The manuscript by Bethe et. al., investigates the effect of soil temperature, soil moisture and exposed carbon on CO2 emission from drained peatlands in proximity to ditches where topsoil removal has been implemented. They create 20 transects from ditch edges and into drained peatland fields and measure soil temperature, soil moisture and CO2, 5 to 8 times during the period. To estimate the exposed carbon, they measure carbon content from transect cores above daily groundwater levels. Furthermore they calculate the time it will take to reach climate neutrality using modelled soil respiration and carbon density removed as topsoil. They find that implementing TSR in ditch proximity of drained peatlands reduce annual soil CO2 emissions by 17%. Furthermore they estimate the payback time for peat removed as topsoil may exceed 100 years.

I think the manuscript is well written and follows a logic trajectory throughout. The manuscript is relevant to the peatland scientific community, as it thoroughly investigates CO2 emissions in drained peatland and the specific method of including exposed carbon is, to my knowledge, still poorly investigated.

We thank the reviewer for their time in reading and reviewing our manuscript and for the prompt and thoughtful feedback on our submission. We are very pleased to see the positive responses and are grateful for the opportunity to make improvements based on the suggestions received.

My only major concern regarding the manuscript is regarding the calculation of exposed carbon, as it is stated in the manuscript that only one core is sampled inside each transect which is used to estimate carbon content of complete soil profile inside the transect. While this method is valid, it is stated in the manuscript that the soil profiles, based on the cores collected, varied greatly and that the transects are in close proximity to one another. If possible, I would like an uncertainty added to carbon content estimated inside the transect and the matter mentioned in the discussion.

Besides this, I don't have any major concerns.

We understand the reviewers concern in regards to our exposed carbon calculation method. We have two points in response 1) during the fieldwork, we took additional soil cores along and adjacent to the transect with a smaller diameter gouge auger to check whether there was significant variation in peat profiles on small horizontal spatial scales. We did not detect large discrepancies in the sequence of layers or their depths along the transect points compared to the main sampling core used for our extrapolations. This consistency of the peat profiles within a transect, together with laboratory constraints were the reason for collecting and analyzing only one core for each ditch border. 2) The reviewer correctly notes the large variation in peat profiles between ditch borders, but it should be noted that these are separated on the scale of 100s of meters and are located in different fields. This

variation is relevant for the overall variation in our observations and conclusions, but not we would argue for judging the validity of our extrapolation procedure to estimate C content within a transect. Nevertheless, we agree with the reviewer that unmeasured variation in C content within a transect will have introduced an unknown amount of additional error in our estimates. However, in the absence of reliable quantitative data of small-scale soil carbon heterogeneity at our site, we believe it would be misleading to attempt to formally estimate the magnitude of this uncertainty. In the revised version we will add a discussion of this issue (and others raised by reviewer 2) by pointing out the potential risks of bias and explicitly highlighting the additional uncertainty introduced by the extrapolation steps in our analysis.

Abstract

L27 – 30: TSR is proposed to reduce CH_4 emission in rewetted peatlands more so than CO_2. – **agreed, the sentence will be rewritten.**

L30: How is it politically challenging? I suggest either explaining it or removing it. – **we will remove this part of the sentence.**

L37 -38: As the exposed carbon is not a common known variable, I would like some more explanation to it. – **We understand that is rarely used variable, but we provide a full definition of the variable in the Methods and introduce it in the Introduction. For clarity, we will slightly change the phrasing in the Abstract to: "(amount of carbon in the soil profile above the ground water table)" but due to space limitations in the Abstract we don't think it is the right part of the manuscript to provide a more complete definition.**

Introduction

L58: Last decades – 20? 50? 80? Be more specific – **we will be more specific and mention intensification of these practices started from 1880.**

L 81-83: appears somewhat redundant with line 65-68 as the role of oxygen in stimulating CO2 emissions has already been explained. Consider combining these two statements. – **We will rephrase the sentences in line 65-68 into: "However, drainage enhances aerobic microbial decomposition rates in the unsaturated peat zone, and therefore increases CO2 emissions into the atmosphere and induces land subsidence (Brouns et al., 2014; Erkens et al., 2016; Joosten, 2009)."**

L 103-105: Something appears to be missing from the sentence please check it. – **Thank you for noticing, we will change the sentence and add 'drivers' ("In addition to these drivers, …").**

L112: there is a discrepancy is the explanation of rewetting inside the parenthesis with the one in the abstract. – **thank you for noticing. We will align the explanations to "rewetting (groundwater table management)".**

L126: Regenerative ditch border is first mentioned here. Please check abbreviation through the manuscript – **This will be corrected .**

Methods

307-336: The exposed carbon calculation relies on the assumption that the carbon densities measured at 360cm is representative of all other distances in each transect. As the exposed carbon variable is a major predictor for CO2 emissions, I find this assumption "brash" as it is known that peat and soil layers can vary much spatially. Please acknowledge this limitation and discuss its implication.

Can the uncertainty be quantified? - **We agree that the potential consequences of this assumption was not adequately discussed in the original version, see our response to the comment above.**

404: missing word – years? - **We will rewrite the sentence to: "We used the model estimates to estimate the 'payback time' defined as the number of years for net negative effects on cumulative CO_2 emissions (net reduced emissions) are to be reached after implementing RDBs."**

Results

509-512: How is the soil moisture only measured to 83% if groundwater levels are at or exceed surface level? Please check it. – **The 83% comes from gravimetric soil moisture determinations and corresponds to saturated conditions for our peat type.**

519-524: please add trend lines and r^2 values to the relationships. - **We feel adding linear trend lines would be misleading, because the actual analyses performed on this data are nonlinear and combine the three predictor values. The purpose of this figure was to show the scale and general patterns of variation of our observations.**

Discussion

705-707: This is important as it implies the importance of peat depth for CO2 emissions – **We will emphasize this more strongly in the Discussion (in the section on management implications).**

729-740: Here I miss a discussion on the exposed carbon assumption. As stated in L735-736: “the DB sites in this study were in close proximity to each other” and 513-516: “ There was also considerable variation in the relative distribution and thickness of the different soil layer types in particular DB 13 was rich in clay, which could suggest a previous riverine history, and DB 7 had quite a large, disturbed gravel layer in the top 1 m.”. This may indicate that the transect soil layer may vary to some extent. “

- **The implications of our exposed carbon assumption will be added in a new section in the discussion, see the response to the comment above.**