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Discussions

Interactive comment on "Soil greenhouse gas fluxes from different tree species on Taihang Mountain, North China" *by* X. P. Liu et al.

X. P. Liu et al.

wanjzhang@126.com

We would like to thank Referee #2 for his constructive comments that helped to improve the manuscript substantially. Please see our detailed response to reviewer's comments below.

Review of Liu et al. Soil greenhouse gas fluxes from different forest types on Taihang Mountain, North China The manuscript reports CO_2, CH_4 and N_2O fluxes from six different forest types/tree species over a period of two years between 2010 and 2012. The authors conclude that CO_2 differs between tree species, seasons and is tightly related to soil moisture and temperature. N_2O fluxes also differ between forest types, but are not related to either soil moisture or soil temperature as is also the case for CH_4 fluxes, which do not differ between forest types. The authors also include other

soil factors such as pH, bulk density, SOC and soil N in order to explain observed tree species differences or lack thereof. The data analysis in the paper must be improved by applying more sophisticated statistical analyses of their GHG time series in comb-nination with the treatment factors (season, tree species, litter). This will also enable the authors to discuss their GHG fluxes to a greater degree and present novel findings. In its present form the manuscript rarely synthesizes their findings, but merely report. There is obviously a great work effort behind this work, but the data analyses and inter-pretation is still far from the standard to be expected in Biogeosciences. It is imperative that the reader reads something new and exciting in relation to GHG. The dataset holds the potential for a good paper, but it is not realized at this point. My recommendation is therefore reconsideration after major revisions incorporating new statistical analyses that can fulfill the authors objectives and subsequent synthesis of their results. I have given relatively detailed comments below as suggestions how to improve the paper.

Abstract Considering the paper in its current form the abstract is clear and well written.

Introduction

1. Page 11039, line 16 – 22: Change sentences "Borken et al. (2003). . ." to "Borken et al. (2003) reported a strong impact of forest type on the soil CH_4 sink between natural mature beech forests and mature pine and spruce plantations in two study areas in Germany. On the other hand, Borken and Beese (2005) reported no differences in soil N_2O emissions between European beech, Scots pine and Norway spruce forests in two study areas in Germany with distinct climate, N deposition and soils."

The sentences have been revised according to your advice, please check (Page 3 Line 16-21).

2. Page 11039, line 24: insert "determining" instead of "identifying" after "Therefore,"

Thanks for your valuable comments, "identifying" has been replaced by "determining".

3. Page 11039, line 25: delete ". . .and determining. . .rates"

Many thanks for your suggestion, the sentence has been deleted.

4. Page 11039, line 27: Add in one line why Taihang Mountain is ideal for studying tree species impact on GHG

Thanks for your valuable comments, the sentence has been added to the end of the paragraph.

5. Page 11040, line 8-16: I suggest deleting this entire section as it is of minor relevance to your research in this paper.

Yes. The section has been deleted according to your advice.

6. Page 11040, line 19: replace "exchanges of GHG" with "hence exchange of GHGs"

Yes. "exchanges of GHG" has been replaced by "hence exchange of GHGs".

7. Page 11040, line 23-25: Is this only in China or does it apply to other countries and is it a general gap in knowledge?

We really appreciate your critical comments. The sentence has been rewritten, please check (Page 5 Line 3-5).

8. Page 11040, line 25-30 & Page 11041, line 1 – 5: Move this paragraph to page 11039, line 27 as a new paragraph before the introduction of Taihang Mountain.

We do agree your comment. As a new paragraph, the section has been moved to the front of introduction of Taihang Mountain, please check (Page 4 Line 1-10).

Materials and Methods

1. Page 11042, line 17-19: Delete part of sentence "Economic. . ., and"

Thanks for your comments. The sentence has been deleted, please check (Page 6 Line 20).

2. Page 11042, line 26-27: define "as usual" in relation to the forest management

practice

Because sampling plot was randomly place in each tree species (Page 6 Line 1-2), there is no doubt that the sampling plots of P. granatum and Z. jujube were managed the same as P. granatum and Z. jujube forests, so the sentence has been deleted, please check (Page 6 Line 20).

3. Page 11043, line 1: insert "are" instead of comma and insert "and" after Mountain

Many thanks for your valuable advice. "are" and "and" has been inserted.

4. Page 11043, line 8-9: delete "because. . .villagers."

Thanks for your valuable comments. The sentence has been deleted.

5. Page 11043, line 12-15: Here it is unclear whether fertilizer or manure application was performed during your study. This needs to be clarified as nutrient addition can impact your results.

The sentence "The fertilizer or manure application was not performed during the experiment" has been inserted. Thanks for your further advice.

6. Page 11043, line 23-24: Do you mean that canopy and community (table 1) cover is the same? Clarify or change wording so it is similar in text and tables.

Many thanks for your suggestion. "canopy cover" and "community cover" has been replaced by "forest coverage".

7. Page 11044, line 5-6: Delete sentence "Fluxes. . ."

We do agree your valuable comments. The sentence has been deleted.

8. Page 11044, line 15: Specify the gas volume you sampled

The gas volume has been added to the sentence, please check (page 8 line 22).

9. Page 11045, line 6-9: please state the name of the p=P/RT constant and change

units of chamber volume and area to SI units (e.g. m3 and m2).

The name of the p=P/RT constant has been stated and the units of chamber volume and area have been changed to SI units, please check (page 9 line 17-20).

10. Page 11045, line 13: replace "soil respiration" with "GHG flux"

"soil respiration" has been replaced by "GHG flux" according to your advice.

11. Page 11045, line 14: 1) specify the weight of the soil sample and 2) define what "close to" means in quantitative terms (is close in meters or centimeters?)

The weight of soil sample and the distance to chambers has been added to the sentence, please check (page 10 line 13-15).

12. Page 11045, line 22-23: Why do you use mean values for the three chambers? You reduce some of the natural variation in the dataset, but does that really serve your purpose to do this. Clarify your arguments for this.

GHG flux of one chamber was calculated based on the rate of change in GHG concentration within the chamber, which was estimated as the slope of the linear regression between concentration and time, data from individual collars occasionally had to be discarded if changes in gas concentrations did not follow a constant linear increase or decrease. GHG fluxes of one tree species were taken as the average of the three replicates. To avoid confusion, the sentence has been deleted.

13. Page 11045, line 23: What do you mean by "Multiple comparisons analysis. . ."? Is it One-way ANOVA with multiple comparisons? And if so, what post-hoc test did you use?

We do agree your valuable comments. The section has been rewritten, please check (page 10 line 22-23 and page 11 line 1-6).

14. Page 11046, line 1-2: What statisitical test did you use when data were normally distributed? Specify.

We do agree your valuable comments. The section has been rewritten, please check (page 10 line 22-23 and page 11 line 1-6).

15. Page 11046, line 5 – 6: you test the impact of season, litter and tree species, but on what time scale do you aggregate data? In my opinion univariate analyses is too simplistic approach and will not reveal if the tree species behave differently over seasons. Two suggestions how you can address this using more complex multiple regression. 1) A mixed model taking tree species and season in to account could give you the same result as the univariate, but also extend to the possible interactions between tree species and seasons. This is a reasonable assumption given that some of the tree species found at Taihang Mountain have adapted to different growing conditions (wet vs drier). 2) A repeated measures ANOVA with tree species and litter removal categorical variables and chamber number as the repeated factor could explore, by implicitly taking temporal variability of GHG fluxes in to account, how these factors affect GHG.

The data analysis has been improved by applying more sophisticated statistical analyses in combnination with the treatment factors (season, tree species, and litter), please check the page 37 table 3.

16. Page 11046, line 5: Unclear what type of "multiple linear regression analysis" you used. Was it stepwise or mixed models or more simple? Specify.

We do agree your valuable comments. The section has been rewritten, please check (page 10 line 22-23 and page 11 line 1-6).

Results

1. Page 11047, line 10: insert "were on average" instead of "averaged". Also in brackets after "average" should info on the uncertainty term: is it standard deviation or standard error of the mean?

Many thanks for your suggestion. "averaged" has been replaced by "were on average" and "(mean ± S.E.)" has been inserted, please check (page 11 line 21-23 and page

12 line 1).

2. Page 11047, line 10-11: get rid of decimals. Maximum of 1 decimal for uncertainty terms. Accounts in the entire manuscript.

Thanks for your valuable comments. Digital in the entire manuscript reserved a decimal fraction.

3. Page 11047, line 25-27 & Page 11048, line 1-2: Insert this part AFTER the N2O result section.

Based on your valuable advice, the part has been moved to the end of the N2O result section, please check (page 14 line 3-7).

4. Page 11049, line 1-4: Unclear sentences. Clarify

Many thanks for your suggestion. The sentence has been rewritten, please check (page 13 line 14-17).

5. Page 11049, line 5: insert "except for" instead of "when" "when" has been replaced by "except for" according to your advice.

6. Page 11049, line 6-8: This sentence sounds strange. It is as if you would expect the overall trend is no effect, but in fact half of your tree species actually show an effect. Describe in objective terms.

Thanks for your valuable comments. The sentence has been rewritten, please check (page 13 line 18-19).

7. Page 11049, line 15: replace "when" with "excluding"

"when" has been replaced by "excluding" according to your advice.

Discussion

1. Page 11049, line 18: replace "average" with "significantly different". I suggest being consistent with "tree species" or "sites" in the entire manuscript. Choose either one,

preferably "tree species"

Many thanks for your suggestion. "average" has been replaced by "significantly different". The "sites" in the entire manuscript has been replaced by "tree species".

2. Page 11049, line 20-23: I am not entirely sure you can extrapolate the cited studies to something about how future vegetation changes shaped response of GHG to environmental change. I suggest to delete.

We do agree your valuable comments. The sentence has been deleted.

3. Page 11049, line 23-26: Delete sentence "The mean. . ." Repetition of results

The sentence has been deleted according to your advice.

4. Page 11050, line 5: change "form" to "from"

Thanks for your comments. "form" has been replaced by "from".

5. Page 11050, line 9-10: specify what "the substrate" is.

"the substrate" has been specified. For example, (the substance on which an enzyme acts). Thanks for your further advice.

6. Page 11050, line 10: replace "the woodland" with "which"

"the woodland" has been replaced by "which" according to your advice.

7. Page 11050, line 11-16. Change sentence to: "The highest CO2 flux occurred in Z.jujube could be attributed to weeding, mineral fertilization and manure application. Annual mineral fertilization and manure application in each spring increased C and N contents of grassland soils in xxxx (mention country), changed chemical element composition, affected easily-decomposable SOC pools and hence soil respiration (Verburg et al., 2004)."

The sentence has been revised according to your advice, please check (page 14 line 24 and page 15 line 1-5).

8. Page 11050, line 16-20: This argument comes out of the blue. According to table 1 all plots have similar understory, so in my opinion this argument here cannot really be backed by your data. Maybe moderate the statement, so that understory vegetation might affect CO2 respiration rates.

We do agree your valuable comments. The sentence has been deleted.

9. Page 11050, line 21: Insert "Not surprisingly, we observed that. . ." before "seasonal changes"

The sentence has been inserted according to your advice, please check (page 15 line 6).

10. Page 11050, line 25-29 & Page 11051, line 1-2: This section is rather trivial and can be omitted without loosing meaning in the rest of the text.

We do agree your valuable comments. The sentence has been deleted.

11. Page 11051, line 2: Insert "Similar to," before "Yan et al. (2006)"

The word has been inserted according to your advice.

12. Page 11051, line 3: insert "we" after "(2010)" and insert "most likely" before "by"

The words have been inserted according to your advice.

13. Page 11051, line 4: delete "coming" and replace "slowing down" with "decreasing"

Many thanks for your suggestion. The word has been deleted and "slowing down" has been replaced by "decreasing".

14. Page 11051, line 5: insert "microbes" after "soil"

The word has been inserted according to your advice.

15. Page 11051, line 5-6: delete sentence "In this study,. . ."

The sentence has been deleted according to your advice.

16. Page 11051, line 13: Is this significant correlation positive or negative? Generally, clarify this throughout the manuscript.

Thanks for your valuable comments. The correlation throughout the manuscript has been clarified.

17. Page 11051, line 14: this is the first time the interaction between soil temp and soil moisture is mentioned. The methodology behind this should be described in 2.4 and results included in 3.2.

Based on your valuable advice, the methodology and results have been described in 2.4 (page 11 line 4-6) and 3.2 (page 12 line 9-11), respectively.

18. Page 11051, line 23-24: Delete this sentence. You only measured SOC and not labile C and so by writing this you implicitly assume that SOC pool is a proxy for labile C, which is not necessarily the case.

Many thanks for your suggestion. The sentence has been deleted.

19. Page 11051, line 25-29 & Page 11052, line 1-3: This is interesting, but you do not follow up on it. There is a lot of factors and contrasting results in play here in your text, but you do not manage to conclude on it and what it means for your study.

Thanks for your valuable comments. The section has been rewritten, please check (page 16 line 11-19).

20. Generally, I miss a short discussion of the temporal variability. Once rain starts CH4 fluxes vary between sink and sources. This implies that CH4 production is switched on and off in these relatively dry soils (see Angel et al. (2012), ISME Journal, vol. 6).

Many thanks for your suggestion. The sentence has been added to 4.2, please check (page 16 line 21-24).

21. Page 11052, line 8-9: insert "but" before "we found" and insert "or seasonal" after "annual"

The words have been inserted according to your advice.

22. Page 11052, line 9-11: delete ". . . and no. . .(Tables 3, 4)."

We do agree your valuable comments. The sentence has been deleted.

23. Page 11052, line 14-16: If you state this, elaborate on why CH4 ox differ and what factors in the soil are important in Menyailo and Hungate (2003) and how that can be connected to your study. The sentence has been deleted. Thanks for your further advice.

24. Page 11052, line 16-17: Again what factors are we talking about. Also, consider whether wetland plants are appropriate to compare with your sites. See Christiansen & Gundersen (2011), Biogeosciences, vol. 8 and Degelmann et al. (2009) Eur J Soil Sci, vol. 60 on tree species differences and CH4

This sentence has been rewritten according to the reference, please check (page 17 line 4-9).

25. Page 11053, line 1-4: Delete sentence

The sentence has been deleted according to your advice.

26. Page 11053, line 5: replace "had been reported frequently" with "in our study reflects previous findings"

"had been reported frequently" has been replaced by "in our study reflects previous findings" according to your advice.

27. Page 11053, line 6- 10: Like what? Inorganic N? Others?

The sentence has been revised according to your advice.

28. Page 11053, line 10-19: I am not sure what you mean here. How does this help explain your findings? Clarify

We do agree your valuable comments. The sentence has been deleted.

29. Page 11053, line 19-26: This is reasonable argumentation, but in Borken and Beese (2006) the litter removal most likely caused wetter soil in turn leading to less diffusion of atmospheric N in to the soil. This is an abiotic phenomena and less so a biotic. However, you cannot test this because you did not measure soil moisture in the litter removal.

Thanks for your valuable comments. The sentence has been deleted.

30. Page 11053, line 23: decreased flux = increased uptake? Do you mean decreased uptake? Also, you cannot prove this phenomenon, but merely confirm their observation. Reformulate.

Many thanks for your suggestion. The sentence has been deleted.

31. Page 11054, line 2-4: repetition of lines 1-3 page 11049. Delete!

Based on your valuable advice, the sentence has been deleted.

32. Page 11054, line 8- 9: delete from "long drought. . ." The sentence has been deleted according to your advice.

33. Page 11054, line 10-12: Move sentence "Rosenkranz et al. (2006) to page 11054, line 22 after "net sink."

The sentence has been moved according to your advice, Please check (page 18 line 23-25).

34. Page 11054, line 12-14: Delete sentence "Chapuis-Lardy et al. (2007). . ."

The sentence has been deleted according to your advice.

35. Page 11054, line 15: Insert "Similar to our study," before Goldberg and Gebauer (2009)

The word has been inserted according to your advice.

36. Page 11054, line 16: change "served" to "serving"

Thanks for your valuable comments. "served" has been replaced by "serving".

37. Page 11055, line 1-3: Delete from "N availability. . .Z. jujube."

The sentence has been deleted. Thanks for your further advice.

38. Page 11055, line 4-5: Move sentence to front of 4.3

The sentence has been moved to the front of 4.3 according to your advice, Please check (page 18 line 9-11).

39. Page 11055, line 8: what type of soil N concentrations? Exchangeable or total N? Clarify.

It was "total N", has been added. Thanks for your further advice.

40. Page 11055, line 12: delete "the majority of" and replace "activities happen" with "mainly take place"

Based on your valuable advice, the word has been deleted and "activities happen" has been replaced by "mainly take place".

41. Page 11055, line 14-29 & Page 11056, line 1-2: I think this entire paragraph must be condensed in to maximum two sentences each of which deals with soil temperature and soil moisture respectively.

We do agree your valuable comments. This section has been condensed to two sentences, Please check (page 19 line 17-23).

42. Page 11056, line 4: Insert "However" before "N2O fluxes". Also specify what time scale it refers to. Annual fluxes?

The words "However" and "Annual fluxes" have been inserted according to your advice.

43. Page 11056, line 10-17: You cannot expect to get a pH effect because the values are similar across the mountain as well as slightly alkaline which does not support high N2O production (see Weslien et al. (2009) European J Soil Sci, vol. 60 in pH effect

in N2O fluxes). I think instead you should discuss why you do not have a pH effect and not necessarily just report others findings. Use the literature to frame your own findings.

We do agree your valuable comments. This sentence has been rewritten according to the reference, Please check (page 20 line 7-9).

Tables

1. Table 1. Usually if letters are different then p<0.05. In your way here it is difficult to get an overview. You should change to a more simple denotion here and elsewhere in the manuscript.

We do agree your valuable comments. Table 1 was the general characteristics for six tree species, so the letters has been deleted.

2. Table 2: Consider the number of decimals. I would give the numbers without decimals to provide better overview

Thanks for your valuable comments. Digital in Table 2 reserved a decimal fraction.

3. Table 3: The info in this table can be incorporated in the text. I suggest deleting.

Many thanks for your suggestion. Table 3 has been replaced by a new table.

4. Table 5: What does the numbers represent? Correlation coefficients? I wondered why there were no negative correlations and made me wonder if this is R2 values. If this is the case you should change it to the correlation coefficients (r) and write the sign (+ or -) The number has been changed to correlation coefficient according to your advice.

Figure

Figure Good figures! Change Y-axis on Fig. 4 (CH4 time series) to -200 - +200 ug CH4 m-2 h-1. 1. Y-axis on Fig. 4 has been changed to -400 - +400 ug CH4 m-2 h-1. Thanks

for your further advice.

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