Biogeosciences Discuss., 8, C5712–C5731, 2012
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Biogeosciences Discussions

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.

D.-G. Kim et al.

donggillkim@gmail.com

Received and published: 14 February 2012

Dear Referee Dr. Stephan Unger:

First of all, we authors appreciate your insightful comments and suggestion on the manuscript bg-2011-222.

In this response letter, at first we described major additions and changes in the revised manuscript and then we responded to each of comments and suggestions addressed by you and two other referees.

First, there are new additions in the revised manuscript as following: 1. Rate of soil

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flux change following rewetting and thawing events by ecosystems types; Table 2 and relevant texts were inserted.

2. Section '3.6 Overall change of gases fluxes following rewetting and thawing' was removed. On the other hand, section '4. Effects of rewetting and thawing on soil gas fluxes: compiled dataset analysis' was added. The section 4 includes two new findings and relevant discussion with two new figures and two new tables as following:

a. Pre-change flux versus flux change by gas type and event type (rewetting and thawing); Figure 5, Table 4 and respective discussion in the manuscript.

b. Mean annual temperature versus flux change, by gas and event type; Figure 6, Table 5 and respective discussion in the manuscript

3. Number of studies used for the analyses in this study: Table 1 and 3, texts in section '2 Methodology'

4. Importance of NO and NH3 gas fluxes in addition to greenhouse gas CO2, CH4 and N2O; Introduction section

5. A figure showing soil CO2 flux increase following rewetting change observed with high temporal resolution measurements in the field; now Figure 2

6. Conclusion section was revised (i.e., including new results)

7. References: references were added as suggested by reviewers and recently published studies

Second, there are substantial changes in the revised manuscript as following:

1. Detail description on uncertainties of CO2 and N2O fluxes in section 5.1 and 5.2 were moved to relevant places in section 3.

2. Previous sections 5.1 and 5.2 were merged with section '5.1. Uncertainties in understanding the responses and mechanisms' and revised throughout the section.

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3. Mechanisms were distinguished between biological and physical in section 3.

4. Section '5 A Blog for open discussion and web based open databases' was shortened and moved to 'Supplementary information'.

Finally, we acknowledged three reviewers' constructive and valuable comments in the 'Acknowledgments' section.

We responded to each of your comments and suggestions as following:

A particular concern is the generalization of the term "response" of the gas fluxes to the events by the authors, which is not well defined.

Response: We appreciated the comment. We have included the text "We define response as the behaviour or reaction of the different soil gas fluxes that result from rewetting or thawing of soils. The responses may vary in intensity and/or duration depending on the gas analyzed as seen in the results section." in lines 168-171 to clarify the term "response".

Fig. 1 does not reflect natural conditions, as the pulses are often transient and often do not return to pre-treatment values. It should be clarified if only maximum responses or general increases above pre-event values are meant.

Response: We understand the concern of the reviewer as these graphs may not represent a "real" response that may only be observed using high temporal resolution measurements. So we have added a new figure showing high temporal resolution measurements of soil CO2 flux change following rewetting observed in the field (Fig. 2). We have modified a legend of the figure 1 as following:

"The figure is a simplification of the response and does not reflect the full dynamics of a pulse response as shown in Figure 2."

Also we have modified relevant texts (see lines 191-195) as following:

"The dataset prepared for this manuscript (n = 338 studies) is dominated by exper-

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iments using discrete measurements that miss the highly detail patterns of soil gas fluxes following rewetting or thawing as shown in Figure 2. Thus, we used Eq.1 as a proxy to represent a simplified response based on discrete measurements of soil gas fluxes."

Secondly, I disagree with one of the main outcomes that there is no significant difference in response among gases only because they fit on a power function when taking all data points into account. This power function is generated by large fluxes as CO2 and N2O being on the top of the curve and small fluxes such as NO being on the bottom. I do however, not always see the single flux response to the events rewetting and thawing fitting on this curve (as i.e. for CO2 after rewetting events).

Response: We understand the concern of the reviewer and we removed the figure and relevant results and discussion in the manuscript.

The arrangement of the sections by gases, response patterns and mechanisms is nice. However, I found that the sections of "General patterns of response" would profit from a more general summary and discussion of the overall literature results, instead of listing data from a few single study examples as it is often exhaustive for the reader to extract the essential general context.

Response: The sections of 'General patterns of response' commonly composed of 1) lists of observed ecosystem types, 2) 1 or 2 examples of the observation and 3) general summary and discussion of the overall literature results. To enhance the general summary, we newly added flux change rates by ecosystem type for each gas (texts and Table 2) in the revised manuscript.

As the authors have done a considerable work gathering information from 338 literature studies from 1956 to 2011 in various ecosystems it would be nice to extract temporal changes in "response" over the last 50 years as probably already affected by global change.

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Response: We think that although this is an important comment, we believe that it is not possible to identify the climate signal based on the differences in the studies because the experiments were done with different conditions (e.g. length, intensity of the pulse, different ecosystem/vegetation/soil type). Since studies dealing with soil emitted gas including greenhouse gas emissions have been conducted intensively recent 10 years due to concerns on climate change we also concerned that 'the temporal changes in response over time' can be extracted from the database may not be able to represent real situation.

Also it would be desirable for the reader to gain information in which ecosystems (e.g. arid vs. humid climates, grasslands vs. forests) rewetting and thawing has the largest effects on the single gas fluxes and where the effect on annual budget is large or negligible. I suggest including such information, as it is needed for a comprehensive understanding of the importance of such events.

Response: We have added flux change rates by ecosystem type for each gas (Table 2 and texts) in the revised manuscript.

Section 4 Knowledge Gaps and future directions should be rewritten in a more general review-like manner as many of the discussed knowledge gaps are very detailed for the single gas flux responses and could be included into the respective Mechanisms and Drivers parts, rather concentrating on the general problems involved in experimental design and modelling such as temporal and spatial resolution of measurements and lab vs. ecosystem studies applicability for several purposes (e.g. understanding mechanisms vs. up scaling and calculating gas budgets).

Response: We moved detail information on uncertainties related to responses and mechanisms of CO2 and N2O fluxes to relevant section 3 'General patterns of responses' or 'Mechanisms and drivers'. Previous sections 5.1 and 5.2 were emerged to section '5.1. Uncertainties in understanding the responses and mechanisms' and revised throughout the section.

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Page 9848 Line12: It would be interesting to know if the responses of different gases have changed over this period from 1956 to 2010, thus, if climate change already plays a role in these events. This has not been looked at and may not be aim of this review but it would be nice to include in the general outcome.

Response: This is a very interesting comment, but we believe that it is not possible to identify the climate signal based on the data collected in the studies because the experiments were done with different conditions (e.g. length, intensity of the pulse, different ecosystem, vegetation and soil type). We also concerned that studies dealing with soil emitted gas have been intensively conducted in recent 10 years due to concerns on greenhouse gas and climate change and 'the temporal changes in response over time' can be extracted from the database may not be able to reflect real situation.

Page 9848 Line 25: I suggest rephrasing to: "The rewetting of dry soils and thawing of frozen soils represent abrupt step changes"

Response: Rephrased as suggested.

Page 9850 Line 1: Please change to "the mechanisms and impacts of changing rainfall regimes and freeze-thaw cycles on"

Response: Rephrased as suggested.

Page 9850 Line 3ff.: I would not go as far as generalizing that most flux measurements are done in "coarse temporal resolution" (i.e.. frequency in eddy covariance as the most used method for measuring CO2 fluxes is 5 and 25Hz). It would be good to specify what flux measurements you are referring to. Further, please clarify "unrealistic simulations of dry-wet and freeze-thaw events".

Response: We appreciate the comments and we revised the part (see line 135-144) as following:

These uncertainties are exacerbated by the coarse temporal sampling resolution of most flux measurements that do not capture the pulse dynamics (Groffman et al., 2006;

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Muhr et al., 2009). Additional uncertainties arise from unrealistic experiments of dry-wet and freeze-thaw events (as discussed in Henry, 2007; Jentsch et al., 2007). These experiments may simulate events that are out of the expected range of soil temperature and soil moisture (i.e., >95% CI) in current and past conditions. These limitations are important for our understanding of the temporal patterns and budgets of gas fluxes because even a single pulse event may contribute substantially to annual flux totals (Lee et al., 2004; Kitzler et al., 2006; Barton et al., 2008).

Page 9850 Line 7: The studies cited here studied ecosystem respiration (thus, only CO2). Please add some references on how the other fluxes (CH4, N2O etc.) are influenced or change to "annual carbon fluxes" to avoid generalization.

Response: We added some references reporting a single pulse event of other gases (CH4, N2O etc.) has been shown to contribute substantially to annual sum of gas fluxes as following:

"These limitations are important for our understanding of the temporal patterns and budgets of gas fluxes because even a single pulse event has been shown to contribute substantially to annual sum of gas fluxes (Lee et al., 2004; Kitzler et al., 2006; Barton et al., 2008)."

Page 9850 Line 13: The authors claim to have created a new database on published studies and claim that this is novel. I do not see the novelty here, as every literature review, particularly the ones doing meta-analyses with published data create a "database" of published studies to extract the current state of knowledge and research challenges". I suggest removing "creates a new database on published studies"

Response: We believe that compiling published information in an organized way (i.e. database) and making it available to the public is important. We believe that the novelty relies on the wealth of organized information that has been compiled for researchers to use and continue adding information. Unfortunately many review or meta-analysis studies do not make the database widely available to the community. Related to soil

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gas flux change following rewetting and thawing, a few previous reviews (Henry, 2007; Matzner and Borken, 2008; Borken and Matzner, 2009; Groffman et al., 2009) have not provided a database on published studies. Also considering the amount of information in the database provided in this study, we believe the database can be recognized as a novel work.

Page 9850 Line 17: "discuss the underlying mechanisms and drivers of responses" This objective lacks specificity – please specify "drivers and responses of what?"

Response: We rephrased the sentence as:

(2) discuss the underlying mechanisms and drivers of variation of soil gas fluxes following rewetting and thawing;

Page 9850 Line 22: Please change to: " where acquired by a literature cross-search of peer-reviewed publications between 1950 and 2010." There is no need to say which search engines and key words you used for that.

Response: For this to be reproducible, it is needed to specify search engines and key words. It is a common description in recent review and meta-analysis study. Please see an example "Global Change Biology (2012) 18, 194–209, doi: 10.1111/j.1365-2486.2011.02502.x"

Also, in the abstract you state "studies between 1956 and 2010". Please correct.

Response: we corrected the year in both Abstract and Methodology sections as following:

"...between 1956 and 2011 using..."

Page 9850 Line 24ff: Please change to: "Studies with field observations", "Similarly, studies of thawing: : :"

Response: We rephrased as:

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"Studies with field observations of rewetting of dry soils include events caused by natural rainfall, simulated rainfall in natural ecosystems, and irrigation in agricultural lands. Similarly, studies of thawing of frozen soils include field observations of natural thawing, simulated freezing-thawing events (i.e. thawing of simulated frozen soil by snow removal, simulated freezing-thawing cycles in the laboratory), and thawing of seasonal ice in temperate and high latitude regions"

Page 9851 Line 3ff. This sentence needs more explanation as it seems out of place and it is difficult to understand what is meant by "changing active layer depths" and why you are suddenly talking about permafrost soils and soil/plant succession effects on them.

Response: We rephrased as:

We did not include the long-term effects of changing active layer depths caused by permafrost thaw in this review, as changes in gas fluxes in response to permafrost thaw are affected by both changing soil and plant successional processes (Turetsky et al., 2007).

Page 9581 Line 11: I have a doubt about the reference to Fig. 1. The soil efflux after rewetting and thawing does not always behave like it is shown in the hypothetical Figure: immediate increase and gradual decrease to pre-treatment values. E.g. in case of CO2 fluxes after rewetting often the initial increase is vary transient and the fluxes behave like this; immediate and transient increase followed by a strong decrease to well above pre-treatment values and then a slow decrease. How did you calculate the response in these cases or what was your period of peak-gas fluxes? Further, in natural studies various rain events are common impeding the return of gas fluxes to pre-treatment values as shown in Fig. 1. The authors should define how they calculated the peak-flux period in such cases.

Response: We understand the concern of the reviewer as these graphs may not represent a "real" response that may only be observed using high temporal resolution

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measurements. Actual responses patterns can vary and Fig. 1 is a simplified and conceptual figure to represent various responses and pattern. We think it is not possible to describe all of expected pattern in the limited space. So we added a note in the caption of Fig. 1 as following:

"The figure is a simplification of the response and does not reflect the full dynamics of a pulse response as shown in Figure 2."

To support the simplified Fig. 1, we also added a new figure now Figure 2 that includes: High temporal resolution (hourly data) of soil CO2 flux dynamics before and after a rewetting event (A); and soil water content (2-16 cm depth) and soil temperature (2 cm depth) dynamics during the same dates of the soil CO2 flux measurements (B) measured during the year 2008 at the San Jacinto Mountains James Reserve (Vargas et al 2010b).

Regarding determination of peak periods, basically peak periods were determined the periods from the initial time fluxes increase following rewetting and thawing to the time fluxes returns to pre-event values or stabilized values. Again, actual responses patterns can vary and Fig. 1 is a simplified and conceptual figure to describe various patterns.

A review of the effect of rewetting and thawing on soil gas fluxes Page 9852 Line 5: Please change "multiple" to "various" and "experimental settings" to "experimental designs"

Response: We appreciate the reviewer's suggestions and rephrased as:

For each soil gas we discuss below: (a) how rewetting and thawing events influence gas fluxes in various ecosystems and experimental designs; and (b) the likely mechanisms and environmental controls underlying the observed patterns.

Page 9852 Line1-3: Reference needed

Response: We were not able to find any further specific reference (i.e., manual) to add

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beside the company name and address of the software as following:

“we calculated the corresponding values from the figure using the software Acrobat 8 Professional ver. 8.2 (Adobe Systems, Inc. San Jose, CA, USA).”

Page 9852 Line 14: It would be nice to have a general overview of ranges listed here of how much CO2 increase in terms of mol m-2 s-1 has been observed in the different ecosystems

Response: Now Fig. 3 (in the revised manuscript) provides general overview of the increase ranges by gas, event (rewetting and thawing) and experimental (field and lab) types and we newly added rate of flux change by ecosystem types for each gas in the text and a table (Table 2).

Page 9852 Line 15: Please remove “pulses observed in”

Response: We removed it.

Page 9852 Line19: Consider changing to “: : :Rs increases after rewetting in soils: : :”

Response: We changed it as suggested.

Page 9853 Line 5: What do you mean by responses? Please specify! Do you mean the maximum CO2-pulse or the general CO2 increase above pre-treatment values?

Response: We revised the sentence as:

“These studies have reported increased CO2 flux after rewetting lasts short-term (ca. 6–24 h) up to 30 d...”

We found in an irrigation experiment that the CO2-pulse in general is very rapid and does not last longer than some hours but that pre-rain values were increased during several weeks (Unger et al., Soil Biology and Biochemistry 2010) and that they were due to different mechanisms (rapid pulse is not explained by soil moisture (extent and longevity are related to antecedent soil moistures and change in soil water potential)

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= probably priming by rain-induced availability of substrate, longer-term increase of soil respiration above pretreatment values is correlated with soil moisture) = probably increased soil microbial growth and turnover of soil organic matter with increasing soil moistures. We have a very recent paper in Agricultural and Forest Meteorology that might be interesting for you in this regard: Unger, S. Máguas, C., Pereira, J.S., David, T.S., Werner, C. (2012) Interpreting post-drought rewetting effects on soil and ecosystem carbon dynamics in a Mediterranean oak savannah, Agricultural and Forest Meteorology, 154-155, 9-18, doi: 10.1016/j.agrformet.2011.10.007 - attached in the supplements

Response: Thank you very much for the insightful comment. We have revised the text accordingly as below (line 306-309) and cited the suggested reference Unger et al. 2012.

It can be difficult to separate the often-confounded factors controlling CO2 flux pulses, requiring measurement of microbial communities, isotopic composition, and/or precise flux timing. For example, Unger et al. (2012) used δ13C to separate out the effects of soil moisture versus substrate availability in an oak woodland.

Further, if studies observed a 30 days response, could it be that there were other rain events in between, triggering further respiration pulses?

Response: We appreciate the comment but we are dependent on study authors and we were not aware whether any other events occurred or not.

Page 9853 Line 7: I do not see a >10000% increase in Fig. 2. Do the Whiskers represent maxima or SD? Please state in the figure legend.

Response: We added detail information for the box plots in the figure legend as following:

“Top and bottom of box are 25th and 75th percentiles; whiskers extend to 1.5 $\times$ IQR (interquartile range) “

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Page 9853 Line 26: consider removing “increased”

Response: we rephrased the sentence to clarify the meaning.

1) increased water in the soil pore space by the rainfall reduce soil CO2 diffusivity rates

Page 9853 Line 27: add comma between “pore space” and ”enhances anaerobiosis”

Response: we added a comma as it was suggested as following:

“(2) the restriction of the soil macro-porosity by the rainfall reduces soil air-filled pore space, enhances anaerobiosis and reduces aerobic...”

Page 9855 Line 14: bracket missing after references, what is meant with Rewetting, thawing and soil gas fluxes database in Sect. 6?

Response: We corrected the typo and we removed ‘Rewetting, thawing and soil gas fluxes database in Sect. 6’ in the sentence.

Page 9855 Line 28: Please give some explanation why colder thawing temperatures increase Rs as it seems unreasonable.

Response: We rephrased the sentence to clarify the meaning as:

“Studies show that the magnitude of increased CO2 flux following thawing is controlled by characteristics of thawing events. For example, frozen soils in colder temperatures show greater increase of CO2 flux following thawing, possibly as a result of higher amounts of substrate accumulated in colder temperatures (Matzner and Borken, 2008; Goldberg et al., 2008).”

Page 9855 Line 29: It would be good to discuss the real mechanisms that were hypothesized by the studies cited as you did for the rewetting also for the freeze-thawing cycles. Thus, why does the first freeze thawing event gives the largest flux response? pore space” and ”enhances anaerobiosis”

Response: We added some information to clarify the meaning as following:

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“Another known factor is freeze–thaw cycle frequency, where the largest CO2 flux increase commonly occurs in the first thawing event (among repeated freezing–thawing cycles) with the effects declining in following cycles (Priemé and Christensen, 2001; Kurganova and Tipe, 2003; Goldberg et al., 2008) due to limited pool of labile substrates that have built up over time (Priemé and Christensen, 2001; Goldberg et al., 2008).”

Page 9859 Line 25: Please change: “at multiple” to “in various”

Response: We changed it as it was suggested as:

“further research is needed to identify the mechanisms controlling the response after rewetting and thawing in various ecosystems.”

Page 9860 Line 22: the term “15 d response” this needs to be defined as said above for CO2

Response: We rephrased the sentence to clarify the meaning as following:

“These studies have observed increased soil N2O flux following rewetting in a short-term (ca., 12 h) up to 15 d”

Page 9861 Line 21-24: There are not really mechanisms described in 3.1. for freeze thawing events.

Response: Mechanisms responsible for increased soil gas fluxes following thawing are described in 3.1.2.

Page 9863 Line 22-23: Please consider changing to “Rewetting studies have commonly reported a short-term increase in NO fluxes (ca. 1-3d): : :” The term “response” needs to be defined as said above for CO2

Response:

We rephrased the sentence to clarify the meaning as:

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“Rewetting studies have commonly reported a short-term increase in NO fluxes (ca. 1−3 d)”

Page 9864 Line 12: It is hard to tell what you mean by “physical mechanisms” for the different gases as there are many (decreased diffusion through pore clogging by water, gas diffusivity, increased substrate supply by shattering of aggregates? etc.) Maybe it would be good to go into more detail and describe which processes are important for which gas.

Response: We appreciated the comments and recognized important matter to improve our understanding increased gas flux following rewetting and thawing and improve current process based soil gas models. We are not aware of the information describing physical mechanisms for each gas in detail so it is not possible to describe it further more detail.

Page 9866 Line 2: Please change: “: : :at multiple: : :” to “: : :in various: : :”

Response: We revised the sentence as it was suggested as following:

“literature on NH3 flux and further research is needed to identify the mechanisms controlling the response after rewetting in various ecosystems.”

Page 9866 Line 5ff: Although I see that taking all preflux and postflux data from all gases into the same function are giving the response shown in Fig. 3 it is hard to believe that all gases responded in the same way to rewetting or thawing with no significant differences. For instance CO2 values in Fig. 3 are only to be found in the upper part of the curve and at least combining the rewetting CO2 response into a regression would result in a different regression with a much smaller slope. I suggest the authors provide proof on the response functions of each of the gases in each of the treatments with information on statistical differences between slopes and intercepts of the single regressions in a separate table or rephrase their conclusion that the combined soil gas response (all gases, thawing and rewetting) would give eqation 2 without stating

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that there were no significant differences between thawing/rewetting and among gas fluxes. Also Fig. 2 already showed that responses of fluxes to rewetting are completely "at multiple" to "in various"

Response: We removed the figure.

Knowledge gaps and future directions Page 9866 Line 20: please remove "of" from the headline

Response: We revised it as: "Uncertainties in understanding the responses"

Page 9867 Line 9: You present a review of 338 studies. I would not say that that is "relatively few"

Response: We removed the sentence.

Page 9867 Line 10ff.: I agree with the authors that many studies do not go into detail of all the questions stated here. I think this is also a problem when trying comparing the overall responses of the single gases to rewetting and thawing events in this review as data are deducted from studies that lack this kind of information. E.g. did you exclude studies that did not state the time-lag between rewetting and peak-fluxes or duration of the peak-fluxes when describing overall responses of the single gases?

Response: If the study clearly provide information how rewetting and thawing affect soil gas fluxes we didn't exclude any study although the study did not provide full set of information describing flux change.

I find that the general term "response" is a bit to broad for the reader to understand the whole dynamics of the pulses and should be defined better in the sections "General patterns of responses".

Response: We added definition of 'response' in the revised manuscript (section 3) as below and also changed 'response' to 'increase' or other specific words in the text.

"We define response as the behaviour or reaction of the soil gas fluxes that results from

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rewetting or thawing of soils."

Page 9867 Line 18ff.: The authors should go more into detail why it would be important to study changes in ratios of different gases in response to rewetting/thawing events, as it is not evident what extra information this would give on the impact on annual gas budgets.

Response: If a study conducts only a single gas measurement (e.g., CO2) it is impossible to know how rewetting of thawing events affect other gases (e.g., N2O, NO and NH3) beside the measured gas and consequently we can misestimate their impact of gas budget (e.g, N). We believed the sentences explained the situation well. Since the different mechanisms would be involved in changing the relative proportion of the emissions quantified information on the change in the relative proportion will provide a chance to improve our understanding on mechanisms as well. We added revised the part as following:

Changes in the relative proportion of CO2, CH4, N2O, NO and NH3 (e.g., CO2/CH4; CO2/N2O) emitted following rewetting and thawing compared with that of pre-disturbance conditions are poorly understood. To report these ratios and the change, additional efforts are required to conduct multiple gases measurements. This is important since the different mechanisms would be involved in changing the relative proportion of the emissions and a good understanding of the variation of the relative proportion could improve our understanding of the impact of rewetting or thawing on annual gas budgets.

Page 9868 Line 3: please remove "of" from the headline

Response: We revised it as: "Uncertainties in understanding mechanisms and drivers"

Page 9868 Line4ff. Maybe the detailed description in the doubts on drivers of N2O fluxes should go to the section where mechanisms and drivers of N2O fluxes are discussed.

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Response: We moved the information into mechanisms and drivers sections.

Page 9869 Line21ff. Why would you want to extend information from pot experiments and lab studies to the regional or continental scale? Ecosystem scale measurements are more appropriate for these calculations. Thus, I would not say there is a critical issue here since these studies have a different focus on trying to understand the mechanisms behind the gas pulses instead of trying to derive regional or continental gas budgets from their data.

Response: As the reviewer well pointed out, questions and hypotheses are different in different spatial scales of studies. Small-scale experiments are eligible to address questions and hypotheses on mechanism but it is hard to address questions how to affect regional scales and overall gas budget including greenhouse gases. In the part, we want to emphasize the need of larger scale of studies to better understand the effect on regional scales in addition to understanding mechanisms and derivers by using the previous small spatial scales studies.

Page 9870 Line19: I suggest citing Unger et al., 2010; 2012 here, as they try to explain mechanisms in CO2 flux increases after rewetting by stable isotope methods.

Response: We add Unger et al. (2012) in the part.

Unger, S. Máguas, C., Pereira, J.S., David, T.S., Werner, C. (2012) Interpreting post-drought rewetting effects on soil and ecosystem carbon dynamics in a Mediterranean oak savannah, Agricultural and Forest Meteorology, 154-155, 9-18, doi: 10.1016/j.agrformet.2011.10.007

Page 9871 Line 23: please correct: ": : :models can be used: : :"

Response:

We revised it as: "as models can be used to generate hypotheses (de Bruijn et al., 2009) to be tested in the field and lab."

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A Blog for open discussion and web based open databases Although I generally agree that data sharing and discussion on recent publications etc. help our understanding on the matter, I am not sure if it is appropriate to advertise the Blog in this review. I suggest removing this information or reducing it largely and putting it in the open Discussion Forum of BGSD.

Response: We think both Blog and open database are new types of information sharing methodology: two-ways communication, self-growing and discussion encouraging platform. Our Blog has been viewed by 520 times by visitors mainly from USA, Germany, Canada, Sweden, China and New Zealand and 19 comments are posted since we opened the Blog.

We moved a section "5 A Blog for open discussion and web based open databases" to a new section "Supplementary information" following "Acknowledgements". Also we reduced the length of the section by removing supporting sentences.

Supplementary information We have created a 'Blog' (web-based discussion) entitled 'Rewetting, thawing and soil gas fluxes' (http://rewettingandthawing.blogspot.com/) and we have uploaded a current version of this review paper section by section as an individual post in the Blog; comments can be left under the separate posts. Open-access datasets, which can be modified by the users, are linked to the Blog: 'Rewetting, thawing and soil gas fluxes database' (https://spreadsheets.google.com/spreadsheet/ccc?key=0AjWu6bR8SA9idHY4Tk5TdDZDMWgtMEJsUVhFOWhKLWc&h
The dataset contains detailed information in the reported studies on soil gas peak flux following rewetting and thawing. The dataset is hosted in web-based spreadsheets and is easily accessible and modified. The authors do not have any relationship with the companies currently being used to host the Blog and databases. Finally, version 1 of this dataset has been archived at the Oak Ridge National Laboratory Distributed Active Archive Center (http://daac.ornl.gov/; A Global Database of Gas Fluxes from Soils after Rewetting or Thawing, Version 1.0) and is available for reproducing the results presented in this study.

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Table 1 Please add the number of field and laboratory studies that enter this analysis to the table legend

Response: We added the numbers in the table and text.

Figure 2 Please correct hyphens at the x-axis.

Response: We were confused by this comment, as we did not have hyphens in the x-axis. What we noted, and now corrected, are the subscripts for each one of the gases. We changed CO2, CH4, N2O and NH3 to CO2, CH4, N2O and NH3, respectively in the x-axis.

Please state in the table legend what the boxes and the whiskers represent (medians, 25% and 75% percentils, standard deviations,maximum values etc.).

Response: We added the information in the figure caption.

Figure 4 Please correct hyphens at the y-axis.

Response: We were confused by this comment, as we did not have hyphens in the y-axis. What we noted, and now corrected, are the subscripts for each one of the gas names. We changed CO2, CH4, N2O and NH3 to CO2, CH4, N2O and NH3, respectively, in of the figure legend.

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