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Discussions

Interactive comment on "Biogeochemical and plant trait mechanisms drive enhanced methane emissions in response to whole-ecosystem warming" *by* Genevieve L. Noyce and J. Patrick Megonigal

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Thank you for your thoughtful comments. Our responses are below in italicized text.

1) My main critique is the discussion around the pattern seen in CH_4 concentrations at depth in the C_4 community. The decline in methane concentrations with warming indicates a shift in where methanogenesis is occurring. With a shift from below the rhizosphere at lower temperatures, to within at higher tempera-

tures. Why do you think this is occurring? Is there less labile C at depth at high temperatures? Is there a shift in the type of methanogenesis occurring to methylotrophic methanogenesis? There should be more discussion of this potential mechanism as methylotrophic methanogenesis has been found to be important in coastal sediments (Zhuang et al., 2016; Xiao et al., 2018).

This is an interesting observation that was not discussed in the paper, so thank you for bringing it to our attention. We agree that warming caused a depth-dependent shift in porewater CH_4 in the C_4 community, with a simultaneous increase at the surface (0-20 cm) and decrease at depth (40-120 cm). As with our primary observation that warming increased methane emissions, there are multiple mechanisms or processes that could cause such a shift in porewater CH_4 concentrations. Of the four mechanisms outlined in this paper, the most likely explanation for the observed C_4 response is an increase in labile C at the surface linked to a decrease in labile C at depth. This is consistent with DOC depth profiles that tend to show an increase in DOC at the surface and a decrease at depth. This could be due to a warming-induced increase in evapotranspiration, leading to slower hydrologic transport of DOC-rich surface porewater to lower depths, or a warming-induced shallowing of the root system, leading to a shift in the location of root exudates. We do not yet have evidence to test either of these mechanisms, but will add text alerting the reader to the observation and providing brief speculation on these potential mechanisms.

We do not presently have isotope or molecular microbial community data to speculate about the influence of warming on methanogenic pathways. The mechanisms proposed above could operate without a change in pathway but quantifying the pathways would nonetheless be very helpful for inferring mechanisms. We plan to add a few sentences about the need to quantity methanogenic pathways and the fact that this is currently underway at SMARTX.

2) Minor comments:

Lines 111 – 112: Can you change the 10-20% of high tides to a comparison as all tides like you did for the low elevation areas? This will make the comparison between the areas easier.

Both percentages are actually for high tides, but we realized our original phrasing was unclear. We will revise these lines to clarify that inundation frequency is 10-20% of high tides in high elevation areas and 30-60% of high tides in low elevation areas.

Lines: 147 – 149: Using 1/2 of the LOD is not a great way to deal with non-detects. Checkout Helsel (2006, Chemosphere). Here they outline why substituting value for non-detects is not a great idea and how to deal with these data. They are a pretty small percentage of your data, but it could be useful to use other methods in the future.

Thank you for drawing our attention to this. Because the non-detects are such a minimal part of the overall flux dataset, there is no substantial difference in the overall effects and conclusions when these values are removed from the analysis rather than set to $\frac{1}{2}$ of the LOD. As a result, we plan to continue using $\frac{1}{2}$ of the LOD for this manuscript. For future projects, however, we will definitely consider the alternatives described by Helsel, 2006.

Figure 1: Can you add a legend describing the colors on your density plot?

We will add a description of the colors to the figure caption in the revised version.

Lines 356 – 359: I really like your discussion of differing plant communities as net oxidizers or net reducers here.

Thank you!

Supplement Table S2: There is a typo in the figure legend. "2017, 2018, and 2018"

We will fix this, thanks for catching that.

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