

Dear editor and reviewers,

We would like to thank you for taking the effort for reviewing our manuscript again and come with some final points of improvement. We agree that the added radiative forcing to the Results deserved some better embedment in the manuscript. Therefore, we added text to the abstract and conclusions, and we discussed the results better. We also clarified the assumptions and changed the focus of radiative forcing a bit to avoid the direct comparison with the GWP. A detailed description of all the changes we made as requested from the reviewers can be found below. Further, we have checked the entire document thoroughly for inconsistencies, typos and unclear descriptions, which we have changed/improved.

We hope you are satisfied with the changes we made and that the manuscript is ready for acceptance.

Kind regards (on behalf of all authors),

Thomas Gremmen & Merit van den Berg

Reply Referee#1

Thanks for the revision of the manuscript. A lot of improvements have been made. I only have some considerations on the statements about top soil removal, a reaction on the new figure (10) and some minor comments:

We are happy to hear that the referee is positive about the revisions.

"L438-439: ""And we also assumed that the removed carbon from the topsoil will be decomposed to CO₂ within 25 years.""

Please remove ""And"" at the start of this sentence.

The sentence was combined with the sentence before, so now 'and' fits better.

Furthermore, in L519-521 you state that ""If all the carbon that is removed from the top 20 cm (15.8 kg m⁻²) is not stored under anoxic conditions, an amount of 557 t CO₂ ha 520⁻¹ will be released over the period needed to decompose that carbon. That is the same amount the reference site is emitting in 27 years.""

So the period needed to decompose that carbon is assumed to be 25 years (L438-439). Please also use this time period in L521 then. But why does it take 27 years to decompose that carbon at the reference site? What is the difference between the carbon in 20 cm of removed topsoil and the carbon in the topsoil of the reference site? I guess that the reference site (where the oxic layer is > 20 cm) emits more CO₂ in 27 years than only 20 cm of top soil does in 25 or 27 years under oxic conditions? "

In L521 we state that the amount of CO₂ that is expected to be emitted from topsoil removal is equal to the amount the reference site is emitting within 27 years. It is a bit uncertain how fast the topsoil will be decomposed, it depends on how much oxygen can enter the soil but we assumed more or less the same flux from the topsoil as from the reference site and rounded the number to 25 years. But to

prevent confusion about the numbers, we changed the decomposition period for the topsoil to 27 and explained that this is based on the flux from the reference site.

It could be that we underestimate the decomposition time of topsoil, since more carbon is exposed in the reference site. But the reference site is not losing young carbon but mainly peat, while in the removed topsoil net more young carbon will be decomposed, which has a higher decomposition rate than the recalcitrant peat.

In general, the precise decomposition time of the topsoil is not that important. The story would not change if the topsoil oxidizes within 20 or within 30 years.

Figure 10: this figure is based on some assumptions (mentioned in the text), but what I miss is the assumption that biomass is harvested or not. If harvesting is assumed, what is assumed for the biomass application and possibly long-term carbon storage?

We agree that we did not mention the point of harvest in these calculations. We assumed that all harvest is being decomposed to CO₂ again within the same year, the same as in Table 3 and Figure 9. We have written this in the text (L443).

Next to that, nothing is mentioned about the radiative forcing in the abstract or conclusions now.

We have added the results of the radiative forcing in the abstract (L34-36) and the conclusions (L587-589)

L531: change "reference site" to "the reference site" or "reference sites"

Is changed.

L555: Change "grow better... ..below surface" to "...grow better at lower water tables, and CH₄ emissions could be significantly reduced if the water table drops below soil surface."

Is changed.

L557: "...can be found in (Vroom et al., Under review)." Correct this.

Is corrected.

L567: Change "...with topsoil removal. Probably..." to "...with topsoil removal, probably..."

Is changed.

Reply Referee#2

Thank you for considering my review and the answers to my questions. You've done a great job revising the manuscript.

We are happy to hear that the revisions are received positively.

With the addition of the RF-modeling, I must however raise a concern. I find that this later addition is not thoroughly discussed in the manuscript. What you see in the results of the RF-modeling is that

all rewetting experiments lead to a period of warming compared to the drained state (curves do not cross the drained curve until 2080-ish). This period of time is important as it is relevant to the goals of the Paris Agreement.

It is also important to stress (also in the discussion) that the RF-modeling here builds upon a steady state (emissions do not change over time), which is not likely as you also mentioned in the discussion about possible reductions in CO₂ uptake from Typha over time. It's also likely that these ponds will not be ponds for very long (the sediment and new peat will reach the water surface and perhaps above) which would possibly reduce CH₄ emissions. I do not propose to change the input to the model, but to at least mention it in the discussion.

To address some of these concerns you could decide to discuss the RF-modeling merely as a way to highlight the differences between the species and the gases, and not necessarily the metric to use for climate mitigation purposes – as it is already internationally agreed upon to use GWP for this.

We agree that some more discussion was needed for the RF modelling, and to point out the effect of a higher radiative forcing for the paludicrops on the short term and lower on the long term, compared to the reference site. We've changed the focus of the results to describe this effect and mention for each species the moment in time from when the radiative forcing of the paludicrops will be lower (L448-450). We removed the part where we describe the limitation of the static GWP (L436-438). We have also added a section in the discussion about the limitation of extrapolating this dataset to the year 2100 (1 year of data and expecting no changes in the fluxes) (L542-551). We do not think that these ponds will form new peat or that sedimentation causes the soil to be elevated above the water table. It is a highly managed (water) system where paludicrops are harvested and water table are kept artificially stable. So we did not add this point to the discussion.

Details

Line 28. Typha (spelling) Typha

Is corrected.

Line 361 year (spelling) yearly budget

Is corrected.

Line 393 “resulting in the highest net ecosystem exchange (NEE) (Table 3).” Discussing NEE is difficult. Highest, although correct in that it was less negative, is a bit misleading. The exchange could be argued is higher if it is more negative than something negative, or more positive than something positive. It's the flux size, regardless of which side of the 0 line that's important here. I would suggest rewording this sentence.

We agree that using the term 'highest' could be confusing with negative numbers. So we have changed it to: 'resulting in the lowest net uptake of CO₂ (NEE)'.

Line 468 You changed to capitalize the Wainscot, but not the entire name. Should be Webb's Wainscot and Bulrush Wainscot

Is changed.