

## ***Interactive comment on “Wildfire switches the typical understanding of boreal peatland methane emissions” by Scott J. Davidson et al.***

**Anonymous Referee #2**

Received and published: 29 May 2019

Davidson and colleagues present a study in which variability in methane emissions have been quantified for different burn severity classes and microtopographic positions in a boreal fen in Canada. The research begins to answer important questions regarding interactions between fire disturbance and methane cycling in the context of boreal carbon cycle feedbacks to climate. The authors find that fire generally reduces methane emissions and, for at least several years following fire, eliminates relationships between water table depth and methane emissions. The paper is based on a relatively small but important data set that is appropriately analyzed. The paper will be suitable for publication after a few relatively minor revisions. I have several overarching comments followed by more specific ones.

This manuscript is rather short, which isn't a bad thing, however I do think there is room

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to expand and add some additional details, especially in the discussion. For example, permafrost is invoked as a potentially important driver in the Introduction, but then is not mentioned in the discussion. The main point regarding the wildfire overriding hydrological controls on CH<sub>4</sub> emissions comes through. But the secondary point that these effects are understudied and may vary with ecosystem type could be developed more.

I would encourage the authors to archive their data and code in open access repositories, ideally where they would be citable with a doi.

It is a little confusing to have CH<sub>4</sub> flux numbers reported normally in the text of the results, and then log-transformed in the figures. It would be best to back-transform for the figures if possible.

P1 L1: Different disciplines may understand peatland methane emissions in different ways. Why not use “Wildfire overrides hydrological controls on boreal peatland methane emissions” or something similarly specific?

P1 L8: Are you referring specifically to a negative carbon cycle feedback to climate, or any negative feedback (e.g. surface energy partitioning)

P1 L19: This sentence seems a little odd since you have not yet mentioned any argument regarding the overriding influence of fire. Maybe reword, or set it up better.

P2 L13: It would be nice to have the briefest of descriptions of hummocks and hollows, I think I know what they are. Also what is the mechanism by which fire alters elevation, causing hummocks. Lastly, it would be interesting to know how prevalent hummocks vs. hollows are on the landscape – are there any papers out there with numbers you could cite (e.g. hummocks make up XX% and hollows XX% of typical fen's in this region).

P2 L17: Can you say specifically which moss species is found at each microform type?

P2 L31: Is your site underlain by permafrost? I don't think it's reported in the methods.

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That could be useful to know.

P3 L1: A single site in both Canada and Russia?

P3 L18: Please give a one or two sentence description of the DOB protocol. The reader should only be obligated to look at other refs if they want all of the juicy details.

P30 L30: Is it possible that these cover variables could have changed of the course of your study? Particularly moss colonization, but also water, which I imagine could change with the weather conditions. Also, could you briefly describe your percent cover approach; since some sites have more than 100% I assume you are looking at over story and ground cover?

P4 L12: Please include justification or reasoning for the -5 mg Ch4/m2/d threshold.

P6 L25: Do both of these studies indicate both of these things, or is each point from one of the studies?

P7 L1: What do you mean by an addition here?

P7 L4: Please expand the discussion of fire effects on water table depth. A more in-depth process level discussion would be nice here, perhaps also with some specifics on the variability within this fen that you allude to.

P7 L13: The resistance of *S fuscum* to what?

P7 L14: Chemical changes in the soil substrate? Can you be a little more specific here?

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Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2019-139>, 2019.