

Thank you very much for this carefully done revision of your manuscript. In my opinion, the manuscript has improved substantially. However, there are quite a few inconsistencies which I ask you to still take care of. Most notably, there are inconsistencies in the statistical approach (correlation/regression, see below) and in what is described in the methods section vs. what is actually presented. I urge you to take care of a description of statistical methods that clearly aligns with what you present as results. I also have a number of more language-related minor issues that should be addressed to improve readability of your manuscript. I consider this a request for minor revision.

Reply: We warmly thank the Associate Editor for the additional detailed and thorough suggestions for improvement. Text and figures were changed accordingly.

8: move "to the atmosphere" to sentence end.

Reply: Text was modified accordingly.

21-22: second half-sentence misses a verb.

Reply: Text was modified accordingly.

22: Unclear meaning of "at seasonal scale". Do you mean "across seasons", i.e. based on a comparison among seasons?

Reply: "at seasonal scale" was replaced by "across seasons"

30: The abstract would benefit from a concluding sentence (a potential implication or similar ?).

Reply: We added a concluding sentence.

34-36: I suggest to refer to all these GHG emissions as decisively "global".

Reply: Text was modified accordingly.

41: "from" rather than "in" smaller water bodies.

Reply: Text was modified accordingly.

54: insert "they" after but, otherwise subject missing.

Reply: Text was modified accordingly.

67: CH₄ "production" rather than "cycling"? "CH₄ cycling" is a rather sloppy expression, hard to see a meaning of this phrase.

Reply: Text was modified accordingly.

91: move "of CO₂ and N₂O" to after "emissions".

Reply: Text was modified accordingly.

107-110: Please rephrase this sentence. It is a rather important one, but has weird syntax. Use "assess" rather than "test" because you do not present a test for differences due to alternative state. Let "in terms of..." follow "differences" immediately.

Reply: Text was modified accordingly.

113-115: Rephrase, first site, then time.

Reply: Text was modified accordingly.

119: insert "the" before laboratory.

Reply: Text was modified accordingly.

121: "of" has wrong font size.

Reply: Text was modified accordingly.

141-143: I cannot follow the logic of this sentence. What is the connection between park closure and time series length? May not be very important, but should be understandable.

Reply: We agree the explanation was not important, so sentence was shortened.

164-165: Statement is not exact. You did not use the headspace technique for pure gas samples. Rework.

Reply: Text was modified accordingly.

183-184: Text repeat, compare lines 173-176. Shorten.

Reply: Text was modified accordingly.

195-202: It is unclear what the point of these computations is. Was this done for Silex only? Shouldn't this be part of the statistics section?

Reply: This section describes the model used in Figs. 5 and S4. We think that the readers that want to refer to the model are likely to look in section 2.3.2 rather than section 2.4, so we prefer to keep the text in this place rather than moving it to the statistics section.

211: Make clear here how you use this equation to predict whole time series of ebullition for each pond.

Reply: We added L218 the following sentence: "Equation (8) is used to predict E_{CH_4} in each pond from time-series of water temperature allowing matching each diffusive CH_4 estimate derived from Equation (1)."

212-226: The statistics section is still pretty unclear and hard to follow despite its brevity. GLMMs were used for two different purposes and this cannot be recognized from the text here: (1) to relate GHG variables to their controls across all ponds, (2) to find differences among ponds. Also, in line 219-221, one believes formal comparisons among seasons were done, but this was not the case. Rather, data was compared among ponds but separated by seasons - this needs rewording. I would welcome a try to improve consistency in the statistical approach by NOT using two different methods (GLMMs and ANOVAs) to test for differences among ponds for entire time-series and separated by seasons (this just confuses the reader, I cannot see a benefit in using two different methods). In lines 222-224 you introduce "Pearson's ... regressions" and thereby start with a confusion of correlation and regression as exchangeable or identical (?) techniques, ignoring their fundamental conceptual difference. This issue of mixing up correlation with regression is prevalent throughout the whole results section and in various figures. I think, in fact, that you almost nowhere use a correlation and thus should not use that word. Pearson may be rightfully considered to be the father of the "Pearson's correlation coefficient" but I do not know a single statistical text-book that would describe a "Pearson's regression". All models used are regressions and the text should reflect this (I note, however, that in some cases, see below, a correlation may indeed be more appropriate). For the statement in lines 223-224, I cannot see an objective (Is this part of the GLMM analysis? Was it done only for Silex?).

Reply: In the present version of the manuscript, we no longer refer to correlation, throughout the text. We have modified and expanded the Statics section in the Methods to accommodate all of the editor's suggestions and comments. The use of the GLMMs was requested by reviewer 2 during the 2 previous rounds of review to account for the nature of the repeated measures in each system (pseudo-replication). However, when testing differences separating the data by seasons the GLMM did not converge due to the low number of data. This then required using a different test, reverting to the ANOVAs. This is explained clearly in the Methods, so we do not anticipate confusion from the readers.

243: Second half-sentence misses a verb.

Reply: Text was modified accordingly.

254: competition "with" macrophytes?

Reply: Text was modified accordingly.

266: Reconsider usage of "together" in context with "pooled", can just be dropped. Applies to multiple locations in the manuscript.

Reply: Text was modified accordingly, here and elsewhere in text.

267: The inclusion of precipitation (or rainfall in line 215) becomes clear later on, but maybe explain your objective behind including this variable as a predictor at an

earlier point. In fact, it would be nice to have a short justification for the variables considered as predictors in the statistics section.

Reply: A short justification of the different tests was added to the statistics section.

275-282 and 292-299: These sections are examples for the confusion of correlation with regression. The word "correlated" appears multiple times but is entirely inappropriate as you always refer to results of regression analysis. This also applies to other text sections, reconsider phrasing using "correlated with" everywhere.

Reply: In the present version of the manuscript, we no longer refer to correlation throughout the text.

304: This is a rare example where a correlation is actually more appropriate than a regression. I cannot see why CH₄ content of bubbles should depend on bubble flux, especially when CH₄ makes up the bulk of the gas in those bubbles. Here, a correlation would be very appropriate, but you use a regression. Reconsider wording but also analysis and figure S3.

Reply: The figure and figure legend were updated accordingly.

306: Reword "during more lengthy series" - weird formulation.

Reply: Text was modified accordingly.

308: Reword "during events", could just be "following drops...".

Reply: Text was modified accordingly.

310: role for what?

Reply: Text was modified for clarification.

313-318: Objective behind doing this is unclear to me. Should be part of methods.

Reply: Text was modified for clarification.

320: The phrase "positively related to" may serve as an example of proper description of a regression result without using the phrase "correlated with".

Reply: In the present version of the manuscript, we no longer refer to correlation throughout the text.

330: Rephrase to "dependency of ...concentration on water temperature". This touches the issue of correlation vs. regression. You mostly use regression techniques, these imply a direction of dependence, thus the phrasing as "dependency between" is not appropriate.

Reply: Text was modified accordingly.

332-339: I think this should be described in more detail in the methods section as well. Here, in the results, please acknowledge differences in the temperature ranges between fitted model and usage of the model. For some ponds, you actually extrapolate (!) outside the temperature range of data used for fitting the model. This should be recognizable to the reader as it entails increased chance for bias.

Reply: We added a sentence in the Methods section to explain that the ebullitive CH₄ fluxes were modelled from water temperature. We added the following sentence “Note that the relations of ebullitive CH₄ fluxes as a function of water temperature were established over a temperature range (7.0 to 26.3°C) that is consistent with the range of water temperature values (2.0-25.9°C) over which the ebullitive CH₄ fluxes were modelled.” in the legend of Figure 7 to address the issue of temperature bounds of the extrapolation.

401: don't use word "test" as you never do this.

Reply: we replaced the word « test » by investigate

414: Sentences misses a subject.

Reply: Text was modified for clarification.

422: again missing subject in "when pooled all data together".

Reply: Text was modified for clarification.

432: Statements with statistics in brackets may better fit into the results section or at least statistics should be reported there.

Reply: Stats were removed from text as they were mentioned in the Results section.

435: This is just a repetition of a result, explanation/interpretation missing here.

Reply: Text was shortened accordingly.

443: "similar", not "equivalent".

Reply: Text was modified accordingly.

462-463: Reword "of a mitigation....fluxes", weird formulation.

Reply: Text was modified accordingly for clarification.

479: Reword "scaled at globally scale".

Reply: Word “scaled” was replaced by extrapolated.

483-492: All this only applies if productivity is high, for sure not in oligotrophic clear-water ponds.

Reply: We agree, and statements refer to 4 ponds in question, which we think is clear from text, and context of this section.

503: I don't understand the logic behind the dilution argument here. Flux out of the system represents a rate of production, especially at longer time scale. The volume of water should not make a difference. Reword or explain.

Reply: The statement was removed.

506: Match what?

Reply: Text was modified accordingly for clarification.

509: Reword "augmentation of".

Reply: Text was modified accordingly.

514-523: Plural precipitations seems inappropriate.

Reply: Text was modified accordingly.

521: Reconsider sentence syntax.

Reply: Text was modified accordingly for clarification.

525-526: Use comma after "clear-water" and "turbid-water".

Reply: Text was modified accordingly.

531-532: Rephrase, very awkward wording.

Reply: Text was modified accordingly for clarification.

536: Hard to follow phrasing. Can variations be dominated by variations?

Reply: Text was modified accordingly for clarification.

539-540: Too simplified. Inorganic carbon contributing to CO₂ emission is hardly a result of surface runoff.

Reply: Text was modified accordingly for clarification.

Fig 2: why use a regression here? A correlation would be more appropriate. Both the regression line and equation should be deleted.

Reply: Figure 2 was updated accordingly to show the linear correlation

561: White and grey need to be Grey and white, I guess. Reorder.

Reply: Text was modified accordingly.

Fig 4: This figure left me entirely confused. I cannot find the respective details behind what is presented here. Are these figures representing results for what is described in the methods at all? Equation (3), but then where is the effect of δ_P ? Or are these results for application of equation (7) being applied to different variables? Where can I find the methods for the equations presented in the figure legend? These do not look like GLMMs at all. The first figure lets me recognize strong differences among ponds, but these are not represented by the single regression model. Serious clean-up needed here.

Reply: We modified the figure to provide an exponential fit as done in other studies for the ebullitive flux.

Figure 5: Is this linked to fig 4 or not?

Reply: Figure 5 shows the time-series of bubble flux and temperature in the Silex pond, while figure 4 shows the bubble flux as a function of temperature in all four ponds.

Fig 7: Again reorder colors "white" and "grey" in the figure legend.

Reply: Text was modified accordingly.

Fig. 9: Word "evolution" may be reconsidered. The journal is also read by biologists.

Reply: Text was modified accordingly.

Table S3: Make clear which base was used for log-transformation, so that original data may be recomputed from values in the table.

Reply: Text was modified to indicate it's a \log_{10} transformation.

Table S6: Details for what is presented here are missing from the statistical methods section.

Reply: We updated accordingly the text of the Statistics Methods section.

Table S7: Log-transformation? Base?

Reply: Text was modified to indicate it's a \log_{10} transformation.

Table S9: A peculiar function is used to fit the ratio of ebullitive to total fluxes here. Why this function? Whole approach is missing from the methods description. Also, does this model agree with what is presented in Figure S5?

Reply: We updated accordingly the text of the Statistics Methods section. We also refer to Fig. S9 in the legend of Table S9. The model in the Table corresponds to the fit of the data in the Figure.

Fig S1: Why is the pressure drop factor not computed continuously, i.e. for a moving time window?

Reply: We followed to procedure given by Zhao et al. (2017). The text of the legend of the figure was updated accordingly.

Fig S2: Do not use plural precipitations.

Reply: Figure S2 was updated accordingly.

Fig S3: Why use a regression here? What is the logic behind this approach?

Reply: Here, we used a correlation, and figure and corresponding legend were updated accordingly.

Fig S4: Why separate the 2 temperature ranges? No logic for this approach presented in the methods. The graph seems very inefficient data presentation, we see the same data clouds two times. In fact the upper four panels could be deleted.

Reply: We updated the Methods section to explain the logic of using three temperature ranges (<, >15, and full). We agree that there is some redundancy in the data presentation, although this might not be as critical for a supplemental figure than for a figure in the main article. However, it allows to present the goodness of fit for each temperature range in a very clear way. The goodness of fit for each of the three temperature ranges with and without the pressure effect is important in the data presentation and discussion (refer to corresponding text in Results and Discussion). We could have made a slightly more compact figure but very crowded with the stats, making the figure much more difficult to read. We decided to favor clarity over compactness, in particular given this is a Supplemental figure.

Also, no description/justification for the transformation $\log(X+1)$ is presentend anywhere. Why +1? The $\log(X+1)$ transformation may make sense for count data, but that is not the case here.

Reply: We added to the Figure legend the following sentence: "To account for zero values, log10 was computed on values plus 1."