

Written in black are comments from the reviewers and editor.

Written in blue are comments from the authors (modifications made in the text are in italic).

All line numbers refer to the R2 version of this manuscript.

Associate editor decision: Reconsider after major revisions

Dear authors,

I send back to review your manuscript to one of the previous reviewer and the way you deal with replication is still an issue. Your study is interesting and deserve publication but you need to find a way around this problem.

Best

Bertrand Guenet

Thank you for your feedback and for the encouragement to continue with the publication of our study. In response to the reviewer's comment on technical replicates, we have modified the title and changed the Abstract and Conclusion sections to better reflect the findings that can be drawn from our approach. We have in particular replaced formulations that imply a broader generalization of our results, and instead rather refer to the actual results of our study.

RC1: Report #1, Submitted on 12 Jun 2024, Anonymous referee #1

The authors revisions answered the input of the reviews, though two important open questions remain

1) The lack of technical replicates remains an issue for this paper. The authors addressed this by reframing parts of the paper, especially with the edits at line 210. However, the new text and the paper as a whole is framed more as a pilot study of permafrost soil depth-dependency and less of of comparison between different habitats. The text (especially the title, abstract and conclusion) should be updated to reflect this.

We have changed the abstract and conclusions to better reflect the actual findings of our study rather than generalizing them, given the lack of technical replication. We have also changed the title to highlight the methodological constraints of the study: *Carbon degradation and mobilisation potentials of thawing permafrost peatlands in Northern Norway inferred from laboratory incubations.*

2) In line 105 of the revised document, it is mentioned that the bulk density of the soil was estimated in the active layer but (perhaps I missed it in the text, supplemental info) remains unreported for the permafrost layer. Other important parameters such as soil moisture remain unreported. Especially for the high depth resolution, these parameters would likely have a wide range of values and impact on the gas flux measurements, especially in the Transition Zone depth.

We thank the reviewer for spotting this issue which was indeed unclear. We have revised the text to clearly state that the values reported in Kjellman et al. (2018) refer to both active layer and permafrost peat (line 95). Furthermore, we now also provide a reference to the water contents of our samples which are reported in Table S11 (line 98).