

Anonymous Referee #1

We thank the reviewer for their constructive comments on our manuscript. Here we provide our initial responses to these comments and will provide a modified manuscript after the discussion is closed.

Title: Wildfire switches the typical understanding of boreal peatland methane emissions.

Authors of the manuscript have studied the topic of utmost importance in the field of environmental research and the topic of their research is within the scope of current journal. In the World with warming climate and accompanying increased fire activity in boreal forest and peatland areas, more attention should be paid to the topic. Methane emissions of boreal fen are so far poorly studied and current manuscript has significant results to fill this gap. The text of the manuscript is fluent and easy to follow. The scientific quality of the research is excellent: experiment planning, data collection and data analysis support that received results have scientific value. I find that the manuscript can be considered for publication after minor revision.

We thank the reviewer for their positive comments about our study.

My specific comments on the manuscript are following:

Specific comments.

Abstract:

Page 1, line 15: Could you be more specific: were the emissions in the MB and SB significantly lower when compared to UB.

We have changed the text; Pg 1, new line 15-16

“For example, emissions were significantly lower in the MB and SB hollows in both years compared to UB hollows”

Introduction

Page 2, line 2: A bracket is missing.

The open bracket is found on Pg 2, new line 1 : “(fire can release between 10-85 kg C m⁻² through combustion and smouldering; Turetsky et al., 2011),”

Page 2, lines 5-13: Could you add also some information about the fire induced deposition of charcoal and ashes, and their effect to the soil pH and physical characteristics.

We have included reference to the impact of ash deposition on soil pH and physical characteristics on Pg 2 lines 12-15. Furthermore, we have moved the paragraphs around for clarity.

Page 2, line 22: You mention the hydrophobicity of the peat as the reason for low surface moisture content. What about deposited ashes?

We have now included reference to the impact of increased ash deposition after fire on soil moisture on Pg 2, new lines 19-20.

“(Doerr et al., 2000). Low soil moisture rates can also occur under increased ash deposition after fire, with increased closure of soil pores by ash causing reduced capacity to hold water and increased runoff (Heydari et al., 2017).”

Methods

Page 3, line 12-14: Please provide Latin names of plants and mosses with proper affiliations. This comment goes for all Latin names mentioned in the text.

We have included the latin names and proper affiliations of the plant species on Pg 3, new lines 16-20;

“This treed fen is dominated by *Larix laricina* (Du Roi) K.Koch, *Picea mariana* (Mill.) Britton, *Betula pumila* (L.), *Equisetum fluviatile* (L.), *Smilacina trifolia* (L.) Sloboda, *Carex* spp. and *Sphagnum fuscum* (Schimp.) Klinggr and brown mosses, largely *Tomenthypnum nitens* (Hedwig) Loeske.”

Page 3, line 15-19: Can you assure that the initial conditions of peatland margin and interior part were comparable by means of vegetation cover and water table conditions?

Although we understand that there are slight differences in environmental conditions between the peatland margins and centre, we do believe that we can successfully compare the two. Furthermore, we now include reference to a comparison study we undertook between methane emissions collected between 2011 and 2014 that was representative of what burned in 2016.

See new Pg 4 new lines 23-25: “In order to determine whether emissions measured from the UB site were representative of emissions from Poplar Fen as a whole, we also compared our fluxes to a previous study of CH₄ emissions collected between 2011 and 2014 at the fen.”.

Page 3, line 29-31: What about the vegetation succession? How much did the vegetation cover change between 2017 and 2018? Could this be the reason for changed CH₄ fluxes?

Although we agree there is the possibility of vegetation succession between 2017 and 2018, we don't think the amount of vegetation cover changed significantly between both years. We do however note the small presence of graminoid cover in the MB and SB hollows compared to zero percent cover in the UB hollows. This is referenced in on Pg 7 new lines 13-15 where we indicate an increase in CH₄ emissions could be attributed to plant mediated transport.

Page 4, line 5-7: Why did you start with the gas collections 7 minutes after chamber was placed?

This method also allows for multiple chambers to be measured at once, therefore increasing our sample size for statistical analyses and has been standard protocol within our research group for many years and has been used in many publications, see:

- **Strack et al. 2017, Effect of plant functional type on methane dynamics in a restored minerotrophic peatland, Plant Soil, 410: 231-246.**
- **Murray et al. 2017, Methane emissions dynamics from a constructed fen and reference sites in the Athabasca Oil Sands Region, Alberta, Science of the Total Environment, 583: 369-381.**
- **Strack et al. 2018, Impact of winter roads on boreal peatland carbon exchange, Global Change Biology, DOI; 10.1111/gcb/1.3844.**

Page 5, line 7: You have used the soil temperatures measured at 30 cm depth, although measurements were done from 2-30 cm depth. Is there any scientific explanation for that?

We used 30 cm depth in the analysis as we found it an appropriate depth given the depth of burn.

Results:

Page 6, line 4-6: Please move this sentence to the Material part. This is partly explaining my question about the conditions in peatlands interior and margin areas.

This has been moved to Pg 4 new lines 23-25.

Discussion:

Page 7, line 2: "lend itself to" sound like informal language to me, but as I am not a native speaker, I might be also mistaken.

We have changed the wording, see Pg 7 new line 26.

"The presence of graminoids in the SB hollows post-fire was also found, which could also lead to increasing CH₄ emissions in the future, as plant-mediated transport of CH₄ is well documented across peatland ecosystems (Bellisario et al., 2016)."

Page 7, line 19: I would also add the time factor to the sentence. I think "whether" the CH₄ emissions will return to similar levels is rather sure. It is much more interesting how long it takes...

We have re-worded this sentence to make reference to how long it will take for methane emissions to recover to a similar level as the unburned site rather than IF they will recover.

Figure 2: Graphics of current figure do not able to understand the microform type for most of burn severity classes.

We have amended the figure;

