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Biogeosciences Discussions

Interactive comment on "Seasonal Variability of Tropical Wetland CH₄ emissions: the role of the methanogen-available carbon pool" *by* A. A. Bloom et al.

Anonymous Referee #1

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General Comments:

This paper proposes a simple model of anaerobic decomposition substrate as an important controller of the seasonality of Tropical regional-scale wetland CH4 emissions. The authors are able to use this hypothesized control to explain the 1-3 month lag between peak inundation and atmospheric CH4 concentrations over the Tropics.

Substrate availability as a primary control on methane emissions is a viable hypothesis, but I feel the paper would be enhanced by a more thorough analysis and discussion of alternative controllers on the seasonality of net CH4 emissions to the atmosphere. It seems possible that the decay constant the authors infer could be explained by other

processes with comparable temporal variability.

A few examples to consider as alternative hypotheses:

1) Growth of macrophytic mats in many flooded rivers contribute to seasonality in CH4 fluxes, both through exudation and active transport in tissues (Melack et al. 2004).

2) Flooding and then stabilization of the wetland area over a month or so could also lead to seasonal variations in pH and redox conditions.

3) The authors explain in one sentence why they think seasonal variation in oxidation is unlikely, but I think that point needs more substantial treatment. Seasonal variations in methanotrophy could also contribute to the observed time lag. Such a seasonality could come about by a changing competitive environment between aerenchyma transport, methanotrophs, and methanogens.

4) You hold N_μ constant, but it should have some seasonality associated with temperature controls on SOM and litter decomposition, exudation, find root mortality, etc. You might examine this sensitivity by considering seasonality associated with NPP (for exudation) and temperature for decomposition (in the same way you imposed temperature dependence in equation (2)).

You might also describe results from Wania et al. (2010), Zhuang et al. (2004), Riley et al. (2011), and others, who spend a lot of effort describing the suite of processes resulting in net CH4 emissions, their relative contributions to uncertainty in net emissions, and their impacts on the seasonality of net emissions.

Specific Comments:

1) The range of Q10 values used in regional to global CH4 models is very large. Please comment on how a much larger value of Q10 would impact your inferences about seasonality. You might re-run your simulations with a Q10 of 3 to see if that removes some of your inferred seasonality in C_μ. Note that at high latitudes, some models use Q10 values up to 4 (Zhuang et al. 2004).

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2) Please give some more details about your uncertainty propagation described in paragraph 15. For example, what are the SCIAMACHY errors, what do they derive from, what is their seasonality? Where did the 16% uncertainty associated with kappa come from? How did you include uncertainty in the non-linear fit? What other uncertainties are you ignoring? For example, error in using GRACE to infer wetland extent? Did you compare to Prigent et al? Can you compare to some of the other inundation datasets (e.g., Melack et al. 2004).

3) Riley et al. (2011) discussed seasonality in substrate availability, and how that seasonality could be modeled (their 'seasonal inundation factor'). Is there analysis consistent with yours?

Technical Corrections:

1) Make sure that CH4 has the "4" as a subscript in all your figures.

2) Clarify in Figure 1 that you are referring to 'peak CH4 emission month'.

3) The legend in Figure 4 is unclear, because the colored lines don't correspond to the first line of the description. E.g., it looks like the blue line corresponds to "top-down wetlands & rice by Fung et al". Please correct. Also, 'Top-down' applies to the current study, right?

4) Change 'methane' to be 'CH4' in Figure 5 to be consistent with other figures. Clarify what 'NH' and 'SH' mean (northern and southern hemisphere, I assume)

Interactive comment on Biogeosciences Discuss., 9, 387, 2012.