

Interactive comment on “Effects of soil rewetting and thawing on soil gas fluxes: a review of current literature and suggestions for future research” by D.-G. Kim et al.

Anonymous Referee #2

Received and published: 22 December 2011

The authors summarize the effects of rewetting and thawing on multiple soil gases (CO₂, CH₄, N₂O, NO and NH₃); discuss the underlying mechanisms and drivers of responses; and identify knowledge gaps and highlight future research. I enjoyed the manuscript and believe the authors demonstrated a robust understanding of the current literature relating to gas fluxes and rewetting and thawing. However, I believe that there are a couple of problems that need to be addressed. My fellow reviewers voiced some of these same concerns. I have outlined these general comments below. I do not suggest minor changes or edits since I agree with the other reviewers that the authors should extensively revise the manuscript and be encouraged to resubmit. Once these revisions are incorporated, I feel that the scientific impact of this research will be more

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accessible to the reader.

In general, I feel that the entire manuscript lacks focus. If the authors dig deeper and find novel connections between gases and rewetting/thawing they have the potential to write a manuscript that will be highly cited in the future. Here are my concerns.

1. Why all the gases? Is the incorporation of NO, and NH₃ necessary? I understand CO₂, N₂O, and CH₄, but I failed to understand how the incorporation of multiple gases really is novel or enhances the impact of the review. I would much rather see the reviews focus on a few gases and delve into their analyses more. Alternatively, if these gases are not removed, I suggest that the reviewers justify why these gases are necessary.

2. What did you learn from all of this literature? Most of the manuscript just lists different studies and details their findings. Although interesting, this is not why I read a review. There really is a lack of not only highlighting common patterns between the gases (so compartmentalized by gas) but introducing anything new. If someone has gone to a monumental effort to compile all this data I want to know the new links and ideas that you have found. If the major finding was that gas fluxes are variable resulting in large increase to no-significant changes following a rewetting or thaw event then why do the review. We already know this and that is why so many people study it. Dig deeper what is something novel that you found from your study. Please, consider comparing the different gases more or possibly talking about them together in the context of environmental drivers such as (labile carbon substrate availability, oxygen availability, or temperature) instead of in separate driver sections.

3. I liked the figures and am wondering why these were not highlighted more in the text. Also consider adding a few more histograms (similar to fig. 4) that not only have the number of studies but the % change in the various gas fluxes on the Y axis. You could include histograms for 1) the amount of water added or better the change in air-filled pore space of the different soils in the studies since many of the gases depend on

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anaerobic environmental conditions; 2) temperature; and 3) carbon substrate availability since this is what drives much of these changes. You should be able to pull these from your studies. Also the fluxes following a power function is good but doesn't necessarily demonstrate that there are no differences between the responses of these gases (see Unger review also) since there are two distinct groups of CO₂ and N₂O being at the top with the other gases at the bottom of the function. The gases did show a similar change from pre-wetting to post-wetting conditions but there are differences between the magnitude of the response. Please address this conclusion in particular. We may be wrong but right now we are confused by the results from the power function.

4. I almost stopped reading after I finding out that section 3.6 was only a couple of sentences. Please expand this section. This is what will enhance the review. See some of my suggestions from the previous section.

Interactive comment on Biogeosciences Discuss., 8, 9847, 2011.