

Biogeosciences Discuss., referee comment RC3  
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## Comment on bg-2021-36

Anonymous Referee #3

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Referee comment on "Temporal trends in methane emissions from a small eutrophic reservoir: the key role of a spring burst" by Sarah Waldo et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-36-RC3>, 2021

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### General Comments

This paper deals with methane emissions in a small temperate eutrophic lake. Emissions were assessed from a variety of measurement techniques (floating chambers, submerged funnels and eddy covariance) together with some environmental parameters (sediment temperature, atmospheric pressure, heat fluxes, met data...) and a neural network (ANN) approach. The paper discusses the links between CH<sub>4</sub> fluxes and the biophysical parameters, as well as it provides an analysis of the temporal and spatial variability of those emissions. The subject is of great interest since methane emissions from reservoirs are still poorly studied and constrained at the global scale. There are very few eddy covariance-based studies with long series (2 years) as presented here. As stated before by reviewers #1 and 2, There is no doubt that the data base gathered here is worth publication in the Biogeosciences journal. Some rearrangements would be welcome before publication.

One of the most striking results presented here is the difference between 2017 and 2018 seasonality and cumulated emissions. Unfortunately, though well argued, there are no direct measurements of nutrients and carbon (TOC, DOC, POC, quality of OM) to support these assumptions. Discussion on the diurnal patterns is also a bit disappointing since the results are not unequivocal.

Authors should focus the paper on the main findings which can be supported by the data provided in the paper, and subsequently, present figures might be a little bit too numerous in that perspective of a more focused paper.

The end of the abstract is mentioning "...there is a trade-off in intensive measurement of one water body versus short-term and/or spatially limited measurements in many water bodies", and also "The insights from multi-year, continuous, spatially extensive studies

like this one can be used to inform both the study design and emission upscaling from spatially or temporally limited results". These statements are indeed interesting and I wish the paper would give clearer insights and develop more on this matter in the discussion and conclusion.

Rearrangements suggested by Rev 1 and 2 would improve the paper a lot since results and discussion are all mixed together at the moment. I am particularly sensitive to the place devoted to ANN gap-filling and on the way it impacts final emission numbers.

Minor comments

Page 4, line13: How was used time-lapse camera in this study?

Page 4, line 27: there were no  $u^*$  filtering at EC-S1? If so, you should argue xwhy

Page 5, line 33: more details are needed on the way Akaike information criterion (AIC) was used to determine fitting rate of change in the chambers.

Page 6, line 10-11: vertical profile were done manually, detail procedure( how long for each level)

Page 6, line 30: give more details about:" a probability design that has been shown to reduce uncertainty relative..."

Page 9, line 26: you should give the information that "both quantitative analyses of the relationship between FCH4 and SedT yielded statistically significant results" before implying a link between those two parameters in lines 22-24

Page 11, line 3: I understand that the sandy substrate mention here was brought for recreation use (beach). Is there any point to measure fluxes at the very specific place?

Page 11, lines 23-24: comment on absolute and relative importance of each factor

Page 11, lines 28, 29 and 30: table 3 instead of table 2

Page 13, line 4-5: any assessment of the mentioned transfer?

Page 13, line 21: any nutrients data to support the suggestion mentioned here?

Page 13, line 26-27: any measurement of residence time and output/input of C to support this?

Page 14, line 2: is this consistent with kinetic found by Grasset et al, 2018?

Page 14, line 28: pattern and patterning instead of patter and pattering

Page 15, line 32: detail input parameter of the model used

Page 15, line 33: Del Sontro et al 2018 ref missing or is this Del Sontro et al 2016?