

Biogeosciences Discuss., referee comment RC1
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Comment on bg-2021-353

Anonymous Referee #1

Referee comment on "Genetic functional potential displays minor importance in explaining spatial variability of methane fluxes within a *Eriophorum vaginatum* dominated Swedish peatland" by Joel Dawson White et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-353-RC1>, 2022

General comments:

White et al. collected soil samples and brought them to the laboratory for an observational mesocosm study under controlled conditions. They measured a suite of ecosystem processes including net ecosystem exchange, respiration, CH₄ flux, and stable isotope analysis. They performed captured metagenomics to examine the microbial community membership and gene content, including organisms directly implicated in CH₄-cycling processes. The paper does not in its current form seem to be driven by any particular hypothesis, but rather is focused on examining fluxes and microbial communities under laboratory conditions that approximate field conditions.

It seems that much of the focus of the paper relies on distinguishing the samples into 3 categories (HFM, MFM, and LFM), with the first and last category only coming from single samples (with 3 technical replicates each). In my opinion this makes the paper more about how two outliers differ from the rest of the samples than about the relationship between fluxes and communities in general. If distinguishing samples among three tiers is how you want to proceed, why not rank all samples by their fluxes and then divide them evenly into these three categories? In its current form this categorization seems to make your statistics very unbalanced.

In terms of the level of inference the authors make, there are several instances that I found problematic. For instance, the authors claim that HFM has higher B diversity than the rest, yet this relationship was not significant, and was also based on a mis-balanced design. The authors also state several times that just because they see several types of methanogens/methanotrophs that these communities ought to continue functioning under future climate scenarios. Without performing an experimental test of this hypothesis these types of speculation should not be in the paper, and especially not a main takeaway (e.g. in the conclusions).

Specific comments:

Line 45: add 'the': is the second most. Also important seems like it needs a qualifier: important for climate?

70-75: nice summary of controls.

86-88: "The targeting of...", this sentence may not be necessary for the scope of your paper. Just a suggestion.

105-108: Just as a comment, this reads a bit like an advertisement.

139-140: Do you mean to say that placement of the mesocosms was varied bi-weekly? "Rotating" could be interpreted as simply turning them.

147: Perhaps change section header to "Flux measurements of mesocosms" for clarity.

171: I assume you mean 'stored at -20C', not '20C'. Please clarify.

260: It becomes difficult to follow the text when there are so many abbreviations. Perhaps consider not abbreviating.

259-263: in a similar vein, there are a lot of abbreviations in this section that haven't been defined yet in the results section. Consider naming them here (or using the full words) for clarity.

302-303: you don't have to italicize the word phylum.

303-304: how do you know that this is due to environmental conditions? This sounds presumptuous without an explanation.

315: bacteria can be lower case and not italicized here.

321-329: I do not like that you can comparing Beta diversity among groups that have very uneven sample numbers. Remind the readers in this section how many samples are in each group.

327-329: is this the Beta diversity of the whole community or just a subset of methanogens and methanotrophs? This sentence would lead me to believe it is the latter and if that is the case this sound be clarified in the section header as well as the text.

Fig 4: show points on the same boxplot graph so readers can understand visually that you are not comparing equal sample numbers.

340: It is not clear in the text why you are doing this analysis three times and reporting three tables. Perhaps you could choose the one most important to your narrative and put the other two in the supplementary? The three tables have identical table legends so it really is not obvious what is distinguishing them and what the reader should take away.

Same comment for Tables 4, 5, and 6.

433-436: We do not know anything about the environmental tolerances of these organisms. I think it is too speculative to make any inferences about the future prospects of these processes under climate change scenarios based on the sole observation that there are members of these different groups present.

489: "with little to no delay in transition period" – what are you basing this statement on?

569-570, 574-575: but these differences were not statistically significant. This should not be in your conclusions.

581-584: If your study experimentally manipulated the environment of these mesocosms to examine future climate scenarios then you might have the data to back up this sentence. I think that just because you are seeing representatives of these different groups does not tell us anything about the future prospects of these microbes or the processes they perform.