simulations show that permafrost carbon inputs (Fig. 5a) do not follow the same trajectory as total permafrost region soil carbon inputs (Fig. 5b), especially under overshoot scenarios. Permafrost carbon inputs continue rising for some time after peak warming, whereas total permafrost region soil carbon inputs closely track the temperature trajectory (Fig. 3a).”

5) Line 312: Which figure? 3d?

Yes, this refers to Figure 3d. The figure reference has been added in the revised manuscript.

6) Line 335: Is this over “permafrost region”? How does this compare to pre-industrial?

Yes. The percentage refers to the combined areal coverage of trees and shrubs within the permafrost region, and the 1.5 °C warming is measured relative to the pre-industrial level (1850-1900). The permafrost region with permafrost carbon changes only minimally in all simulations. We have revised the sentence for clarity: “Upon 1.5 °C warming (projected for the 2040s relative to 1850–1900), trees and shrubs are expected to cover approximately 62 % of the area where permafrost carbon is non-zero.....”.

Meanwhile, we have clarified the distinction between “permafrost area” and “permafrost region” in the first paragraph of Section 3 (“Results”), since “permafrost region” is used when discussing permafrost carbon and related fluxes: “the permafrost area is defined as the area where soil temperature remains below 0 °C for at least two consecutive years, whereas for carbon-related variables the permafrost region is defined as the area where permafrost carbon exceeds zero in UVic ESCM. The area with non-zero permafrost carbon is 17.2 million km² and changes only minimally throughout the simulations.”

7) As we discussed in our emails, please clarify “permafrost soil C” vs “permafrost region soil C”, and that the “region” area is changing.

Thank you for the comment. To clarify the distinction, we have revised the terminology throughout the manuscript by replacing “permafrost region soil carbon” with “total permafrost region soil carbon”. Regarding the changing permafrost “region” area, we have clarified this point at the end of the first paragraph in the Section 3 (“Results”).

8) Figure 6: Are there no or very few broadleaf trees in the permafrost region and that’s why they are not shown here?

Yes. Broadleaf trees are absent and C4 grasses have negligible coverage in the permafrost region, so they are omitted from Figure 6. We have clarified this in the caption: “Notably, broadleaf trees and C4 grasses are not shown because their presence in the permafrost region is negligible.”

9) Line 393: But you just said additional warming is higher in stabilization scenarios.

Thank you for pointing this out. The original sentence sought to state that, by 2300, the additional warming in stabilization scenarios is 22–56 % greater than in their overshoot counterparts, but its wording was ambiguous. We have now revised it for clarity: “By 2300, the additional warming under SWL-2, SWL-3, and SWL-4 exceeds that of OS-2, OS-3, and OS-4 by 0.03 [0.01 to 0.04] °C, 0.07 [0.02 to 0.11] °C and 0.07 [0.03 to 0.10] °C, respectively, which is 22 % to 56 % higher than in the corresponding overshoot scenarios.”

10) Figure 7: What's the difference between (c) and (d)? They're the same y-axis label and description in the figure caption. Oh I see! (c) is overshoot scenarios, and (d) is stabilization. Pls make this clear in the caption.

Panels (c) and (d) indeed both showed the additional permafrost area loss due to permafrost carbon feedback, but under different scenarios. To avoid confusion and ensure consistency with other figures, we have now combined them into a single panel (c) that displays all scenarios together.

11) Line 519: Is this also from Canadell et al. 2021

No, this is from Nitzbon et al. (2024), which has now been added to the revised manuscript.

12) Line 577: But in Fig 10a and b changes are relatively small until about 1.0 °C

We agree. Our intention was to highlight that the strongest permafrost degradation occurs just below 1.5 °C warming level. We have revised the sentence to clarify this point as follows: "The maximal sensitivity occurring just below 1.5 °C global warming level suggests the fastest permafrost degradation is anticipated to take place within Paris Agreement's warming levels."

13) Line 680: hopefully this will become more clear once you use different terminology.

Thank you for the suggestion. we have replaced all instances of "carbon release" with "carbon loss" throughout the revised manuscript.