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Biogeosciences Discussions

Interactive comment on "The ratio of methanogens to methanotrophs and water-level dynamics drive methane exchange velocity in a temperate kettle-hole peat bog" *by* Camilo Rey-Sanchez et al.

Anonymous Referee #2

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The study reports methane (CH4) fluxes over two growing seasons (2017 & 2018) from a kettle-hole peat bog and captures spatial (vegetation zone) and temporal (monthly) variability with its sampling design, as well as the fluxes associated with plant stems and leaves. The authors also report dissolved CH4 profiles and soil biogeochemical and microbial community characteristics.

The manuscript is well-written, clearly presented, and provides a thorough methods description, though at times the phrasing could be briefer. The flux data are valuable given that the system represents a warm end-member for temperate bogs and the

slight CH4 sink for some of the plant stem observations is interesting. The attempt to link biogeochemical process (CH4 flux) to microbial community data is also a strength of the study, especially the breakdown of lineages of methanotrophs and methanogens by genus, however the limitations should be more carefully discussed, for example that DNA is not indicative of activity.

The weakness of the study is that the temporal coverage and frequency of flux observations is relatively scarce despite the well-known high variability associated with methane flux. The latter means both that drivers such as temperature are found not to be important drivers of CH4 – because the seasonal temperature gradients may not have been captured – and that generally many environmental variables show weak/no relationship to methane. While the authors are correct to point out that a wide variety of factors influence fluxes, statistical power may have been low enough to limit the outcome of those analyses. Furthermore, what is measured is net flux, and concurrent production, oxidation and transport processes regulate methane flux, making interpretation more difficult.

Major Comments Figure 8. I am concerned about this plot. The relationship appears to be driven by the low CH4 exchange velocities for TMW-S (dark blue dots) however, looking at Appendix Fig B1, TMW-N has very high and variable exchange velocities which, if they were plotted, might undermine the reported relationship. If you remove the outliers from TMW-N and maintain TMW-N, do you then retain the relationship? How would this affect the results?

The conclusions are currently just a summary of the results that have already been reported. I think here there should be a greater attempt to zoom back out and generalize from the results or return to the global change context of the work.

Minor Comments Do you have concurrent CO2 observations? It appears you don't, but if you did, evaluating the CH4:CO2 ratio can provide insight into whether CH4 emissions are being limited by overall carbon flow (i.e., low CO2 respiration overall) or

competing respiration processes (i.e., low CH4 in spite of high CO2).

Is the methanogen/methanotroph ratio calculated from absolute abundance or relative? In either case, is variability in just one or the other driving the ratio variability? Is it primarily shifts in importance of methanotrophs or methanogens? If so, can this permit a more specific interpretation, e.g., variation in methanotrophy explains variation in net flux.

I suggest authors could make the zone names more specific/obvious as it is hard to recall which the acronyms refer to. Perhaps: OW = Water, FSL = Mat or Sphagnum, TMW = Tamarack, MES = Shrubs, Lagg is OK. Or Zone 1,2,3,4,5 (corresponding to concentric rings). I think this more closely ties to the central objective of the study which was to evaluate spatial heterogeneity.

Transpose table 1. Columns should be variables, rows should be entries.

Figure 3. Try grouping by wetland zone rather than month, That way you can show the full timeseries in one block, easily compare among blocks and easily see the single-block dynamics.

Line-by-Line Comments Page 13, Line 26: Check units (g m-3)? I think it should be Mg m 3. Page 15, Line 16: Mean day-time air temp? Page 15, Line 18: These range from negative to positive. Page 19, Line 22: fluxes Page 26, Line 27: can you comment on how much we can interpret from Genus level differences?

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