

Biogeosciences Discuss., referee comment RC3  
<https://doi.org/10.5194/bg-2022-122-RC3>, 2022  
© Author(s) 2022. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## Comment on bg-2022-122

Anonymous Referee #3

---

Referee comment on "Relationships between greenhouse gas production and landscape position during short-term permafrost thaw under anaerobic conditions in the Lena Delta" by Mélissa Laurent et al., Biogeosciences Discuss.,  
<https://doi.org/10.5194/bg-2022-122-RC3>, 2022

---

This manuscript presents data from a short-term anaerobic incubation study. The authors present results from six individual samples from three different locations. The goal of the study is to understand the potential effects of temperature, "landscape position", and the addition of glucose to CH<sub>4</sub> and CO<sub>2</sub> production from the soil samples. The premise of the study is interesting and timely.

However, the incubation time of the experiment appears to have been too short, as the methanogens were still in lag-phase. Based on the information presented in the study, I found the links between their results and conclusions unconvincing. I think this could be improved by adding more details and specificity to the methods section, in particular. More details about the "landscape position" of the sample site would be helpful (i.e. slope, aspect, vegetation cover, etc). I think it would be helpful to consider the scope of the experiment when formulating conclusions. Six samples (from three locations) were incubated for ~70 days. While interesting, there are not enough data points presented in this study to draw meaningful conclusions for permafrost landscapes as a whole.

I strongly suggest that the authors simplify the sentence structure throughout the article. I think that the article can be substantially shortened by removing redundancy and superfluous information/sentences. Most instances of conjunctive adverbs (however, finally, on the other hand, likewise, etc.) should be removed. Also consider the difference between GHG "emissions" and "production" and change your wording accordingly.

**Line 10:** "release more greenhouse gases". More compared to what? I suggest you remove "more" or be more specific.

**Line 11:** "to address the large heterogeneities of GHG releases". Spatial heterogeneities?

Temporal heterogeneities? I suggest you be more specific here.

**Line 11:** I suggest you reformulate this sentence. Your study is not really addressing "large heterogeneities of GHG releases". You are trying to understand what the relationship might be between GHG emissions and soil parameters and what factors might be causing large 'spatial' heterogeneities in GHG emissions from permafrost landscapes.

**Line 13:** Two depths? Do you mean sediment from two depths from three Lena Delta cores? I suggest you be more specific/clarify.

**Line 15:** "Samples from located in upland or slope positions". Typos here.

**Line 16:** Same typo as above "from located in"

**Line 18-19:** I suggest you rewrite/simplify this sentence and make it easier to read.

**Line 20:** In addition, our study **identified** different CO<sub>2</sub> production...

**Line 23:** Suggestion: Climate change is causing increasing temperatures and permafrost thaw, which might lead to increases in the release of greenhouse gases CO<sub>2</sub> and CH<sub>4</sub>.

**Line 36:** "Due to the low temperatures, the organic matter..."

**Line 36:** The statement that all permafrost soils act as a C sink is misleading. Check out: Elder et al. 2021 <https://doi.org/10.1029/2020GB006922>; Anthony et al., 2021 <https://iopscience.iop.org/article/10.1088/1748-9326/abc848/meta>; etc.

**Line 40:** Consider using an oxford comma throughout the article. It is the standard and will really improve the clarity of your sentences.

**Line 47:** The paragraph beginning on line 47 is two sentences long. Consider merging it with the preceding paragraph.

**Line 53:** Consider rewriting this sentence to reduce the number of commas and clauses. Currently, it is difficult to read.

**Line 57:** Consider eliminating both instances of “able to produce”. It is not necessary (i.e., not all soils produced the same quantity of CH<sub>4</sub>...)

**Line 59:** Suggestion: “Even though several factors controlling C decomposition have been ...”. I would consider rewriting this sentence to make it more neutral.

**Line 61:** What do you mean by “a single temperature”. As opposed to temperature profile with depth? Can you be more specific?

**Line 62-63:** Suggestion: “Therefore, the relationships between different temperatures, landscape positions, and C production under anoxic conditions are not well understood.”

**Line 62:** Consider defining “landscape position”. It is not clear to me what you mean by this term. Can you be more specific? Same for “different temperatures”. Do you mean the natural spatial heterogeneity of ground temperature in permafrost landscapes (i.e., cooler temps under forest cover, temperature profiles with depth, etc.)?

**Line 64:** consider replacing “form” with “type” and “amount” with “quantity”

**Line 64:** released

**Line 72:** Consider adding Hughes-Allen et al., 2021 to the list of references as it discusses specifically differences in GHG emissions from different types of thermokarst lakes.  
<https://doi.org/10.1002/lno.11665>

**Line 77:** I think you are overstating the lack of studies/info here. A quick google search turned up many studies from the last three years describing both experimental studies and *in-situ* analyses.

**Line 84:** Typo. "King"

**Line 84:** Consider finding a different term for "C control". It's not clear what you mean here.

**Line 85:** Typo. Citation doubled "Koch, Knoblauch, et Wagner 2009".

**Line 86:** You start discussing methods here without yet discussing the objectives of your study. Consider reordering these sentences/paragraphs.

**Line 88:** You mention landscape positions often, but again, you never define this variable. Please consider defining/being more specific.

**Line 89:** Define "short term". Days, weeks, months?

**Line 93:** microbes  microbial community composition? Quantity of microbes? Please be more specific.

**Line 107:** I suggest you make "The soil sampling was carried out..." the beginning of a new paragraph.

**Line 107:** I strongly suggest that you break up this sentence into two shorter sentences. End the first sentence where the colon is.

**Line 109:** You can remove "after excavating the active layer"

**Line 112:** Does "with a well-drained upland soil profile" apply to the topography of all three sites? The sentence should be restructured so that it ends with "respectively".

**Line 110-113:** You mention twice that the cores were chosen based on their location within the local topography. I think you can reorder/rework these sentences to make it flow better.

**Line 115:** replace "another" with "one"

**Figure 1:** I suggest that you add Figure sublabels (i.e., a, b) so that you can reference them in the figure caption.

**Line 127:** "Electrical conductivity and pH were measured from pore water for better comparison between samples." Better comparison compared to what? A different type of method? This sentence isn't super clear to me.

**Line 128:** I think this equation would be more readable if it was presented in normal equation form (i.e., inline equation)

**Line 131:** how many samples is one series?

**Line 132:** Can you describe the relationship?

**Line 135:** I suggest that you use "organic material" rather than "organics".

**Line 136:** I suggest that you remove "In the end".

**Line 142:** I suggest that you keep the passive voice here that you are using throughout the methods. For example, "Sterilized tap water was added to samples with a moisture content of less than 30% to limit the effect of gas dissolution (Henry's Law).

**Line 152:** I suggest you say, "The effects of glucose are usually observed within less than 48h".

**Line 153:** How are you measuring the gas? And do you mean one week as in 7 days or one working week as in days.

**Line 156:** Ok now I see the gas section. Maybe just add that it is describe in the following section.

**Line 162:** I suggest that you eliminate "Finally"

**Line 172:** I suggest that you keep the tone neutral here. Eliminate "We decided". Just explain what you did.

**Line 170-175:** I think this paragraph can be cleaned up to be more specific and easier to understand.

**Line 202:** check spelling Kuskal-Wallis

**Line 207:** I suggest "All soil samples, except P15-F, had a pH between 6.5-7.5."

**Line 211:** Do you mean TOC **weight percent**?

**Line 242:** ...CH<sub>4</sub> production at **either** 4°C **or** 20 °C

**Line 242:** CH production rates were **consistently** below...

**Line 249:** I don't think you mean emissions here, rather production

**Line 255:** Very long sentence. I strongly suggest that you rewrite it to focus on succinctness and clarity.

**Results section:** Limit the results section to the actual results. Currently, you are mixing in some discussion elements. These should really be saved for the discussion section.

**Line 296:** Error in figure cross reference

**Line 325:** I suggest you write 1-2 overview discussion sentences rather than restating the results section.

**Line 325-330:** This section is really heavy on words like “nevertheless, likewise, however, etc.” These should be used more sparingly for easier reading. I also believe that you can reduce this paragraph to two sentences.

**Line 330-339:** Very nice paragraph and interesting. Can you expand more here, especially the relationship between C and N and anaerobic CO<sub>2</sub> production?

**Line 340:** Can you clarify the sentence?

**Line 351:** what is lysis?

**Line 352:** A concluding sentence would be nice/helpful to wrap up the ideas you present in the preceding section.

**Line 363:** I think it would be helpful to define lag time much earlier in the paper.

**Line 373:** I don't think it's appropriate to make this leap from your study to this general statement that glucose availability is not a driving factor for CH<sub>4</sub> production in mineral soils.

**Line 380-382:** Interesting ideas. Can you expand more here, especially on topographic position? I am not seeing the link between topographic position and the results/factors influencing CH<sub>4</sub> CO<sub>2</sub> production that you discuss in this section.

**Line 385:** There are many newer available articles which discuss this subject. Check out

Roy Chowdhury, Taniya & Berns, Erin & Moon, Ji-Won & Gu, Baohua & Liang, Liyuan & Wulschleger, Stan & Graham, David. (2021). Temporal, Spatial, and Temperature Controls on Organic Carbon Mineralization and Methanogenesis in Arctic High-Centered Polygon Soils. *Frontiers in Microbiology*. 11. 10.3389/fmicb.2020.616518.

**Line 400-405:** Rather than summarizing the Herbst study so specifically, can you give a more general summary and explain how their result relate to yours and why they might differ?

**Line 406:** I suggest “confirm” rather than “are in line with”

**Line 410-415:** I think this paragraph can be streamlined and made more concise. Please be specific about how the results/conclusions of the studies you discuss are related to your results.