

Reply to RC2:

The authors have done hydrological modelling of peatland WTD and its impacts on CO₂ fluxes in current and future climates under different rewetting scenarios. Overall the study is well conducted and clearly represented. The study is highly topical considering the importance of peatland ecosystems in GHG budgets and the open questions still surrounding them. I only have a few minor comments on the manuscript.

1. Concerning the rewetting scenarios: Are there actual management practices, that can focus the rewetting seasonally? I am only aware of the more nature-based methods, such as ditch-blocking. I appreciate that discussing actual, real-life management practices is not the point of this manuscript but it would perhaps be helpful to somewhere explain how these scenarios used here relate to real life, as your findings rather strongly suggest that considering the seasonal variation in rewetting is important.

In some cases, management practices place impermeable membranes along the edges or surrounding peatlands. These artificial interventions aim to sustain higher water levels, especially during summer, than would be achieved through nature-based solutions. These artificial engineered management practices are especially relevant in the context of bogs as opposed to fens. Such practices can also ensure that areas outside the project site, such as neighboring agricultural fields, are not affected by the rewetting. However, it is an expensive solution.

In addition, the outcome of this study can serve as a reference for discussions on realistic expectations on CO₂ emission reductions. Especially, in cases where nature-based solutions are planned, and where a return to more natural hydrology will still encompass temporal variability and climate induced droughts leading to occasional high emission rates.

In the manuscript, we will include how our rewetting scenarios relate to practical, real-life management practices.

2. Choosing one RCP is understandable considering the amount of variables that are already present in the study. I do not suggest that you introduce a milder climate scenario here but I think it would be good to acknowledge in the discussion that this is the scenario leading to strongest impacts of climate change. This is particularly relevant for your manuscript, as you assess the cascading impacts of two climate-related variables. It would be highly interesting to know (perhaps in a future paper) if this relationship of WTD and T_a cancelling each other out is visible in other climate change scenarios, or would the influence of one overpower the other.

We agree in your comment regarding the choice of the RCP leading to strongest impacts of climate change. We will not introduce additional climate scenarios in the manuscript, but we

will highlight in the discussion that this scenario corresponds to the strongest climate change impacts.

3. Throughout the paper, you refer to the ground surface as "terrain", i.e. on L63 and L129. Is there a particular reason why you don't just say "surface"? I'm not sure I've ever heard this use of the term terrain, and at least for me, this was somewhat confusing.

We will change the term from terrain to surface.

4. I would advise on renaming the two future time periods as "mid-century" (or something like that) and "end of century". Distant future, to me at least, seems to be something further in the future than within my own lifespan, and since your simulation covers this century, it seems like a much clearer choice to refer to that.

We will rename the future time periods in line with your suggestion.

Fig.3: Could you make the lines within the legend a little thicker, so that it is clear which line (blue or black) is referring to modelled and measured values?

Certainly, we will.

Finally, while the language is generally very good, I would advise a thorough read-through of the manuscript, or employing the help of a proof-reader. I have listed below some parts that need refining, but I did not conduct a thorough language check.

Thank you for your language corrections. We will proofread the manuscript carefully, possibly with support from a professional proofreader.

L70. Do not account for neither: double negative.

L85: Sentence starting with "For example through..." is not a full sentence.

L91: field-scale, not field scale

L113: Should this be "continuous", not "contiguous"?

L126: This probably should be "automatically", not "automatic"

L306: There is no need to say "such as rewetting", since this is the only management practice discussed in this paper.

L311-313: This is a confusing sentence.

L657: "In 2023, CO₂ emissions from drained organic soils in croplands and grasslands was estimated to

accounted for 6.7% of Denmark's total emissions" --> "was estimated to have accounted for"

L687: "Such nature-based solutions are not likely to reduce..."