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Interactive comment on "Rhizosphere to the atmosphere: contrasting methane pathways, fluxes and geochemical drivers across the terrestrial-aquatic wetland boundary" *by* Luke C. Jeffrey et al.

Anonymous Referee #1

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Review of manuscript bg-2019-11

This study address multiple types of CH4 emissions in wetlands (ebullition, diffusion and plant-mediated flux), their temporal variability (diurnal cycles and seasonal differences), the spatial variability among four wetland vegetation communities in both permanent och seasonal wetlands, and links to wetland soil properties. Hence, it stands out as a potentially valuable study for improved understanding of wetland CH4 emissions. However, I have some concerns and questions below that I think should be addressed

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General comments:

It would be good to early on clarify that the word wetland is here used in a broad sense including both wet vegetated environments and open waters/lakes.

L 160 and elsewhere: In warm environments, bubbling can sometimes happen rather continuously leading to very high R2 values (I have experience this myself several times in the tropics). Given the short measurement periods and the very high flux rates sometimes found from the floating chambers, I wonder if they did not received considerable bubbling in such a continuous way leading to linear increase in the headspace. The high variability in the diffusive flux in Fig 3 also seem to support this guess. Are there any data on surface water concentrations of CH4 that could be used together with modelled piston velocities to estimate diffusive flux, or are there any other independent data to verify the high fluxes found as diffusion fluxes? If not, I would hesitate to report the very high fluxes (up to 10 mmol m-2 d-1) as diffusion and I would instead report values from flux chambers as total open water flux including both diffusion and ebullition. This would be a minor loss for the manuscript, compared to the risk of considerably overestimating diffusive fluxes.

I think that it is difficult to claim that this study cover seasonal differences for the CH4 emissions, which are known to have a high day-to-day variability, because there seems to have been on measurement day per season only.

Specific comments:

Abstract: Please define "AVS".

L84-86: Tiny language thing: Two "now" in same sentence.

P156-158. How many replicate floating chamber measurements were performed during each measurement time at each location, and how many measurements times during each campaign?

L185: 10 minute intervals in the daytime sampling would return in the order of 4-6 mea-

surements per hour, but Figure 4 does not show that many points. Were fluxes really measured ad 10 min intervals as said here? L226-230: Please show unit and value of R, as there are several versions to choose from. Should there not be a conversion from ppm to partial pressure in the equation, e.g. s*(1/1000000)*Total_Pressure?

Given the variability, was there really a significant difference between day and night?

L264-265: This statement does not seem to hold for Veg C right?

L265-266: See above: Was there a significant diel variability?

Line 267-268: Is the Veg C flux really negative or rather not significantly different from zero, ie Veg C flux is to be seen as zero?

L269-271: See above comment. I think data and its variability indicate the the floating chambers received lots of ebullition in spite of the gas accumulation being linear. Please provide independent evidence supporting that numbers represent diffusive flux only, or consider reporting fluxes as total flux.

L275: I do not follow the end of this sentence and do not see how Figure 4 can support this statement.

L330 and elsewhere: Is re-flooding the only possible explanation of the differences found in the redox between the seasonal and the permanent wetland? Could not the difference also represent a difference between areas with emergent aquatic plants having O2 leaking out from the roots and maintaining oxidized conditions, and on the other hand areas without this type of root zone aeration in the permanent wetland? This root zone aeration is mentioned below in another context. Should it not also be highlighted here when discussion the sediment redox depth profiles?

L 387-389 and elsewhere: Some studies have highlighted different patterns. See e.g. Milberg et al. 2017 AoB Plants. doi.org/10.1093/aobpla/plx029

L410-411 and elsewhere: Is the difference between passive and pressurised gas trans-

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fer the only possibility? The sediment redox potentials reported correlate with CH4 fluxes. Could the sediment conditions not also be influenced also by root depth or root density varying between plant species? If there are no clear explanations, and speculations are necessary, it would be good to highlight not only one alternative (that are frequently discussed in the literature) but also other possible alternatives.

L412-413 and elsewhere: See above. Another perspective could be that that no significant CH4 fluxes were found from the Veg C site. I suggest letting the statistics decide the perspective.

L419-425: Why is not possibly more extensive root zone aeration by the additional tree roots mentioned as one hypothesis?

L428-429: See above. (a) Consider the possibility that the floating chambers reflect total flux and not diffusion only. (b) I am not convinced this study can make claims about seasonal differences based on one measurement day per season only as day-to-day fluxes can be highly variable. Therefore, parts of the discussion about reasons for the seasonal difference seem obsolete.

L451: I suggest removing "Permanent" here, because many large non-permanent wetland areas are also important (most tropical wetlands vary greatly in size over a year).

Fig 1 and elsewhere: Why were not all measurements and core collections taking place nearby eachother? How comparable are the results if data were collected far apart?

Figure 4 and elsewhere: (a) Does Fig 4 really show seasonal fluxes? Can at all seasonal fluxes be claimed from two measurement days as shown here? How to know that these two days were representative of whole seasons? (b) Please inform readers how many replicate measurements were made at each time point for the fluxes?

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