Dear Prof. Schindlbacher,

We highly appreciate the valuable comments you made on our paper. They were all enlightening and helped improved our manuscript. We respect and posed no objection on your ideas and recommendations and carefully considered them individually. Below we would like to confirm the correction made in response to your comments. Additional corrections have also been made on the previous manuscript following the remarks of other reviewers, so we would appreciate it if you could also refer to our responses made for other reviewers. We hope that the present correction will meet the criteria for your positive evaluation and fulfills your requirement for the paper's acceptance. We will be glad to receive any further suggestions for the paper's improvement that you may have.

Please take note that those written in **black** were your comments while those in **blue** were our responses

Aguilos et al. present results from a two and a half years soil warming study in a forest grown on former peatland in northern Japan. The topic is in the focus of Biogeosciences and is of high relevance in climate change research. The presented paper in Biogiosciences Discussion however, to my feeling, does not meet the high standards of the journal. The main outcome of the study, that the former peat soil likely loses high quantities of C under warmer conditions, is of relevance and should be published. However, the speculation about Q10 and heterotrophic basal respiration could be reduced to a minimum. I am sorry for being so critical. The reasons, you find below in the comments.

Major comments:

In the study soil was trenched to 30 cm depth. It however seems that the former peatland soil is much deeper than 30 cm (as the organic layer is already reported to be 40 cm thick; P6420). What if there were roots below 30 cm? - What is likely, considered that the trees on site were 40 years old. Unless authors dont give a reasonable explanation why they did not trench down to the bedrock (or groundwater table), this will be seen as a major weakness of the study.

In order to prove whether trenching depth is sufficient or not, we established three 15 × 15 cm^2 plots beside the chambers in control plots. We collected 15 × 15 × 15 cm^3 soil blocks each for the three layers (i.e. 0-15, 15-30, 30-45 cm deep) and coarse and fine roots were collected on each soil block, then washed and ovendried to determine their biomass contents. The root biomass for each layer was 664±64SD, 156±22, and 41±8 gDW m^{-2}, for 0-15, 15-30, and 30-45 cm deep, respectively. Based on the new results, we considered that the contribution of roots below 30 cm deep to soil respiration could be minor at trenched treatments.

Supporting our result, a previous soil coring and minirhizotron study made within Teshio Experimental Forest have shown that the fine roots of both bamboos (*Sasa senanensis* and *Sasa kurilensis*) and prevailing trees (the same species within our site) were concentrated in the surface soil (0-15 cm) and decreased with increasing soil depth (Fukuzawa et al., 2007, Ecological research, 22, 485-495). This similar pattern was observed in our site.

In addition, we collected soil core samples beside the chambers in control plots at 5, 10, 20, and 40 cm deep in the soil with 5 replicates to determine C contents and stock within the surface

30 cm soil layer. Accordingly, we deleted the sentences on the soil carbon content at P6419L15-25 and P6429L11-13 in the previous manuscript, then we added new sub-sections ”Soil and root biomass measurements” in the Material and method section, and “Soil carbon content and root biomass” in the Results section to show this newly observed data as follows:

“2.5 Soil and root biomass measurements

In August 2011, soil sample cores of 100 cm^3 (5 cm in diameter) each were collected besides the five chambers in control plots at 4 depths (5, 10, 20 and 40 cm) to evaluate the soil carbon content and density in the study area. Dry bulk density was obtained by weighing the samples after 2 days of oven-drying at 80 ˚C. Soil carbon content was analyzed using an automatic NC analyzer (Sumigraph NC-900, Sumika Chemical Analysis Service, Japan), attached to a gas chromatograph (GC-8A, Shimadzu Corp., Japan). Three homogenized soil samples with 49 to 52 mg weight were analyzed to get the average for each core.

In addition, root biomass (> 0.5 mm in diameter) was measured every 15 cm soil layer down to 45 cm deep at three of the five points where the soil cores were sampled. Soil blocks with 15×15×15 cm were collected at each layer, and roots in the blocks were collected. The root samples were washed and oven-dried at 80 ˚C for two days and weighed.”

“3.1 Soil carbon content and root biomass

The soil carbon content was 99±32 SD, 111±32, 188±22 and 233±45 g kg^{-1}, at 5, 10, 20, 40 cm deep, respectively and evaluated soil carbon density at surface 30 cm soil layer was 17.6±1.6 kgC m^{-2}. The root biomass was 664±64, 156±22, and 41±8 gDW m^{-2}, for 0-15, 15-30, and 30-45 cm soil layers, respectively. The root biomass sharply decreased with the increase in depth and >95% of the roots in the collected soil was in the surface 0-30 cm soil layer.”

However, the large proportion of heterotrophic respiration to total soil respiration obtained in this study might be partly caused by incomplete trenching, thus in the discussion section 4.3 , we acknowledged the possibility by mentioning the disadvantages caused by trenching method as follows:

“4.3 Contribution of heterotrophic respiration to the total soil respiration

Our result showed that heterotrophic respiration rate (not associated with warming) governs the total soil respiration rate given its 71% contribution. Several studies report the similar contribution of heterotrophic respiration such as, 67% for a mixed hardwood forest in Massachusetts (Bowden et al., 1993); 77% for a lowland old-growth beech (*Nothofacus*) in New Zealand (Tate et al., 1993); >70% for *Picea abies* stands in Northeast Bavaria, Germany (Buchmann, 2000); and 56 to 69% for a subalpine forest dominated by lodgepole pine (*Pinus contorta*) trees in Niwot Ridge, Colorado (Scott-Denton et al., 2006).

However, because we applied trenching method to separate heterotrophic and autotrophic respirations, it could have altered the microorganism activities and thus, decomposition of soil organic matter due to the absence of living roots (Kuzyakov, 2006), which may had caused the underestimation of the observed heterotrophic respiration. On the other hand, because trenching itself could stimulate root decomposition and soil respiration and the phenomenon can last for more than 6 to 9 months (Zhou et al., 2007), the data obtained in 2007 could have overestimated the contribution of heterotrophic respiration to total respiration. Uncertainties still remain as to the contribution of root respiration below the trenching depth (30 cm), although our root biomass survey shows minor contribution of the root below 30 cm to the whole root biomass within the surface 45 cm soil layer. Contribution of roots in deep layer could cause an overestimation of the heterotrophic respiration in the unwarmed-trenched treatment, and underestimation of the autotrophic respiration estimated as the difference between the two treatments (unwarmed-trenched and control). Given these disadvantages in the method, our estimated values may include uncertainties to some extent."

The discussion on how warming affected Q_{10} and heterotrophic basal respiration, which comprises a major part of the paper, is highly speculative and not supported by any statistics. Also the concept how Q10 and basal respiration were calculated might be overthought.

The calculation of Q10 from seasonal soil respiration data is problematic (see comments of Reviewer 1, which I completely agree with). Beside the suggestions of Reviewer 1, I also suggest to compare only Q10 values and basal respiration which were calculated over the same temperature range. Soil temperatures at warmed plots showed a broader spectrum (0-24_C (Fig 6)) as control plots (0-20_C). Hence, it is difficult to conclude if basal respiration and Q10 were influenced by warming treatment, or if the differences in Q10 and basal respiration resulted from theoretically lower temperature sensitivity at the end of the temperature spectrum which, however, was only evident at the warmed plots (20-24_C).

Following your and other reviewer's comments, we determined daily Q_{10} and R_{10} in the equation, $F_c = R_{10} \times Q_{10}$^$((T_s-10)/10)$, for each chamber by least-squares method using hourly soil respiration and temperature data within 15 days moving windows (previous and following 7 days each). Figure I shows the seasonal variation in Q_{10} and R_{10}, and Table II shows the summary of statistics of each treatment.

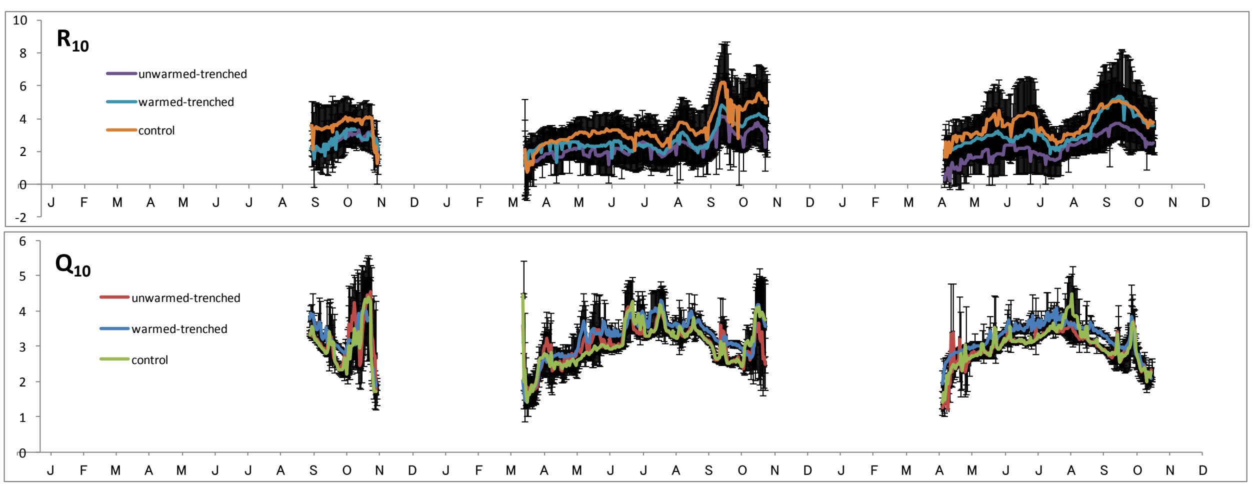

Figure I. Seasonal variation of Q_{10} and basal respiration rates at 10ºC (R_{10}). Colored lines indicate the daily average of 5 chambers for each treatment and vertical bars denote standard deviation for each day per treatment.

Table I. Temperature sensitivity (Q_{10} and R_{10}) of soil CO_2 efflux rate for each treatment. Whole data obtained by 5 chambers and certain period (3 years or each year) were used to analyze the significant difference among treatments. Values were shown as average±standard deviation (number of data). Tukey-Kramer HSD test was used to check the significant difference among treatments and values in a row followed by different superscript letters denote significant difference ($p < 0.001$) among treatments.

	Unwarmed–trenched	Warmed–trenched	Control
		Q_{10}	
3 years	3.03 ± 0.65^{a} (2275)	3.24 ± 0.60^{b} (2304)	3.03 ± 0.64^{a} (2307)
2007	3.20 ± 0.90^{ab} (311)	3.29 ± 0.75^{a} (303)	3.04 ± 0.78^{b} (312)
2008	3.03 ± 0.66^{a} (1095)	3.25 ± 0.65^{b} (1123)	3.05 ± 0.65^{a} (1114)
2009	2.98 ± 0.49^{a} (869)	3.21 ± 0.47^{b} (878)	3.00 ± 0.58^{a} (881)
		R_{10}	
3 years	2.50 ± 0.89^{a} (2275)	2.94 ± 1.52^{b} (2289)	3.59 ± 1.45^{c} (2307)
2007	2.65 ± 0.57^{a} (311)	2.68 ± 1.09^{a} (288)	3.64 ± 1.15^{b} (312)
2008	2.41 ± 0.97^{a} (1095)	2.77 ± 1.42^{b} (1123)	3.47 ± 1.55^{c} (1114)
2009	2.55 ± 0.86^{a} (869)	3.24 ± 1.69^{b} (878)	3.72 ± 1.42^{c} (881)

These analyses showed that warming treatment increased not only the heterotrophic and basal respiration rate but also Q_{10}, thus we revised the manuscript (including the title, abstract, materials and method) according to these new results. However these results still support one of our conclusions that "if we predict the soil heterotrophic respiration rate in future warmer environment using the relationship between soil temperature and soil heterotrophic respiration obtained at present climatic condition, the rate can be underestimated". The new title is "Soil warming in a cool-temperate mixed forest with peat soil enhanced heterotrophic respiration rate and temperature sensitivity".

In agreement with your recommendation and the suggestion from Reviewer #1, fitting regressions for shorter periods and for each chamber has the advantage of showing the seasonal variation and the daily standard deviation for each treatment. In addition, we can check the significant difference among the treatments, so we decided to use the newly computed results. All new results were reflected in the revised paper.

For your information, we also determined Q_{10} and R_0 (basal respiration rate at 0 ºC) using soil respiration rate obtained at the same temperature range (0-20 ºC). If we use the hourly data set, the Q_{10} became 2.80, 2.88, 2.82 for unwarmed-trenched, warmed-trenched, and control treatment respectively, while the values were 2.79, 2.74, and 2.81, respectively in the previous manuscript. On the other hand, the R_0 became 0.93, 1.15, and 1.33, respectively, while the original values were 0.93, 1.21, and 1.33, respectively. This calculation supplied relatively higher (lower) Q_{10} (R_0) compared with those of previous manuscript, and warming enhanced both Q_{10} and R_0. However, because of the disadvantages in the determination of temperature sensitivities adopted in the previous manuscript, we did not use these values for the revised manuscript instead, we used Q_{10} and R_{10} determined by least squares fitting for shorter periods.

General comments:

As recommended by Reviewer 1, the paper should be edited by a native speaker.

We will subject our revised manuscript to an English-editing company prior to resubmission.

Authors gathered CO2 data in very high temporal resolution. They could try to find out if the warming effect was equal over time or changed throughout the observation period, seasons, day-night, periods with high or low soil moisture/temperature, during or after litter-fall and so forth. This would be very interesting.

I appreciate your helpful suggestion, however, because we did not collect tree phenological data (including litter-fall) to be able to stand such analysis, the obtained conclusion may be vague, thus we abandoned to include in this study.

Missing statistics regarding comparison of Q10 and basal respiration from different treatments could be solved by calculating Q10 and basal respiration for each chamber and then calculating and comparing the treatment means, instead of comparing single Q10 numbers calculated out of mean CO2 fluxes and temperatures. Generally, I am not sure if two and a half years of warming is enough to draw conclusions about variations in Q10 and basal respiration – especially, as pre-warming CO2 measurements seem to lack. - And considering all the problems regarding calculating Q10 out of seasonal CO2 data as mentioned by Reviewer 1.

Following your recommendation, we determined seasonal variation in Q_{10} and R_{10} for each chamber and averaged the values for each treatment in the revised paper, as mentioned above.

It seems that there were no pre-treatment CO2 measurements. This is a problem as authors found higher (20-40%) basal respiration on warmed-trenched plots as on control-trenched plots. If there were no pre-warming CO2 measurements, to my understanding, it is not clear how to distinguish if the higher basal respiration resulted from soil warming (as concluded by authors) or if the warmed-trenched plots already showed higher basal respiration before the warming treatment. If pre-warming basal respiration was really higher at the later warmed chambers, than the estimate of 74% increase in soil respiration due to warming would be overestimated.

Unfortunately, we failed to collect observed data before warming (14 July to 19 August, 2007) because of the problem in the data-logger, so we cannot confirm the uniform soil condition among plots before the treatment. However the newly analyzed temperature sensitivities (Q_{10} and R_{10}) shows that the significant difference among treatments was observed in 2008 and 2009 and was not observed in 2007, thus it is likely to consider that the warming increased the sensitivities. In addition, we set up chambers covering larger area for each treatment (4.05 m^2) compared to previous similar warming experiments to achieve ±20% precision at 95% confidence interval (P6418L2-7 and P6420L3-5). Accordingly, the difference in the pre-warming condition among treatments is considered to be minimized.

This discussion was also added to the last part of the subsection "4.2 Temperature sensitivity"

Authors used infrared heaters to warm the soil. I suggest giving more information on how that worked out. So far only soil temperatures at 5cm soil depth are provided. Where temperature differences at the soil surface similar, or much higher? Also a picture or conceptional drawing of a warmed chamber would be helpful. To give a more accurate estimate of the contribution of autotrophic and heterotrophic soil respiration, CO2 efflux from decomposing trenched roots should be accounted for.

We added one figure in Materials and method section to show our warming system (Figure II).

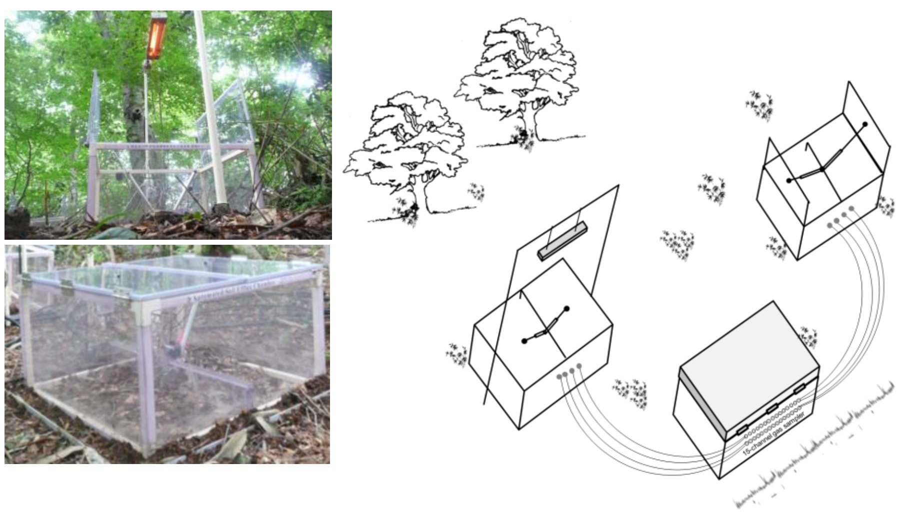

Figure II Images of warmed-trenched plot (upper left); a closed chamber with trenching (lower left); and a schematic illustration of the multi-channel automated system.

We observed the difference in the soil temperature profile between unwarmed- and warmed trenched treatments from 22 August to 7 September 2011 (Figure III). The temperature difference between the treatments linearly decreased with the soil depth. The difference at soil surface (-1 cm in depth) was 0.35ºC higher than that at -5cm, and decreased down to ca. 1ºC at -35 cm.

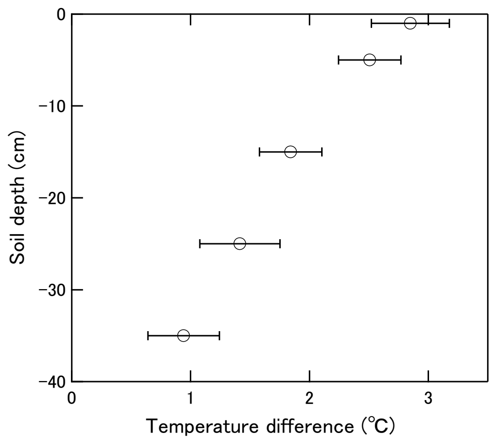

Figure III Difference in the soil temperature profile between unwarmed- and warmed trenched treatments from 22 August to 7 September 2011. Open circles and horizontal bars show the average and standard deviation during the observation period, respectively.

We added this figure and information at the first part of sub-section 3.1.

We revised the sub-section "4.3 Contribution of heterotrophic respiration to the total soil respiration" as mentioned above by adding discussion on the uncertainties in the contribution of autotrophic and heterotrophic respiration caused by adopting trenching method. However, we did not include the estimation of CO_2 efflux from decomposing trenched roots here to avoid further over-thinking.

Specific comments:
Abstract:

L1: We conducted a soil warming experiment in a forested peatland in northern Japan, during the snow-free seasons 2007-2009. (snow-free instead of snowless throughout the whole paper)

We revised all "snowless" throughout the whole manuscript.

L3: ... respiration rate and its temperature sensitivity...
L8: ..was carried out....and autotrophic respiration. (delete: from the total soil respiration)
L11: ... contributed 71 % to total ....
L20: ... in the temperature sensitivity of heterotropic soil respiration (Q10 of 2.79 and 2.74 determined....

We apologize for our poor English composition. We already revised accordingly.

L13-14 and the whole manuscript and figures: mean 3.52 +- 1.74 _ mol m-2 s-1 of what ? CO2, C? For example: 3.52 +- 1.74 _ mol C m-2 s-1

All units were changed into µmol C $m^{-2}s^{-1}$, although we considered that we do not need to show which, because 1 mol CO_2 includes 1 mol C and the amounts are same when we use mol for the unit.

Last sentence: I do not understand that.

Results suggest that if we predict the soil heterotrophic respiration rate in future warmer environment using the current relationship between soil temperature and heterotrophic respiration, the rate can be underestimated.

This sentence (in abstract and conclusion) was revised into:

Results suggest that global warming enhances not only the heterotrophic respiration rate itself but also its Q_{10} and basal respiration rate in forests with high substrate availability. Thus if we predict the soil heterotrophic respiration rate in future warmer environment using the relationship between soil temperature and soil heterotrophic respiration obtained at present climatic condition, the rate can be underestimated.

Introduction:
P6417: L5: actually it is the second largest flux in the terrestrial C cycle (not global)
L15: ...the decomposer community..
L17: Hence, the feedback strength may not be as large as the prediction obtained by assuming constant temperature sensitivity of soil organic matter decomposition (Friedling...
L28: ...with high carbon stock...
P6418: L1: We conducted a soil warming experiment in a cool-temperate mixed forest on peat soil. For precise....

We revised according to your suggestion.

L7-L15: This part should be completely rewritten. Please define your hypotheses here. We hypothesized that..... because.......

We hypothesized that soil warming would stimulate soil heterotrophic respiration in forest with high soil carbon and water stock because of the high substrate availability without severe water stress. We also expect that warming alters not only respiration rate but also the relationship between soil temperature and respiration, which leads to a change in the temperature sensitivity of respiration such as Q_{10}. While several studies have questioned the validity of using Q_{10}'s (Lloyd and Taylor, 1994; Kirschbaum, 1995; Davidson et al., 2006; Bronson et al., 2008), we used the parameter because it offers a convenient point of comparison to previous studies.

Materials and methods:
Authors always refer to “chambers” and not plots, which makes the whole section difficult to read and understand (at least for me). It might help if you once state, that you have placed an automatic chamber on 5 trenched plots, 5 trenched-warmed plots, and 5 control plots, and then refer to trenched plots, trenched-warmed plots, and control plots in the further text.

The second sentence in sub-section 2.2, “There were three chambers within each group that were randomly assigned to one of the three treatments: (1) warmed-trenched; (2) unwarmed-trenched; and (3) served as undisturbed-control chamber (neither trenching nor warming).” was revised as follows;
“There were three chambers within each group that were randomly assigned to one of the three treatments: (1) warmed-trenched; (2) unwarmed-trenched; and (3) served as undisturbed-control chamber (neither trenching nor warming), thus we placed an automatic chamber on 5 warmed-trenched plots, 5 unwarmed-trenched plots, and 5 control plots.

P6419: L15 onwards: it would be important to determine C and N contents and stocks of the whole soil profile and not only for the first 5cm soil depth.

As above mentioned, we measured soil carbon content at 5, 10, 20, 40 cm deep in the soil with 5 replicates to evaluate the soil carbon density at surface 30 cm in the soil, following your recommendation.

P6423: L3: This quality checking successfully removed bad quality data (Fig. 1). -> This sentence actually belongs to the results already.
Generally, it seems that data processing was done very thoroughly – which is very much to appreciate.

This sentence was moved to the first part of the sub-section “3.2 Soil CO_2 efflux and the warming effect”. We appreciate your high evaluation on our data processing.

Results:
In accordance with Reviewer 1 + statistics for Q10 and basal respiration are missing.

Discussion:
See general comments and comments from Reviewer 1.
Table1: Statistical significance?

We revised following your recommendation as mentioned above.

Fig 1: The figure could be skipped as the data processing is nicely explained in the methods.
Figure 8 could be deleted. It is mentioned in the text, that there was no relationship between soil moisture and CO2 efflux.

We removed these figures.

Fig 2 and Fig 3 could be merged and soil moisture data could be added
Fig 3: is much too small – these are the main results and they should be presented more prominently

We merged and added soil moisture data as Figure IV in the last part of these response.

Fig 4 and Fig 5 (and Fig 6) show the same – don't they?

We fully revised especially sub-section "3.2 Soil CO_2 efflux and the warming effect" as follows, by adding Figures I, II, III, and IV and Table I in this response, and deleting Table 1, Figures 1, 2, 3, 4, 6 and 8 in the previous manuscript. However, we remained Figure 5 just to show the overall temperature sensitivity for each treatment (but the regression equation was changed to the new one). We also revised related sentences in the manuscript describing new methods to determine seasonal variations in Q_{10} and R_{10}.

"3.2 Soil CO_2 efflux and the warming effect

Soil CO_2 effluxes in all the treatments roughly paralleled to the seasonal variation of soil temperature. Increasing the rate at the start of growing season in spring until summer and decreases towards leaf fall in autumn (Figure IV). Soil warming increased the heterotrophic respiration rate consistently across the entire measurement period ($p < 0.001$). The efflux rate of control chamber was almost the same with that of warmed-trenched chamber in 2007, but was intermediate between the effluxes of warmed and unwarmed trenched chambers. Mean heterotrophic respiration rate was 4.67, 5.87, and 6.91 (μmol C m^{-2} s^{-1}) during snow-free period in 2007, 2008, and 2009, respectively, at warmed-trenched treatment, showing increasing trend from 2007 towards 2009. This increase is likely caused by the increasing temperature during this period. Across all seasons within the 3-yr warming period, soil CO_2 efflux was greatest in the warmed-trenched chambers (Figure IV). Warming increased the efflux by 74% (or around 25% per ºC) (mean 6.11±3.07SD μmol C m^{-2} s^{-1}) compared with that of the unwarmed-trenched treatments (mean 3.52±1.74μmol C m^{-2} s^{-1}) ($p<0.001$), while the control chambers obtained 4.98±2.44 μmol C m^{-2} s^{-1}.

The difference in soil CO2 efflux between unwarmed-trenched and control chambers showed that heterotrophic respiration contributed 71% of the total soil respiration and the remaining 29% was assumed to be the autotrophic respiration (Figure 7 in the previous manuscript). Autotrophic respiration peaked in advance (June to July) from that of heterotrophic respiration (August) in both 2008 and 2009. For over 20-month period, total soil respiration rate reached 2.74 kgCm^{-2} wherein 1.94 kgCm^{-2} of it had been contributed by heterotrophic respiration. Calculating for an equal period of measurement from 22 April to 19 November for both 2008 and 2009 showed that total soil respiration rate dropped from 1.20 kgCm^{-2} in 2008 to 1.13 kgCm^{-2} in 2009 while soil heterotrophic respiration decreased from 0.86 kgCm−2 in 2008 down to 0.81 kgCm−2 in 2009. A higher average soil temperature in 2008 (15.5 and 15.6 ºC for control and unwarmedtrenched treatment, respectively) than that in 2009 (14.8 and 15.0 ºC, respectively) was observed from June to September, and this could cause the decrease in the soil respiration rates in 2009. The rate of decrease in the total soil respiration from 2008 to 2009 (0.07 kgCm^{-2}) was primarily driven by the decrease in the soil heterotrophic respiration (0.05 kgCm^{-2}).

An exponential function described the relationship between the soil CO_2 efflux and soil temperature for each treatment (Figure 5 in the previous manuscript, but changing the regression equation). Q_{10} values in unwarmed-trenched, warmed-trenched and control were 2.44, 2.44, and 2.54, respectively, with little difference between unwarmed- and warmed-trenched treatments. Meanwhile, basal respiration rate at 10ºC in soil temperature (R_{10}) differs among treatments with a higher R_{10} in warmed-trenched chambers (3.59 µmol C m^{-2} s^{-1}) compared with unwarmed-trenched chambers (2.75 µmol C m^{-2} s^{-1}). Control chambers showed the highest (3.91 µmol C m^{-2} s^{-1}) owing to the contribution of root respiration.

Seasonal variation in Q_{10} and R_{10} (Figure I) showed that Q_{10} tended to be high in summer except very high values obtained jut after snow melt and before snow accumulation, while R_{10} tended to be high in Autumn. Comparing whole 3-yr data set, R_{10} in warmed-trenched chambers (2.94 ± 1.52 µmol C m^{-2} s^{-1}) was significantly higher than that in unwarmed-trenched chambers (2.50 ± 0.89 µmol C m^{-2} s^{-1}) (Table I). Control chambers showed the highest R_{10} (3.59 ± 1.45 µmol C m^{-2} s^{-1}) owing to the contribution of root respiration. The significant difference caused by warming was observed in 2008 and 2009, but not in 2007. The increase in R_{10} was observed in 2009 compared with that in 2008 for all treatments.

Similar to the case for R_{10}, warming increased the Q_{10} significantly, if we compare data in whole 3 years, 2008, and 2009, while there was no significant difference between unwarmed-trenched and control treatments for the 3 years. Contradictory to the case for R_{10}, Q_{10} in 2009 was lower than that in 2008 for all treatments. The short term determination and averaging of Q_{10} and R_{10} in Table I increased the values compared with the case obtained as in Figure 5."

Thank you very much.

Sincerely yours,

The Authors

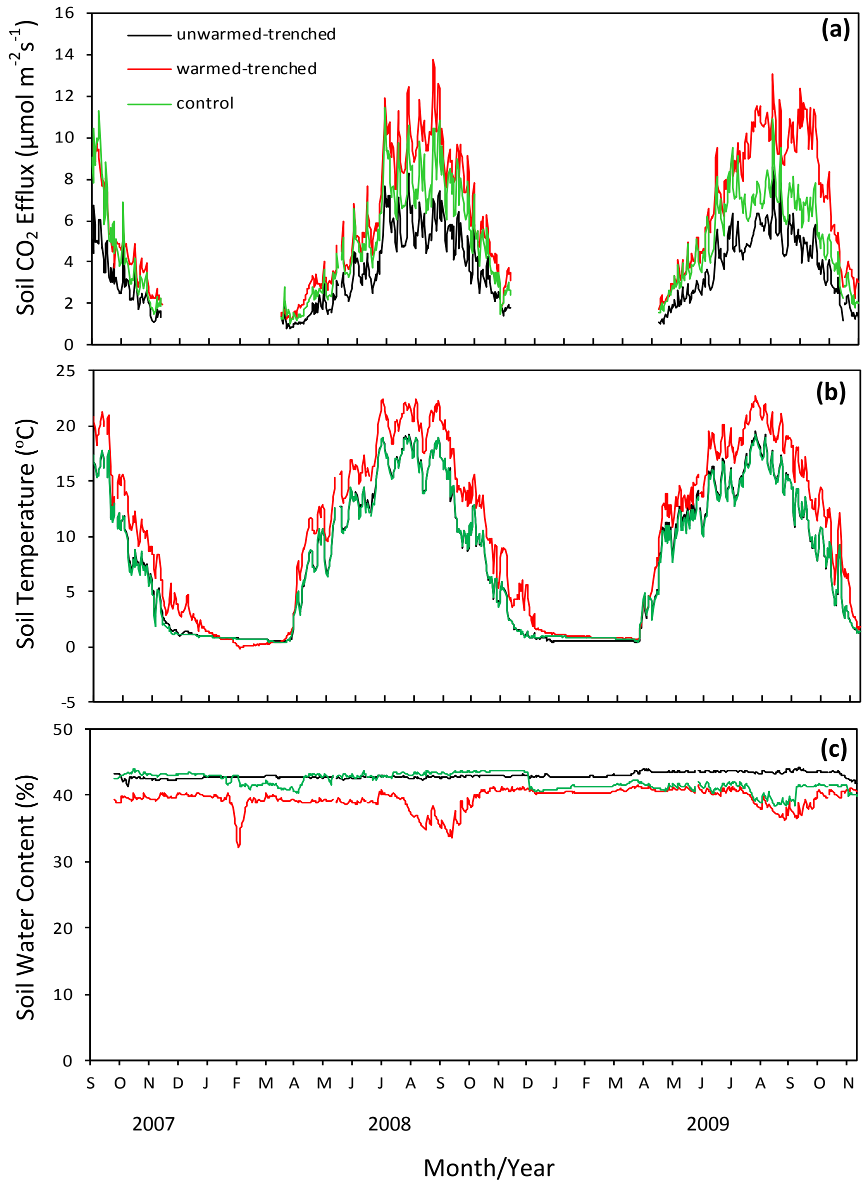

Fig IV Interannual variation of (a) soil CO_2 efflux; (b) soil temperature; and (c) soil water content in unwarmed-trenched, warmed-trenched, and control treatments during the study period in 2007–2009. All data are daily averages.