

RESPONSE TO REVIEWERS

We have made changes as per Reviewers' comments and have reorganized and simplified the results section. We have created two supplementary tables which incorporate the Reviewers' requests for more information and for a simplified way of representing the data.

REVIEWER 1 COMMENTS

Introduction

-lines 47-50 please give an explanation what do you mean under the peat quality? Some economic value or quality for microorganisms or something else?

RESPONSE: we have reworded as "Carbon dioxide production rates indicate the biogeochemical quality (e.g. nutrients, humification etc.) because..."

Section 1.2- for giving the audience the hunch of the significance of the topic, please also bring out the area of peat production sites (e.g. globally) or percent of peat production sites from global peatland area.

RESPONSE: we have added global numbers for greater context.

-lines 81-83- GHGs on active milled peatlands was also measured by Salm et al. (2012) (some of the sites in his study), please also consider his work in the introduction and also in the discussion.

RESPONSE: added as per reviewer

Methods

Section 2.1: I would prefer to have more background data about the sectors of the site, like peat layer thickness, and some general parameters such as pH, peat decomposition

Section 2.1: Also I would like to have the information if the similar peat production works were done on all sectors in similar amount. Also, if similar amount of peat per hectare (or production field) was removed in all sections. In peat production, they tend to remove different amounts depending on the peat decomposition (e.g. white, brown or black peat)

RESPONSE: Added the information as per above; in site description and in Table S1.

Section 2.2: how often the chamber measurements were made? Maybe you could also give the number of measurements per sector.

RESPONSE: some further info added in section

Line 150-151: was peat temperature profile measured during each flux measurement campaign?

RESPONSE: yes it was. Line in text modified "For each measurement, peat temperature was taken..."

Results

I would like to have the short analysis of all measured variables (peat temperatures at different depth, peat volumetric water content), e.g. average values with standard deviations or some table, per sections. The the rest of the results sectors can be easier to discuss;

In different parts 3.1.2, 3.2.2, 3.4.1 sentences with long lists of numerical results are given (marked in yellow in uploaded pdf), although the results are also presented in

easier to understand figure. I would prefer the numerical results as a table (maybe in annexes), to make understanding these values easier.

RESPONSE: agree that the text can get a bit cumbersome. We have condensed these into Table S2.

Discussion

Lines 360-364: discuss also the results of Salm et al. 2012

RESPONSE: added sentence to discussion reporting the mined results in Estonia.

Lines 378-379: it is said that there is almost no influence of surface temperatures on measured CO₂ flux, but you also measured temperatures in deeper peat layers, what about those?

RESPONSE: there was no correlation with deeper soil temps but no attempt at correlating with time-lag temperature was made

REVIEWER 1 COMMENTS IN THE M/S (supplement)

GENERAL RESPONSE: All issues related to citations (missing or not in reference section) have been addressed. All minor editorial suggestions and changes have been accepted.

2.1 The site coordinates were indeed incorrect and these have been corrected.

Around Line 380, the citation to be added is a Pers. Comm. with an industry scientist.

REVIEWER 2 COMMENTS:

L1 "Year of extraction...?"

RESPONSE: Changed to "Duration of extraction..."

L14 "...a peatlands control of CO₂/CH₄" strikes me as odd phraseology. Consider rephrasing.

RESPONSE: changed to "...alters the controls on CO₂ ..."

L18 "Higher" is used throughout the manuscript to describe some of the results. This can be confusing when the study also involves a vertical aspect, e.g. tree height, peat depth. Consider using "greater".

RESPONSE: changed as suggested throughout

L36 Soil C stores.

RESPONSE: changed

L40 Carbon dioxide is released.

RESPONSE: changed

L50 "Decomposition rates are greatest..."

RESPONSE: changed

L63 Vacuum harvesters are not used everywhere peat is extracted – perhaps state “in Canada”?

RESPONSE: changed

L64 also, peat structure/porosity after years of drainage?

RESPONSE: Not sure what reviewer is referring to.

L67-68 Abdalla et al, 2016 is a review paper – they do not directly measure CH₄ or the oxic layer of the peat.

RESPONSE: removed this citation

L73 Add “...in North-American undisturbed peatlands” as you do not cite studies from other geographical areas.

RESPONSE: sentence was unclear. We are referring to ditches and not geographical area. Reworded as “...labile C normally found in the ditches...”

L74-75 Too many references cited here, especially as you use e.g.

RESPONSE: these references are representative of relevant previous work

L76-77 If I were new to peatland research, I would get the distinct impression from reading this introduction that C studies have only been carried out in Canada. Would suggest that you either explicitly state “in Canada” or add references from other parts of the world to support the generalized statements here.

RESPONSE: Not all are reporting research in Canada, Updegraff et al. conducted their research in Minnesota, USA. Added two European studies removed others.

L88 There is no real sense of the composition of the study site. Please add peat depths, bulk density, nutrient composition, C content etc. presence of vegetation in the ditches.

RESPONSE: similar to Reviewer 1. We have this info from student theses have included in Table S1.

L100-101 Please state the reason(s) for these times? How often were the sites measured within these dates?

RESPONSE: harvesting starting dates are determined by spring snow thaw – when the fields are dry enough such that harvesting equipment can get on the fields; Measurements were taken to attempt to cover the summer and shoulder seasons but we had COVID restrictions on travel that restricted our coverage towards the later end of the study.

L110 Extraction not production

RESPONSE: change made

L116 Previous measurements by others or preliminary measurements in this study? If the former, please state by whom.

RESPONSE: added ‘our’ “...because our previous measurements...”

L124 Change to “As the first C flux measurements began....”

RESPONSE: change made

Fig. 2 I’m struggling to understand this figure. What does the horizontal dashed line represent? A caption should be stand-alone information, so please provide some of the information from L111-114 here.

RESPONSE: Sentence added to figure caption "The field contouring results in about 50 cm difference in surface peat elevation between the centre of the field and the edge of the field.

L131 Collars have not been measured before now. Please add details of size.

RESPONSE: in the next line the size of the chambers is given. The chambers fit into the collars as is standard in this technique. No change made.

L131 prior to measurement? Please state the length of time until the first measurement. Do you think that collar insertion may have influenced subsequent flux values?

RESPONSE: In this actively harvested site, we did not have the ability to keep collars in the fields as they would have been destroyed by machinery during harvest operations. Collars were inserted and measurements were taken within minutes. This would be a potential issue in a saturated environment especially for methane. However, the surface layer is dry such that harvesting can be done. We don't believe that this had any adverse affect on the results.

L138 Was the chamber equipped with an internal thermometer? In the absence of a cooling system, temperature increases well beyond the ambient air temperature must be a feature, even with opaque chambers. How did you minimise/account for chamber heating?

L158-159 Air temperatures from within the chamber?

RESPONSE: We use cooling systems when working in vegetated systems to avoid any chance of a temperature increase inhibiting stomatal response. All of our chambers have fans to stir the air; while this does not cool the air, it does prevent gradients building from the surface. Recall that this is an actively harvested site with machinery on the fields. The practicality of moving over the peat to efficiently measure from a variety of locations for the times that we had access dictated a more compact system. Yes, the Ta is inside the chamber. We surmise that any increase in temperature would cause an overestimation of the CO2 emissions thus making our numbers a conservative estimate.

L162 Why such a high rejection rate in 2018?

RESPONSE: Our protocol is designed to be conservative in rejecting data and likely removes more than is required. But remaining data is robust. Note 2018 was a preliminary campaign and short in duration so no adverse affect on larger data set. Likely this is due to the fact that the PP systems required manually taking the reading from the screen at fixed intervals while the LosGatos and Li-Cor units saved concentrations at higher frequency.

L171-175 Delete "spanning...site".

RESPONSE: we feel that this would change the intent of the passage. It is intended to indicate that the fields chosen represent the widest possible range of the continuously extracted fields at this location. From less than 3 years to greater than 30 years.

Fig. 3 Do we assume from the diagram that peat depth at the site is around 85-90cm?

RESPONSE: no. This is the ditch surface. The peat depth is much greater. This will be clear when peat descriptive information is added earlier in the paper as per R1 and R2 requests.

L204 Why were two GCs used?

RESPONSE: simple logistics. Very busy lab.

L270 I don't think you state the number of flux measurements used. Rejection rates

(L162) seem very high so perhaps the number of fluxes left for modelling and discerning a

relationship with soil temperature was too small?

L380 I don't think you state the number of flux measurements used. Rejection rates (L162) seem very high so perhaps the number of fluxes left for modelling and discerning a relationship with soil temperature was too small?

RESPONSE: Number of samples is given in the F stat as per standard reporting notation where the second number is N-1. For example, $F_{8,942}$ means that there were 943 observations.

L316-317 And yet they appear in Fig. 8?

RESPONSE: modified. "The 50 and 80 cm samples...in the profile, however they were included in the C^{14} dating."

Fig. 8 What does the horizontal dashed line represent?

RESPONSE: sentence added to caption. "The horizontal line is drawn to show that these elevations are approximately equal"

L323-337 It is very hard to read the data in this section – would it be possible to condense the numbers and direct the reader to the relevant figure/table?

RESPONSE: similar to R1 comments. We have created Table S2.

L386 subscript 2 in CO_2 .

RESPONSE: changed.

L456 Not surprising if your dataset is too small or you haven't covered all possible temporal variation.

RESPONSE: methane is complicated by production and oxidation. Tight relationships occur in wet, saturated sites which is not our case. Sentence was removed.

L469 Please add details of absence/presence of vegetation in drain ditches in Methods section.

RESPONSE: added.

L476-477 ...and at other times of the year, especially outside the active extraction period.

RESPONSE: Sentence was deleted. Please note that the ditches are frozen 5-6 months of the year in this location.

L481-482 Is this relevant for how emission factors are derived for this land use category?

RESPONSE: sentence changed for clarity. "The newly opened sectors are a greater source of CO_2 to the atmosphere for the first few years but then the emissions become independent of the duration of harvesting. This suggests that two different emission factors, one for newly opened and then for older sectors may be appropriate."