Dear Reviewers,

Thank you for your thoughtful and balanced assessment of our manuscript. We appreciate your recognition of the efforts made to address the main technical comments, as well as your constructive remarks regarding the study's novelty, model performance, and associated uncertainties.

#Response to associate editor

Following your suggestions, we have carefully revised the manuscript and slightly adjusted the wording where necessary to further clarify the limitations of our approach.

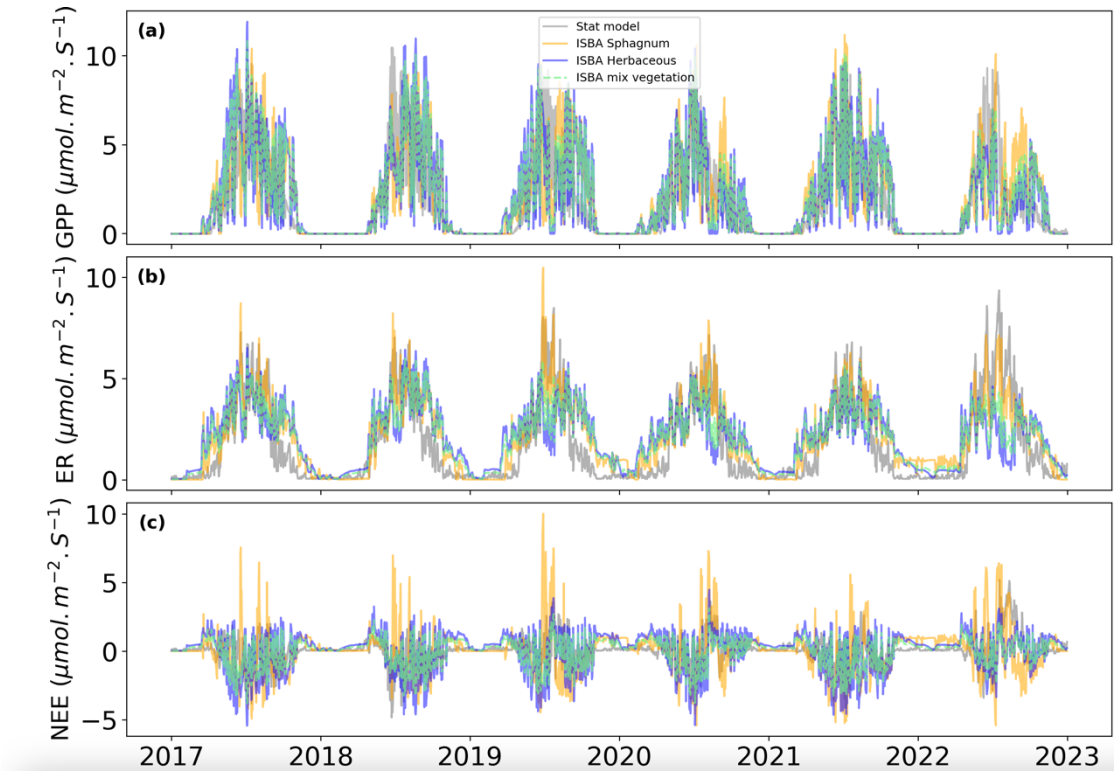
#Response to RC1

Dear authors,
thank you for your thoughtful revisions that have strongly helped to clarify your manuscript. Please provide some proof for your statement in lines 286-287 in the revised manuscript that "soil moisture did not appear to strongly constrain organic matter decomposition in near surface moss dominated layers". How does your data support this statement?

We thank the reviewer for this comment. We have clarified this point in the manuscript. In particular, we now explicitly refer to Figure A4 (b) and (e), which shows a closer agreement between modeled and observed soil respiration for Sphagnum when θ(z) is excluded. This supports our decision to remove θ(z) for Sphagnum while retaining it for herbaceous vegetation to preserve contrasting drought sensitivities across vegetation types.

I think it could help to add a line for ISBA with mixed vegetation to Figures 1 and 2 for more direct evaluation of the model performance.

We thank the reviewer for this suggestion. The mixed vegetation dataset is already extensively shown in the validation results in the Supplementary Material. We initially tested its inclusion in this figure as well, but this substantially reduced readability when comparing the three main datasets. For clarity and consistency in the main text, we therefore retained only the three primary datasets here, while ensuring that the mixed vegetation case is fully documented in the Supplementary Information.



Please also check all figures for colour blind friendliness.

Thank you for the reminder, we’have already done that following reviewer 2 advice.

We hope that these revisions adequately address your concerns and improve the overall clarity of the manuscript.