

Interactive comment on “Hysteretic temperature sensitivity of wetland CH₄ fluxes explained by substrate availability and microbial activity” by Kuang-Yu Chang et al.

Anonymous Referee #2

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This study addresses an interesting and important topic in the methane community, the seasonality of CH₄ flux, and its causes, emphasizing the thawed period. The study makes use of observational results at two high-latitude sites and previously published modeled results for those sites and further analyzed the differences in CH₄ flux and its dependencies on temperature and substrate, microbial biomass before and after the highest temperature. My major comments are as below:

1. The thawed period is used for the analysis; however, it is not clearly defined. I assume it is different from growing season, which is determined based on vegetation. The thaw period is defined with temperature, precisely soil temperature. I did see how it

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is defined. As we know that the soil temperature has a very long fluctuation around zero degrees in the shoulder season, how that is used to define the thawed period. Please clarify. 2. The authors used the highest temperature to separate the two periods; this needs to be justified. The strong fluctuation of soil temperature in one year, even the highest degree can be in a few days how to distinguish the temperature difference as < 0.1 degree in two days, particularly when those two similar temperatures are in a few days apart. I think it might be good to use a running average of the soil temperature. 3. Line 154, both air and soil temperature, are used to define the thawed season. It needs a very clear definition on that. In the figure, authors used ground temperature in some places; please keep consistent of air temperature, soil temperature, and ground temperature, which one is used and what it represents. Is the soil temperature $< 5\text{cm}$? is the ground temperature surface temperature? Did air temperature consistent with soil temperature? If not, how are they correlated? How many days of delay in terms of the highest temperature? 4. Although two sites are claimed to be used in the analysis, they are not in equal weight in the analysis. The authors claimed that one site has strong variation, while the other does not. This is not a solid justification. 5. This paper highlights the substrate control, but both acetate and H_2 were not validated against the observational data. How to prove the robustness of the study? Please clarify. 6. As the conceptual diagram shows in figure 7, why the figures 1 – 2 were not plotted in the similar format to clearly show the hysteretic response. The current plotting is not straightforward in terms of supporting the figure 7. 7. Figure 9 might need to be clearly defined, see my previous comments, and put in the first section of the paper. It is the foundation of the whole manuscript. 8. The figure legend of blue color to red color representing the start date to end date, does the highest temperature is in the exact middle of the thawed period? Can you mark the highest temperature on that legend and in the figures? 9. The writing is confusing in some sentences; please revise for clarity purposes. 10. There are a few duplicate references in the bibliography.

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