Biogeosciences Discussions

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Comment on bg-2021-216

Anonymous Referee #2

Referee comment on "Excess soil moisture and fresh carbon input are prerequisites for methane production in podzolic soil" by Mika Korkiakoski et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-216-RC2, 2022

Korkeakoski et al. investigated the dynamics of methane production and oxidation at a field manipulation experiment subjected to an irrigation treatment. However, the field manipulation experiment occurred against the background of a strong drought, so the results were perhaps not as clear as they had originally hoped. To investigate the processes contributing to methane flux, the authors also undertook two separate laboratory experiments: soil incubations to quantify rates of methane production and oxidation and mesocosm experiments with a glucose addition to simulate the effects of plant root exudates on methane production and oxidation.

Overall, I found this to be a very nice, convincing manuscript. It was nicely written, relatively easy to follow, and the interpretation of the results was on-point. My greatest concern was with two of the statistical analyses: the pearsons correlation and the mixed effects model for environmental drivers. With the statistics, you want to be testing something that is biologically meaningful; how biologically meaningful is a correlation between oxidation and copper concentrations? I think this analysis should be constrained to predictors that are biologically meaningful. Similarly, the mixed effects model seemed to not capture the most important drivers of methane oxidation rates: the diffusion limitiation of methane into the soil. This is discussed directly later, so I am not so concerned about this.

One note on the presentation. I struggled a bit with the figures because many of them were quite busy and didn’t transfer well to black and white (I always print things to review them). Looking at them again online, even having them in color doesn’t help so much. Color palettes from R-color brewer might help? Beyond my complaints about the figures, I really only have minor comments and a few technical corrections as outlined below and really enjoyed reading the manuscript.

Specific comments.

p.2 line 19: Technically the boreal samples in Blazewicz were from a rich fen.

- 4 lines 20-25: change to "per week". I didn't fine these numbers so helpful, the ones on lines 29-30 seemed much more relevant. Rain input in mm is much easier to interpret, I think this would be better to present when discussing the treatment and the specific liters could be given in parentheses. Also nice would be the total amount of water added.

p.5 Could add that 2017 was monitored as a baseline prior to beginning experimental treatments to check for initial differences between the plots.

- 8 line 1. I was confused about what microbial C has to do with any of this, why this as a reference amount? Maybe just specify the amount of glucose added?

Results

Section 3.1: What I missed here was directly addressing if there were pre-treatment differences in the environmental conditions between the experimental plots. Figure 6 seems to indicate that this is unlikely as the behavior is similar, but would be nice to address directly (if possible).

- 14 line 15: I found this really confusing: position on the plot is higher, uptake rate is smaller, is flux higher?

Figure 3. Hard to tell the lines apart and figure out what the figure is showing.

Figure 4. could improve with adding indication of precipitation. There are a lot of lines, again a bit visually challenging.

Figure 5. The combination of flux and soil temperature here is really difficult to see anything and even to distinguish between the lines. This one is important but it doesn't work.

Figure 6. panels a and b could easily have same axis, so why don't they? Also helpful would be an indication in panel a that there was the pre- and post-treatment period, and an indication of net uptake or net realease.

Figure 7: panel a: where are the boxes for O treatments? panel c: is that a point way over on the right side nearly under the figure legend? It should really be a bit better shown on the plot. I would also suggest using gray and open boxes for this figure to improve readability.

Figure 9. Note different y-axis scales again, CH4 flux seems to be missing part of the unit. Colors difficult to distinguish. Again, this indication of net emission or net uptake could be helpful.

Discussion: really nice.

- 21 lines 20-25 could use a figure reference plus it could help to tie some of this to the newer soil literature that discusses the spatial distributions of microbes and substrate as a key control on soil processes (partly summarized in the Schmidt et al. 2011 Science paper).
- 21 28-32: this was the only part that I didn't think was so well supported, both the part about the distribution of organisms (what if it's active vs. dormant?) and I don't see from Figure 8 a strong correlation between flux and soil moisture.
- 22 line 20: don't forget about the other fermenters! E.g. Tveit et al. 2013
- 23 line 11: „with one exception"; line 13: "while" should be "and"

Data is available and accessible via the provided DOI.